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FOREWORD

The Ethiopian Economics Association (EEA) is pleased to issue the proceedings of the 18 th International Conference on the Ethiopian Economy that was held from July 23 to 24, 2021 at EEA's Multi-purpose Conference Hall. EEA has been organizing annual conferences on the Ethiopian Economy every year as part of its overall objectives of promoting the development of economics profession in Ethiopia and contributing to the policy formulation and implementation process of our country through research, training, public dialogue forums and publications and dissemination activities.

EEA launched its international conference series in June 2003, after organizing 11 annual national conferences. This series has proved to be an excellent forum at which researchers from Ethiopia and abroad present and discuss their findings. It has also provided a platform for young Economists (both men and women) to gain experience in public speaking and dialogue.

This year's conference was co-sponsored by Friedrich Ebert Stiftung (FES), UCL Energy Institute University College London, World Bank, International Growth Centre (IGC), Economic Commission for Africa, FDRE Policy Studies Institute (PSI) and International Maize and Wheat Improvement Centre (CIMMYT). The contribution of these partners was critical for the organization of this important conference and other activities of the Association. I would like to take this opportunity to thank them all!

The 18th International Conference was held during the COVID-19 pandemic which led to considerable scale down in terms of number of days (from 3 to 2), number of presentations, and participants. At the conference, about 33 presentations were made in 2 plenary and 2 parallel sessions with the attendance of about 300 persons over the two days. In addition, 2 panel discussions and one key note speech were also included. Out of the 33 presentations, about 16 were presented by partner institutions and the rest were presented by individual researchers.

The conference was opened by H.E. Dr. Nemera Mamo, State Minister of Planning and Development Commission (Now Ministry of Planning and Development) in the presence of higher dignitaries and invited guests. I would like to thank, H.E. Dr. Nemera for honoring EEA with his presence and delivering key messages as part of his official opening. It is a demonstration of the continued collaboration between the Ministry and EEA.

The editorial committee reviewed papers that were presented at the conference and communicated its comments and suggestions to the authors. After passing through technical and language editions, the editorial committed selected 19 papers to be included in these proceedings.

At this juncture, on behalf of the Ethiopian Economics Association, I would like to thank all the speakers and authors of the papers and the conference participants whose active participation made the conference meaningful and dynamic. The many professionals who dedicated their time to the conference and served as chairpersons and rapporteurs deserve due thanks for their special contributions. The staffs and Executive Committee of the Ethiopian Economics Association deserve a special recognition for their enthusiasm and perseverance in managing the conference from inception to completion.

EEA's conference proceedings are flagship publication of the Association and are serving as key references for students, lecturers and researchers at various public and private higher learning institutions. Let me reassure our members and stakeholders that EEA is committed to strengthen its capacity and seek new and innovative ways of addressing the economic challenges the country has been facing.

Happy Reading!

Amdissa Teshome (PhD)
President, Ethiopian Economics Association

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Determinants of Financial Inclusion Gender Gap in Ethiopia: Evidence from Decomposition Analysis

Shemelis Kebede Hundie*[1] and Daniel Tadesse Tulu[2]

Abstract

In Ethiopia, the gender gap in financial inclusion is high, and the effect of socioeconomic variables on the gap is not well investigated. As a result, this study uses the World Bank's Global Findex database from 2017 to analyze the magnitude and determinants of the gender gap in financial inclusion in Ethiopia. Using the Fairlie decomposition technique, we find a statistically significant gender gap in all indicators of financial inclusion under study in Ethiopia. The result shows that the highest financial inclusion gender gap is observed in formal saving followed by formal account holding. The decomposition results show males are 16.5%, 16.6%, 8.9 %, 8.4 %t, and 5.8% more likely to have a formal account, formal saving, borrowing, emergency fund possibility, and debit card ownership, respectively. We further decompose these gaps using Daymont and Andrisani approach and the result reveals that differences in coefficients between males and females explain 57.7% in formal saving, 43.4% in formal account holding, and 110.9% in borrowing from formal financial institutions. About 54.2% of the total gender gap in the possibility of raising emergency funds is attributed to differences in characteristics/predictors between the two genders while the gender gap in debit card holding is explained by the interaction between differences in characteristics and coefficients. Being older, more educated, and wealthier favor financial inclusion, with age, employment, and education has a greater effect. Furthermore, gaps in coefficients, productivity, and advantage to males and disadvantage to females aggravate the gender gap in financial inclusion in Ethiopia. Gender mainstreaming in economic activities to increase income, employment opportunities, and education for females to bridge the gender gap in financial inclusion is important.

Keywords: Ethiopia, Gender Gap, Financial Inclusion, Decomposition Analysis

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1. Introduction

Financial inclusion refers to enabling all individuals and businesses in an economy to have access to useful and affordable financial services that meet their needs (Sha'ban *et al.*, 2019). It indicates all efforts that primarily enable low-income people to access affordable formal financial services (Omar & Inaba, 2020). According to Zins and Weill (2016) financial inclusion is related to having an account at a formal financial institution that enables a person to save and borrow money. Access, usage, and quality are the three dimensions of financial inclusion. Access refers to affordability and physical proximity. Usage implies regularity, frequency, and duration of time used whereas quality refers to the customization of products to client needs and appropriate segmentation to develop products for all income levels (Triki & Faye, 2012).

Nowadays, financial inclusion has been regarded as a vital instrument for realizing multidimensional macroeconomic stability, sustainable and inclusive economic growth, employment generation, poverty reduction and income equality in both developed and developing nations (Omar & Inaba, 2020). Furthermore, financial inclusion plays a crucial role in meeting the United Nation's Sustainable Development Goals (Kuada, 2019; Omar & Inaba, 2020). For instance, access to finance enables the impoverished segment of the society to enhance their production and productivity that can improve their food security (SDG 2), invest in human capital and health (SDGs 3 and 4), promotes gender equality (SDG 5), and meet the decent work goal and innovation goal (SDGs 8 and 9).

Financial inclusion is still one of the most significant development priorities. As a result, there is increased interest in intellectuals, financial institutions, governments, policymakers, and others (Abel *et al.*, 2018). The significance of financial development in every country's economic growth is critical. It is a crucial component of economic development since it functions as the economy's "blood." For the economy to remain healthy, financial development must flow in the same way that blood does in the human body. According to research conducted in 67 low and middle-income countries, financial development is an important instrument for poverty reduction (Boukhatem, 2016; Nanziri, 2016; Ogunleye, 2017). Hence, financial development in one country denotes that there is alternative funding for the poor and disadvantaged group because it enhances access to finance. Financial inclusion is one of the major indicators of financial development (Hajilee et al., 2017; Li, 2018; Singh, 2019).

Access to finance contributes to economic development (Aterido *et al*., 2013; Desalegn & Yemataw, 2017; Zins & Weill, 2016). We cannot think of development without finance. When there are fast and accessible financial services, it is easy for individuals as well as organizations to fulfill their needs. In one way another, they are gratifying themselves and they are partaking in economic activities via different level investments. Hence, financial inclusion denotes having all kinds of financial needs in a continuous way for sustainable economic prosperity. Financial inclusion reduces poverty and income inequality (Aslan et al., 2017; Neaime & Gaysset, 2018; Ogunleye, 2017; Park & Mercado, 2017).

It appeared that the financial inclusion of women is vital in the broader socio-economic play in developing nations. Sharma and Kukreja (2013), and Sujlana and Kiran (2018) noted that for the inclusive growth of a country, inclusive financing remains mandatory. Financially independent citizens contribute to a strong and independent economy. Thus, ensuring financial stability for citizens is ensuring sustainable development.

World Bank (2019) data shows one-third of the population of adults remains unbanked. From these, about half % are women population which are living in rural areas. In developing nations, the gender gap of owning accounts is only 9 %. This is shocking news for countries since the gender gap has a big implication on economic development. Financial exclusion of women hampers their participation in any economic activities, diminishes innovation, and deteriorates participation in entrepreneurial endeavors (Fareed *et al*., 2017). Credit and other financial services can provide small-scale farmers with the opportunity to improve farm productivity and transition from subsistence farming to large-scale and commercial farming. In the short run, credit can help farmers increase their purchasing power to gain necessary production inputs and finance their operating expenses, while in the long run, it can help farmers to make profitable investments. Female farm managers, however, are 9 %age points less likely to live in a household with access to credit than male farm managers (Buehren et al., 2019).

The gender gap is an important dimension in the debate over access to finance that has received less attention. It has often been contended, for example, that a lack of access to finance stifles female entrepreneurship and inhibits women from participating in the contemporary market economy. Recent worldwide data analysis demonstrates the extent to which Sub-Saharan African (SSA) countries are distinguished by a degree of gender that is different from other regions (Aterido et al., 2013). Females are still less likely than males to have an account with a financial institution, according to the World Bank's 2017 Global Findex Database (Demirgüç-Kunt et al., 2018).

One reason a woman may have less access to formal credit is that she is less likely to possess and manage tangible assets that may be used as collateral. Furthermore, women have lower levels of human and social capital on average, which might limit their access to formal finance and this disadvantages women. When financing is scarce, farmers are more inclined to utilize sub-optimal amounts of productive inputs, reducing their productive potential (Buehren et al., 2019). Deléchat et al. (2018) find a robust negative relationship between being female and financial inclusion as in previous studies, and their analysis points to legal discrimination, lack of protection from harassment, including at the workplace, and more diffuse gender norms as possible explanatory factors.

An initiative led by the World Bank Group focuses on accelerating country-based reforms to achieve countries' national financial inclusion goals. The initiative is called The Financial Inclusion Support Framework (FISF). Commenced in 2013, the initiative is supported by G20 countries to improve the existing situation regarding financial services in unbanked and under-banked sectors. With the national support program and knowledge components, FISF is committed to helping countries to build financially strong nations. National support program component under its four themes- national financial inclusion strategy, and monitoring and evaluation; financial infrastructures, such as payments and credit reporting systems; diversified financial services for individuals and enterprises; and financial consumer protection and financial capability has been implemented by different countries. Ethiopia is among few counties like Mozambique, Rwanda, Indonesia, Zambia, Pakistan, Vietnam, and Cote d'Ivoire that launched Country Support Programs in 2015. Supporting strategies for national financial inclusion in Ethiopia was also one of the moves of the initiative (Brief, 2018). Even though Ethiopia has put remarkable efforts into promoting financial inclusion, is not as successful as other East African countries. Evidence shows that Ethiopians, especially women, prefer informal saving clubs rather than formal financial institutions. In this regard, Lakew and Azadi (2020) argued that this preference, combined with unemployment and low income, is the barrier to the financial inclusion strategy in Ethiopia.

Some economies have had gains in account ownership but missed out on opportunities for greater progress because women were insufficiently included. In Ethiopia, account ownership has risen by 18 % age points among men since 2014, roughly twice the size of the increase among women (Demirgüç-Kunt et al., 2018). At the economic level too, gender gaps have mostly remained stable. Economies that had no gender gap in 2014 generally still do not have one; the converse is also true. But there are exceptions. In 2014, no gender gap was found in Burkina Faso or Ethiopia. Since then, these two economies have seen a big growth in account ownership — but more among men than among women. As a result, both now have a double-digit gender gap in account ownership.

The availability of finance and its accessibility have a significant impact on farmers' production start-up and subsequent performance. Obstacles to obtaining adequate loans will affect farm households' technical efficiency. Increased output production as a result of better credit availability is, therefore, evidence of binding credit constraint (Komicha & Öhlmer, 2007).

Women farmers are less productive than male farmers in Ethiopia (Ethiopia's Ministry of Agriculture and Natural Resources et al., 2018). According to the World Bank and ONE (2014), the agricultural productivity gender gap in Ethiopia was found to be 24%. This gap is attributed to women's unequal access to key agricultural inputs including labour, land, fertilizers, improved seeds, and knowledge which in turn are highly determined by access to financial resources. This is because, financial resources constraint is a barrier to modern agricultural technology adoption (Balana et al., 2020). Constrained access to finance affects not only the agricultural productivity and efficiency of women but also their chance of participating in off-farm activities and self-employment. For instance, Komicha and Öhlmer (2007) found that the mean technical efficiency score of credit unconstrained farm households is 12% higher than that of credit-constrained farm households in Ethiopia. Mukasa et al. (2017) argued that credit constraints result in a productivity loss of about 60% in Ethiopia and the majority of the losers are female-headed smallholders.

Financial exclusion impedes the entrepreneurial endeavors of women and prevents them from actively participating in market economies (Aterido et al., 2013; Kuada, 2019). It is argued that the availability of financial resources will encourage talented but poor entrepreneurs to start their businesses. According to Beriso (2021), lack of access to finance is the leading major factor hindering Ethiopian women entrepreneurs in entrepreneurial activities.

Being financially excluded relative to men, women in Ethiopia are constrained from participating in various economic activities to their full potential. They lag behind their male counterparts in terms of productivity and efficiency due to the low adoption of modern technology. Besides, women earn lower income from self-employment and wage income. All these impede the endeavors of Ethiopian women to pull themselves from the poverty trap and aggravate income inequality.

The financial inclusion gender gap, therefore, is a major challenge for Ethiopia to realize inclusive growth, the full potential of women's economic empowerment, and gender equality. Despite the seriousness of the consequences of the financial gender gap in Ethiopia, empirical studies that address factors determining the gap are non-existent. Given this background, the current study tries to examine how socioeconomic characteristics contribute to the financial inclusion gender gap by considering different indicators of financial inclusion.

This paper makes two major contributions to the existing empirical literature. First, to the best of the authors' knowledge, this paper counts the first of its kind for Ethiopia that attempts to examine gender gaps in access to formal financial accounts, formal savings, formal credit, debit card holding, and an emergency fund in Ethiopia. Unlike Lakew and Azadi (2020), Abdu and Adem (2021), and Desalegn and Yemataw (2017), which focused on determinants of financial inclusion, this paper focuses on determinants of the financial gender gap in Ethiopia. Second, the majority of the previous related empirical literature dealt only with a single dimension of financial inclusion mainly that is related to access. This fails to capture the full picture of financial inclusion. The present study tries to cover all the three dimensions, access, usage, and quality, of financial inclusion in examining the determinants of financial inclusion gender gap in Ethiopia. The results of empirical analysis show that the gender gap in financial inclusion is highest in the ownership of formal savings, followed by formal account holding, borrowing, emergency fund possibility, and debit card ownership, respectively. In addition, being a female was found to decrease the likelihood of financial inclusion for all its indicators. Age, income level, employment status, and education explain financial gender gap in Ethiopia. Finally, the overall gender disparity in financial inclusion in Ethiopia is attributed to differences in observable characteristics, differences in coefficients, and the interaction between characteristics and coefficients. Furthermore, the differences in productivity, advantages to males, and disadvantages to females determine the gender gap in financial inclusion.

The remainder of this paper is organized as follows. Section 2 presents data and methods of data analysis. Section 3 discusses results on the financial inclusion gender gap in Ethiopia and section 4 is devoted to conclusions and policy implications.

2. Data and Methods

2.1 Variables and Sources of Data

Data for the study were obtained from the 2017 Global Findex Database which was based on survey data collected by Gallup Inc., as part of its Gallup World Poll. The 2017 Global Findex Database was compiled using nationally representative surveys of more than 150,000 adults age 15 and above in 144 countries in 2017. From each country surveyed, approximately 1000 people were randomly selected and interviewed. The entire civilian excluding the institutionalized population were the target population of the survey.

The 2017 Global Findex database includes updated indicators on access to and use of formal and informal financial services. It has additional data on the use of financial technology (or fintech), including the use of mobile phones and the internet to conduct financial transactions. The data reveal opportunities to expand access to financial services among people who do not have an account — the unbanked — as well as to promote greater use of digital financial services among those who do have an account. It also provides micro-level information – gender, age, income and education – that will be used in our estimations. The current study focuses on determinants of financial inclusion gender gap in Ethiopia.

Following the previous related literature, this study focuses on three main indicators of financial inclusion, i.e. formal account, formal borrowing, and formal saving.

Formal account ownership refers to the fact that the individual has a bank account either at a financial institution or through a mobile money provider. Formal saving refers to the fact that the individual saved money using an account at a financial institution in the past 12 months. Formal borrowing means that the individual borrowed from a financial institution in the past 12 months.

In order to examine the gender gap in availability of modern technology in the financial services, we use debit card holding as an indicator. Besides, whether or not it would be possible to come up with an amount equal to 1/20 of gross national income (GNI) per capita in local currency within the next month is used as an indicator to shed light on factors determining the financial resilience to unexpected gap between females and males on their expenses. All aforementioned financial inclusion indicators are dummy variables that take 1 if the respondents respond "Yes" to questions and 0 otherwise. Variable name, variable description, and expected sign of explanatory variable is presented in Table 1.

Table 1: Variables Definition and Expected Sign

Variable Name	Description	Expected Sign
Dependent Variables		
Account	The respondent owns (or not), alone or with someone, an account in a formal financial institution. It takes 1 if the individual owns an account, and 0 otherwise.	Not applicable
Borrowing	The respondent has (or not) saved in a formal account in the past 12 months. It takes 1 if the individual has saved in the past 12 months, and 0 otherwise.	Not applicable
Saving	The respondent has (or not) borrowed from a formal financial institution. It takes 1 if the individual has borrowed in the past 12 months, and 0 otherwise.	Not applicable
Emergency	Dummy that takes 1 if the respondent came up with an emergency fund, and 0 otherwise.	Not applicable
Debit Card Holding	Dummy that takes 1 if the respondent accessed account using mobile phone or internet, and 0 otherwise.	Not applicable
Explanatory variables		
Female	Dummy that takes 1 if the respondent is a female, and 0 otherwise.	-
Education	Instruction level of the respondent: Primary education or less; and Secondary education. It takes 1 if the respondent completed Secondary education, and 0 otherwise	+
Age	Age of the respondent in years.	+
Age square	Age in years of the respondent squared	-
Income quantile	Income quintiles of the respondent: Income1 for poorest (20%), Income2 for second poorest (20%), Income3 for third poorest (20%), Income4 for fourth poorest (20%), and Income5 for fifth poorest (20%).	+
Employment	Dummy that takes 1 if the respondent is in the workforce, and 0 otherwise.	+

Source: Authors' Compilation

2.2 Estimation Strategies

Blinder (1973) and Oaxaca (1973) introduced the decomposition method, which was later extended by Neumark (1988) and Oaxaca and Ransom (1988, 1994) to decompose outcome variables between two groups into a part explained by differences in observed characteristics and a part explained by differences in the returns to these characteristics (Bauer & Sinning, 2008; Fairlie, 2005, 2017; Jann, 2008). However, if the result is binary and the coefficients are from a logit or probit model, the technique cannot be used directly (Fairlie, 2005). Since all dependent variables in this study are binary, the conventional Oaxaca-Blinder decomposition technique to decompose the financial inclusion gender gap is not appropriate because it generate inconsistent estimates, therefore, provides misleading decomposition results (Fairlie, 2017; Sinning et al., 2008). To overcome this problem, this study applies a Fairlie decomposition approach, which best fits binary dependent variables.

The standard Blinder-Oaxaca decomposition of the male/female difference in the average value of the dependent variable, for linear regression, is as follows:

$$-\bar{Y}^F = \left[\left(X^M - X^F\right)\hat{\beta}^M\right] + \left[\bar{X}^F\left(\hat{\beta}^M - \hat{\beta}^F\right)\right].. \quad \textbf{(1)}$$

Where $\bar{X}^j$ is a row vector of average values of the independent variables and β^j is a vector of coefficient estimates for gender j. Following Fairlie (1999, 2006), and Ghosh and Chaudhury (2019), this study applied the Fairlie decomposition technique for a nonlinear equation, $Y = F\left(X\hat{\beta}\right)$, to analyze the gender gap in financial inclusion in Ethiopia. Fairlie decomposition model can be specified as:

$$\bar{Y}^M - \bar{Y}^F = \left[\sum_{i=1}^{N^M}\frac{F\left(X_i^M\hat{\beta}^M\right)}{N^M} - \sum_{i=1}^{N^F}\frac{F\left(X_i^F\hat{\beta}^M\right)}{N^F}\right] + \left[\sum_{i=1}^{N^F}\frac{F\left(X_i^F\hat{\beta}^M\right)}{N^F} - \sum_{i=1}^{N^F}\frac{F\left(X_i^F\hat{\beta}^F\right)}{N^F}\right] \quad \textbf{(2)}$$

Where, N^j is the sample size for gender j (M=male, F=Female). $\bar{Y}^j$ is the mean probability of outcome variable for sex j, X_i^j is the vector of independent variables for sex case j, $\hat{\beta}_i^j$ the vector of coefficient estimates including a constant term, and F is the cumulative distribution function from the logistic distribution. The first term in brackets represents the part of the gender disparity caused by differences in group X distributions (i.e., differences in the distributions of the independent variables), and the second term represents the part caused by differences in group processes deciding (i.e., differences in the coefficients) levels of Y. The second term also includes the portion of the gender difference created by unmeasurable or unobserved endowments between classes.

Notably, in the first term of the equation, we use the male coefficient estimates $\left(\hat{\beta}^M\right)$ as weights, while in the second term, we use the female distribution of independent variables X^F as weights.

An equally valid expression for the decomposition is:

$$\bar{Y}^M - \bar{Y}^F = \left[\sum_{i=1}^{N^M} \frac{F\left(X_i^M \hat{\beta}^F\right)}{N^M} - \sum_{i=1}^{N^F} \frac{F\left(X_i^F \hat{\beta}^F\right)}{N^F}\right] + \left[\sum_{i=1}^{N^M} \frac{F\left(X_i^M \hat{\beta}^M\right)}{N^M} - \sum_{i=1}^{N^F} \frac{F\left(X_i^M \hat{\beta}^F\right)}{N^M}\right] \quad \textbf{(3)}$$

Here, the female coefficient estimates, $\left(\hat{\beta}^F\right)$ are used as weights for the first term in the decomposition, and the male distributions of the independent variables $\left(X^M\right)$ are used as weights for the second term.

The Blinder-Oaxaca decomposition technique's alternative method of measuring the decomposition often yields different estimates, which is the well-known index problem (Fairlie, 2006; Ghosh & Chaudhury, 2019). A third choice is to use coefficient estimates from a combined sample of the two groups to weigh the first term of the decomposition expression. In our research, we used this method to measure decomposition. We used coefficient estimates from a logit regression with a sample of all gender groups in particular.

However, a separate calculation is needed to assess the position of gender differences in particular variables in the distance. Consider the case where X comprises two variables: X_1 and X_2. As a consequence, the independent contribution to the gender gap can be expressed as:

$$\frac{1}{N^F} \sum_{i=1}^{N^F} F\left(\hat{\alpha}^* + X_{1i}^M \hat{\beta}_1^* + X_{2i}^M \hat{\beta}_2^*\right) - F\left(\hat{\alpha}^* + X_{1i}^F \hat{\beta}_1^* + X_{2i}^M \hat{\beta}_2^*\right).. \quad \textbf{(4)}$$

Similarly, the contribution of X_2 can be expressed as:

$$\frac{1}{N^F} \sum_{i=1}^{N^F} F\left(\hat{\alpha}^* + X_{1i}^M \hat{\beta}_1^* + X_{2i}^M \hat{\beta}_2^*\right) - F\left(\hat{\alpha}^* + X_{1i}^M \hat{\beta}_1^* + X_{2i}^F \hat{\beta}_2^*\right).. \quad \textbf{(5)}$$

The amount of the contributions from individual variables would equal the cumulative contribution from all of the variables measured for the full sample, which is a useful property of this technique. The cumulative contribution of sex differences in the independent variables to the gender disparity in the dependent variable is calculated using this methodology. It also helps us to determine how much each independent (explanatory) variable contributes to the overall difference. The change in the average predicted probability from replacing the female distribution of a specific variable with the male distribution while holding the distributions of the other variables' constant is the contribution of each explanatory variable to the gap.

A one-to-one matching of cases between the two groups is used in the decomposition technique (Aterido et al., 2013; Ghosh & Chaudhury, 2019). Because the groups are different sizes, a sample is taken and the process is repeated 1000 times, with the mean results being reported. We draw a random sub-sample of females with or without replacement equal to the size of the full male sample and match the sample by their respective rankings in predicted probabilities because the number of females and males is not equal. We draw 1,000 different sub-samples because the decomposition estimates are sensitive to the sub-sample chosen, and our results are based on average values obtained from the decomposition method carried out over these sub-samples.

We used decomposition techniques suggested by Daymont and Andrisani (1984) to decompose the disparities in financial inclusion between males and females into a part explained by differences in observable characteristics, a part explained by differences in estimated coefficients, and a part explained by interactions between characteristics and coefficients.

$$\bar{Y}_M - \bar{Y}_F = \left(\bar{Y}_M - \bar{Y}_F\right)\beta_F + \bar{X}_F\left(\beta_M - \beta_F\right) + \left(\bar{X}_M - \bar{X}_F\right)\left(\beta_M - \beta_F\right) = E + C + CE.. \quad \textbf{(6)}$$

where E denotes the portion of the raw differential due to endowment differences, C denotes the portion attributable to coefficient differences, and CE denotes the portion that can be clarified by the relationship between C and E. Bauer and Sinning (2008) created the Stata command "nldecompose," which is used to estimate Equation 6.

The decomposition strategies discussed thus far do not provide a detailed breakdown of each independent variable's contribution to the disparity in financial inclusion between the two classes. Furthermore, path dependence and identification issues associated with the selection of a reference group in which dummy variables are included among the independent variables plague the techniques. To solve these issues, we used the detailed decomposition technique developed by Powers et al. (2011). When dummy variables are used in the predictors, this approach manages path dependence (Schwiebert, 2015; Yun, 2004), computes asymptotic standard errors (Yun, 2005a), and overcomes the identification problem associated with the choice of a reference group (Yun, 2005b, 2008). According to Powers et al. (2011), the raw difference can be expressed as a sum of weighted sums of the unique inputs in terms of the total components.

$$\overline{Y}_M - \overline{Y}_F = E + C = \sum_{k=1}^{K} W_{\Delta X_k} E + \sum_{k=1}^{K} W_{\Delta \beta_k} C = \sum_{k=1}^{K} E_k + \sum_{k=1}^{K} C_k .. \qquad \textbf{(7)}$$

$$C = \sum_{k=1}^{K} C_k = \sum_{k=1}^{K} W_{\Delta \beta_k} \left\{ \overline{F\left(X_F \beta_M\right)} - \overline{F\left(X_F \beta_F\right)} \right\}$$

$$E = \sum_{k=1}^{K} E_k = \sum_{k=1}^{K} W_{\Delta X_k} \left\{ \overline{F\left(X_M \beta_M\right)} - \overline{F\left(X_F \beta_M\right)} \right\}$$

Where $W_{\Delta X_k}$ is the weight component for the explained component (E) and $W_{\Delta \beta_k}$ is the weight for the unexplained component (C).

4. Results and Discussions

In this section, we present both preliminary results based on descriptive statistics and econometric decomposition analysis from different decomposition techniques.

4.1 Descriptive Statistics

The data used in this study comprises 39.8% males and 60.2% females. About 71.3% of respondents attended secondary education and 28.7% have primary education. The average age of the sampled respondents is 33, with 15 and 98 minimum and maximum ages, respectively.

Descriptive statistics and inferential statistics, such as t-test and chi-square tests, as set out in Table I-IV of Appendix Section, are used to present a preliminary finding on the gender differential in financial inclusion and selected socio-economic variables. The findings from Table I show that there is a statistically significant age gap between males and females in our study. Males are on average older than their female counterparts by three years. Table III shows that there is no statistically significant association between level of income and gender, which lays down preliminary evidence that the financial gender gap in Ethiopia is not mainly attributed to the difference in income level between males and females. Educational status and employment status are statistically associated with gender. It shows that a larger proportion (76.3%) of females attended primary education compared to males (63.8%). However, the proportion of males who attended secondary education (36.2%) is higher than that of females. This confirms that there are great education gender gaps in Ethiopia. According to the World Economic Forum (2021) Global Gender Gap Report, the education gender gap in Ethiopia amounts to 15% - 20%. There is a statistically significant association between gender and employment status in Ethiopia during the study period.

4.2 Explaining Financial Inclusion Gender Gap

4.2.1 Fairlie Nonlinear Decomposition Estimates

Table 2 shows the results of Fairlie's nonlinear decomposition. The gender dummy has a statistically significant positive relationship with all indicators of financial inclusion — that is formal saving, formal account, formal borrowing, and the possibility of emergency fundraising. It implies that the likelihood for females to be included in these financial inclusion indicators is less compared to their male counterparts. On the other hand, there is no statistically significant difference between males and females in debit card holding. Except in debit card holding, the coefficient of age and age square is positive and negative respectively and both are statistically significant. This finding suggests that individuals have a higher propensity to save, own a formal account, borrow from formal financial institutions, and raise emergency funds at a younger age when they are economically active. Nevertheless, this effect reduces at an older age. This finding corroborates with the results of Zins and Weill (2016), Mndolwa and Alhassan (2020), and Ghosh and Chaudhury (2019).

As can be shown in Table 2, the size of the financial inclusion gender disparity varies depending on the financial inclusion indicator. Males are more likely to be financially included than their female counterparts on all financial indicators. To be more precise, the gender differences in formal account ownership, formal saving, formal borrowing, the likelihood of coming up with an emergency fund, and debit card ownership are 16.5 %, 16.6 %, 8.9 %, 8.4 %, and 5.8 %, respectively. These gaps are positive and statistically significant, meaning that males are 16.5%, 16.6%, 8.9%, 8.4%, and 5.8% more likely to have a formal account, formal saving, borrowing, emergency fundraising, and debit card ownership, respectively.

Table 2: Fairlie Decomposition Result

Variables	Formal Account		Formal Saving		Formal Borrowing	
	Logistic Results	Decomposit-ion	Logistic Results	Decomposit-ion	Logistic Results	Decomposit-ion
Gender	0.530***		0.604***		0.377***	
Age	0.167***	-0.102***	0.136***	-0.095*	0.049**	-0.021
Age square	-0.002***	0.093***	-0.002***	0.086*	-0.001**	0.025
Income1	-1.803***	-0.004	-1.944***	-0.002	0.199	-0.002
Income2	-1.649***	-0.002	-1.337***	-0.006**	0.425*	0.000
Income3	-1.178***	0.003	-1.174***	0.006**	0.124	0.001
Income4	-0.873***	0.005**	-0.774***	0.000	0.100	0.000
Education	1.513**	-0.041***	1.045***	-0.024***	-0.382**	0.008
Employment	0.469***	-0.008	0.700***	-0.014**	0.679***	-0.028***
Constant	-3.598***		-3.648***		-1.790***	
Group (male)		0.530		0.425		0.455
Group (female)		0.367		0.259		0.357
Difference		0.163***		0.166***		0.098***
Explained gap		0.057 (35%)		0.049 (29.5%)		0.017 (17.3%)
Unexplained gap		0.106 (65%)		0.117 (70.5%)		0.081 (82.7%)
Observations	1000	1000	1000	1000	1000	1000
$LR\ \chi^2(9)$	278.29		219.33		54.25	
$\Pr ob > \chi^2$	0.203		0.000		0.040	

**** p<0.01, ** p<0.05, * p<0.1*

Source: Authors' Computation using Stata 16

We find that the lower use of formal financial services and digital financial services by females can be explained by gender disparity in age, education, and employment status. This implies that the observed financial inclusion gender disparity is attributed to females being less educated and less employed than men. Our finding corroborates with the findings of Aterido et al. (2013) and Asuming et al.(2019) for Sub-Saharan Africa, Zins and Weill (2016), Botric and Broz (2017) for Central and Eastern Europe, Mndolwa and Alhassan (2020) for Tanzania, and Ghosh and Chaudhury (2019) for India. Out of the total financial inclusion gender gap mentioned above, the proportion explained by differences in socioeconomic characteristics (age, income, education, and employment) differs across the financial inclusion indicators. In the case of formal account ownership, only 35% of the gap is explained by differences in these socioeconomic variables. The differences in socioeconomic variables explain 29.5% of the gender gap in formal saving and 17.3% in formal borrowing. Among the financial inclusion indicators considered in this study, group differences in socioeconomic variables better explain the gender gap in debit card holding (65.5%) while the contribution of the socioeconomic variables in explaining gender gap in case of the possibility of coming up with emergency fund is the least (7.1%). The results show that higher proportion of the gender gap in indicators of financial inclusion, except debit card holding, is attributed to differences in other factors across gender.

The only major driver for the gender gap in formal borrowing is employment status, which narrows the gap. This is because income derived primarily from employment is seen as a guarantee for borrowing in a risky environment (Bell & Mukhopadhyay, 2020).

In Ethiopia, a lower proportion of the gender disparity in financial inclusion is explained by socioeconomic characteristics, implying that other non-socioeconomic factors are also to account for the reported gender difference. The gender disparity in financial inclusion is attributed to a variety of causes, including socio-cultural, institutional, legal, and regulatory barriers, according to the literature (Adegbite & Machethe, 2020). Ethiopia has a diverse population, patrilineal ethnicity, and customs, which make women vulnerable to socio-cultural norms, especially in rural areas. For example, customary norms prevent Ethiopian women from inheriting property, owning it, and transferring it in the same way as their male counterparts do (Bezu & Holden, 2014; Kumar & Quisumbing, 2015). Furthermore, young rural women in Ethiopia possess less productive assets than males (Doss et al., 2020), putting them at a disadvantage when attempting to use their assets as leverage for financial services, protect themselves from income shocks, and increase their income through the use of productive assets (International Fund for Agricultural Development [IFAD], 2019). Ethiopian women are unable to participate in many agricultural practices that include male labor due to traditional beliefs which limits their income-generating activities.

Women in Ethiopia face greater and more systematic obstacles to accessing formal financial services, according to Demirgüç-Kunt et al. (2013) and Stevenson and St-Onge (2005). According to the World Bank (2019), only 24% of Ethiopian households are headed by women, and productive assets in Ethiopia are managed by the household head (Fafchamps & Quisumbing, 2002). As a result, regardless of their financial needs, most females depend on male decisions about getting access to and using financial resources. This supports the findings of Demirgüç-Kunt et al. (2013)

and Deléchat et al. (2018) that women are less likely to have an account, borrow, or save in a formal financial institution in countries where women are restricted from household headship, employment, mobility, or asset ownership.

Table 2: Continued

Variables	Debit Card Holding		Emergency	
	Logistic Results	**Decomposition**	**Logistic Results**	**Decomposition**
Gender	0.421		0.406***	
Age	0.025	-0.037	0.050**	-0.013
Age square	0.000	0.031	-0.001***	0.021
Income1	0.000		-1.918***	0.013***
Income2	0.000		-1.174***	0.002
Income3	-1.674		-1.240***	-0.002**
Income4	-1.306	-0.006***	-0.142	0.001
Education	2.141	-0.021**	0.409**	-0.018***
Employment	0.992	-0.005	0.211	0.002
Constant	-4.462		0.210	
Group (male)		0.116		0.673
Group (female)		.058		0.589
Difference/gap		0.058***		0.084***
Explained gap		0.038 (65.5%)		.006 (7.1%)
Unexplained gap		0.020 (34.5%)		0.078 (92.9%)
Observations	1000	1000	1000	1000
$LR\ \chi^2(7)$	125.87		163.762	
$\Pr ob > \chi^2$	0.000		0.000	

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' Computation using Stata 16

Financial inclusion, according to Abebe et al. (2017), necessitates paying close attention to institutional concerns such as gender-responsive finance technologies, efficiency, affordability, accessibility, and sustainability. Women in Ethiopia, on the other hand, lack collateral, formal identification, and mobility owing to social norms (World Bank, 2017b). Inappropriate product offerings and a lack of gender-specific regulations are both significant barriers to women's financial inclusion in Ethiopia.

Other barriers to Ethiopian women benefiting from financial services include legal and regulatory issues. Women, for example, are constrained by account opening requirements, obstacles to accessing formal identification, and a lack of gender-inclusive credit reporting (AFI (Alliance for Financial Inclusion), 2017; World Bank, 2017b). Furthermore, there are major gender differences, at least within urban areas: older teenage boys were slightly more likely than girls of the same age to influence financial capital (39 % vs. 21 %) (Jones et al., 2019).

4.2.2 Daymont and Andrisani Decomposition Estimates

This section presents the overall gender disparity in the selected financial inclusion indicators decomposed into differences in characteristics, differences in coefficients, and interaction effects in this section. The findings of the decomposition (gender gap) are consistent with those in Table 2. In comparison to their male counterparts, females lag in all indicators of financial inclusion. The following sections look at the factors that contribute to the gender gap in financial inclusion in Ethiopia.

Table 3: Daymont and Andrisani Decomposition Results

	Saving		**Account**		**Borrowing**		**Emergency**		**Debit Card**	
	Coef.	**%**	**Coef.**	**%**	**Coef.**	**%**	**Coef.**	**%**	**Coef.**	**%**
$Omega = 1$										
Char	.049***	29.5	.057***	35.1	.017	17.2	-.006	-7.2	.031***	54.2
Coef	.096***	57.7	.071**	43.4	.108***	110.9	.043	51.4	.006	10.4
Int	.021	12.8	.035*	21.5	-.027	-28.1	.047*	55.8	.020	35.3
$Omega = 0$										
Char	.070***	42.3	.092***	56.5	-.011	-10.9	.041	48.6	.051	89.6++
Coef	.117***	70.4	.106***	65	.081**	82.7	.090***	107.2	.026	45.8
Int	-.021	-12.8	-.035*	-21.5	.027	28.2	-.047*	-55.8	-.020***	35.3
$Omega = wgt$										
Prod	.065***	39.5	.073***	45	.019	19.1	.012	14.5	.042***	73.1
Adv	.060***	36.4	.054***	33.1	.048***	48.7	.043***	51.5	.009	16.2
Disadv	.040***	24.1	.034***	21.9	.031***	32.2	.028***	34.0	.006	10.7
Raw	.165***		0.163***		.098***		.084***		.057***	

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' Computation using Stata 16

The weighting introduced by Neumark (1988) was applied in specifying Omega and the bootstrap method was used to drive analytic standard errors of the components of the decomposition equation to judge the statistical significance of the estimates.

The overall gender disparity in financial inclusion can be decomposed into three components: differences in observable characteristics/predictors, differences in coefficients, and the interaction between characteristics and coefficients. Furthermore, the overall gender disparity in financial inclusion is decomposed into differences in productivity, advantages to males, and disadvantages to females.

The estimates of characteristics and coefficients for formal saving are both positive and statistically significant at the 1% level of significance, meaning that the gender gap in formal saving is due to differences in both measurable characteristics and coefficients. The gender gap in financial inclusion is widened by both characteristics and coefficients. The total gender gap in formal saving is due to differences in productivity (39.5%), advantages to males (36.4 %), and disadvantages to females (24.1 %).

In the case of formal account holding, the gender gap is caused by differences in observable characteristics, coefficient differences, and their interaction. All of the estimates are positive and statistically significant, meaning that they all add to the worsening of the gender gap in formal account ownership. About 45 % of the total gender gap in account holding (16.3 %) is explained by differences in productivity, 33.1 % by advantages to males, and the remaining 21.9 % is due to disadvantages to females.

The difference in coefficient explains 110.9 % of gender disparity in formal borrowing when Omega is 1 and 82.7 % when Omega is 0. The advantages to males (48.7%) and the disadvantages to females (32.2%) in formal borrowing explain a 9.8% gender gap in formal borrowing, indicating that there are no gaps in productivity in formal borrowing. The gender gap in emergency fund availability is explained by males' advantage (51.5%) and females' disadvantage (34%), while only a difference in productivity accounts for around 74.1 % of the gender disparity in debit card holding.

4.2.3 Detailed Decomposition Estimates

Table 4 shows the contributions of each socioeconomic variable to the financial inclusion gender gap between males and females. It outlines the results of the decomposition, as well as the contribution of each socioeconomic variable to the overall gender gap in financial inclusion. The first section of the table shows the decomposition results, which are consistent with those in Table 3. The total financial inclusion gender disparity is decomposed into gaps due to variations in socioeconomic characteristics and differences in coefficients for each indicator of financial inclusion.

About 57.7% gender gap in formal saving is explained by differences in characteristics/predictors between the two groups. Differences in coefficient account for 57.7% of the observed gender disparity in formal saving, with age differences explain about 43.4% of it. Endowment gaps account for just 42.3 % of the overall gender differential in formal savings, with differences in age (100%) and employment status (74.3%) accounted for the majority of the gap. Since income and asset accumulation are positively associated with age, the financial gender gap in Ethiopia during the study period is well explained by age differences across gender. The average age of the women in our study is lower than that of the males, indicating that men have an age advantage. Furthermore, in Ethiopia, the gender gap in employment status is enormous. Due to insufficient access to training and education, Ethiopian women are less likely to be employed, more likely to be underemployed, and more likely to receive lower wages from their employment (Mat, 2020). According to the World Economic Forum (WEF, 2020), only 77 % of women were employed, while 88 % of men were employed. Furthermore, Ethiopian young women are less economically active than their male counterparts. According to Mat (2020) and World Bank (2017), young women in Ethiopia who are not in employment, education, or training (NEET) are higher than young men (15.1% for women vs. 5.7% for men). The World Economic Forum (World Economic Forum, 2019) report shows that Ethiopian gender parity in education is low (85%, with the rank of 140th) because human capital investment is insufficient and penalized women than men which resulted in a low literacy rate for women (44% of women vs. 59% of men). Low employment, low skills, and education of women resulted in a low earning rate. According to Mat (2020) and the World Bank (2017), young women in Ethiopia are more likely than young men to be unemployed, educated, or trained (NEET) (15.1 % for women vs. 5.7 % for men). According to the World Economic Forum (WEF, 2020), Ethiopian gender parity in education is poor (85 %, ranking 140th) due to inadequate human capital spending, which penalizes women more than men, resulting in a low literacy rate for women (44 % of women vs. 59 % of men). Women's poor earning rates are due to a lack of employment, expertise, and education.

Table 4: Detailed Decomposition Results

	Saving		Account		Borrowing		Emergency	
Decomposition Results								
	Coef.	**%**	**Coef.**	**%**	**Coef.**	**%**	**Coef.**	**%**
E	.070***	42.3	.092***	56.6	-.011	-10.9	.041**	48.6
C	.095***	57.7	.071**	43.4	.109***	110.9	.043	51.4
R	.165***		.163***		.098***		.084***	
Due to Difference in Characteristics (E)								
Age	.113***	100.44	.105***	64.254	.048**	49.3	.053***	62.9
Age square	-.104***	-80.307	-.093***	-57.21	-.056**	-57.7	-.054***	-64.5
Income1	-.011***	-10.745	-.009***	-5.7869	.000	.6	-.012***	-12.7
Income2	.002**	1.8019	.002***	1.2361	-.001**	-1.1	.002***	1.9
Income3	.0023***	3.2095	.002**	1.7949	-.000	-.1	.007***	7.8
Income4	.007***	7.0639	.004**	2.4683	-.001	-1.1	.004**	4.9
Education	.023**	15.653	.035***	21.404	-.011	-11.6	.003	3.4
Employment	.038***	74.342	.046***	28.403	.010	10.8	.034**	44.9
Due to Differences in Coefficients (C)								
Age	.718*	434.1	.4005	245.7	.398	407.7	.466	556.5
Age square	-.291	-175.7	-.147	-90	-.174	-177.8	-.146	-174.2
Income1	.001	.8	.006	3.4	-.006	-6.4	.008	9.7
Income2	-.006	-3.4	-.005	-2.9	.023	23.6	-.006	-6.6
Income3	.015	8.9	.022	13.7	-.007	-7.5	-.031**	-37.6
Income4	-.036**	-22.3	.002	1.2	.009	9.3	-.048**	-57.3
Education	-.006	-3.9	-.006	-3.4	-.004	-3.7	-.028	-34
Employment	.052	31.2	.150	92.3	-.088	-90.5	.141**	168.4
Constant	-.351	-212.1	-.353	-216.5	-.043	-43.8	-.312	-373.3

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors Computation using Stata 16

It means that equalizing male and female employment status would result in a 74.3 % reduction in the gender gap in formal savings. The discrepancy was widened by differences in income level 1 (the lowest 20%) and age square, while the remaining socioeconomic variables narrowed the reported formal saving gender gap. Differences in the coefficients of the fourth quantile of income are expected to broaden gender disparities in formal saving, while differences in the coefficients of age are expected to narrow them.

Differences in endowments account for 56.6 % of the gender disparity in formal account holding at formal financial institutions, while differences in coefficients account for 43.4 %. Age differences (64.3%), employment status

(28.4%), and educational qualification (21.4 %) each account for a greater proportion of the total reported gender gap in formal account ownership.

Differences in socioeconomic characteristics of groups, which accounted for 48.6% of the overall gender gap, explain the gender disparity in the ability to come up with an emergency fund. The larger proportions are explained by age (62.9%) and employment status (44.9%), both of which are expected to widen the gap in explaining the observed gender disparity. Furthermore, the financial inclusion gender gap was narrowed in the second, third-, and fourth-income quantiles.

5. Conclusions and Policy Implications

Even though the overall financial inclusion in Ethiopia has improved over time for both men and women, the gender gap has remained unchanged. Women's exclusion from financial services has ramifications for financial inclusion as a whole, as well as women's political, economic, and social participation. To meet long-term growth goals, the gender gap in financial inclusion must be closed. Using various econometric decomposition techniques, the primary goal of this study is to investigate the financial inclusion gender gap and the effect of socio-economic variables in understanding the gap. We used the World Bank's Global Findex 2017 data for this, and we are forwarding policy suggestions for bridging the gap.

We investigated the presence of a financial gender disparity in financial inclusion using Fairlie decomposition techniques. In all indicators of financial inclusion, women are less likely to be financially included, according to the empirical results. Except for debit card holding, the included socio-economic variables account for less than 40% of the overall gender gap, implying that factors such as socio-cultural, institutional, legal, and regulatory issues play a role in explaining the observed gap. During the study period, age, employment status, and educational level are among the socioeconomic variables that reliably describe the financial inclusion gender disparity across all indicators.

We have used Daymont and Andrisani's (1984) methodology to break down the overall financial inclusion gender disparity into socioeconomic gender gaps, coefficient differences, and differences in the interaction of the two. Furthermore, this method breaks down the average gender gap into disparities in productivity, as well as advantages and disadvantages for men and women. The empirical results indicate that gender gaps in saving and account holding in Ethiopia are explained by differences in measurable characteristics and coefficients, while gender disparities in borrowing and emergency fund raising to unexpected expenses (financial resilience) development are solely due to differences in coefficients. Gender disparity in saving and formal account ownership is related to differences in productivity, advantages to men, and disadvantages to women, while gender disparity in borrowing and debit card holding is attributed to advantages to men and disadvantages to women. Only gaps in productivity account for the gender disparity in emergency fund availability.

We investigated the degree to which socioeconomic variables explain the gender disparity in financial inclusion in Ethiopia using a detailed decomposition method. We found that the gender disparity in financial inclusion in Ethiopia is primarily due to variations in included measurable socio-economic variables rather than differences in coefficients, and the variables that play a key role, in this case, are the respondents' age, employment status, and educational level. In conclusion, females in Ethiopia are unable to use financial services due to their lack of education, employment, age, and earnings/income. However, socio-economic variables explain less than half of the gender gap in financial inclusion in most indicators. Therefore, future studies need to focus on the impact of socio-economic, socio-cultural, institutional, legal, and regulatory factors in the study of the on financial inclusion gender gap in Ethiopia. Policies, to improve access to financial services for women, need to address the growing gender gap in employment, education, and earnings/income. Among In most indicators, however, socio-economic factors account for less than half of the gender disparity in financial inclusion.

The following policy recommendations are derived from the analysis. Closing the financial inclusion gender gap requires bridging the employment gender gap by enhancing females' level of employment, which will increase their likelihood of accessing formal financial services. Ethiopia needs to close the gender gap in education by promoting females' level of education to close the financial inclusion gender gap. Increasing females' educational status will reduce their likelihood of being excluded from financial services. Moreover, providing financial education to women will enhance their financial literacy, which will enhance they are being included their participation in financial services. For all these recommendations to be feasible, Ethiopia needs to apply gender mainstreaming in all sectors of its economy since gender gaps in each sector may be reflected in the financial sector gender gap. Therefore, applying a gender lens to reduce the gender gap in each sector of the economy has the potential to close the gender gap in financial inclusion in the country.

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Appendix

Table I: Statistical Significance of Gender Gap in Respondent's Age (t-test)

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Female	602	31.89203	.536695	13.16818	30.838	32.94605
Male	398	34.62312	.7448988	14.86069	33.15868	36.08755
combined	1,000	32.979	.4403049	13.92366	32.11497	33.84303
diff	-2.731089	.8958148			-4.488986	-.9731923

diff = mean(Female) - mean(Male) t = -3.0487

Ho: diff = 0 degrees of freedom = 998

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0

Pr(T < t) = 0.0012 Pr(|T| > |t|) = 0.0024 Pr(T > t) = 0.9988

Table II: Statistical Significance of Gender Gap in Respondent's Age-Square (t-test)

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Female	602	1190.214	43.68786	1071.912	1104.415	1276.014
Male	398	1419.045	66.10657	1318.822	1289.083	1549.008
combined	1,000	1281.289	37.3495	1181.095	1207.997	1354.581
diff	-228.8309		75.9974	-377.964		-79.6979

diff = mean(Female) - mean(Male) t = -3.0110

Ho: diff = 0 degrees of freedom = 998

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0

Pr(T < t) = 0.0013 Pr(|T| > |t|) = 0.0027 Pr(T > t) = 0.9987

Table III: Chi-Square Test of Association between Gender and Discrete Explanatory Variables

Explanatory Variables				
Income level 1 (poorest 20%)				
Gender	Income level 1 (dummy)			Pearson χ^2
	0	1	Total	
Male	83.2%	16.8%	100%	
Female	86%	14%	100%	1.5509
Total	84.9%	15.1%	100%	
Income level 2 (second 20%)				
Gender	Income level 2 (dummy)			Pearson χ^2
	0	1	Total	
Male	84.2%	15.8%	100%	
Female	83.6%	16.4%	100%	0.0670
Total	83.8%	16.2%	100%	
Income level 3 (third 20%)				
Gender	Income level 3 (dummy)			Pearson χ^2
	0	1	Total	
Male	83.9%	16.1%	100%	
Female	82.1%	17.9%	100%	0.5819
Total	82.8%	17.2%	100%	
Income level 4 (fourth 20%)				
Gender	Income level 4 (dummy)			Pearson χ^2
	0	1	Total	
Male	80.4%	19.6%	100%	0.8959
Female	77.9%	22.1%	100%	
Total	78.9%	21.1%	100%	
Educational status of respondents				
Gender	Education (dummy)			Pearson χ^2
	Primary	Secondary	Total	
Male	63.8%	36.2%	100%	
Female	76.3%	23.7%	100%	18.0810***
Total	71.3%	28.7%	100%	
Employment status of respondents				
Gender	Employment (dummy)			Pearson χ^2
	Out of workforce	In workforce		
Male	10.6%	89.4%	100%	
Female	30.4%	69.6%	100%	54.1174***
Total	22.5%	77.5	100%	

Table IV: Chi-Square Test of Association between Gender and Dependent Variables

Dependent Variables				
Formal Account				
Gender	Account (dummy)			Pearson χ^2
	0	1	Total	
Male	47%	53%	100%	
Female	63.3%	36.7%	100%	25.9562***
Total	56.8%	43.2%	100%	
Formal Savings				
Gender	Saving (dummy)			Pearson χ^2
	0	1	Total	
Male	57.5%	42.5%	100%	
Female	74.1%	25.9%	100%	29.9102***
Total	67.5%	32.5%	100%	
Formal Borrowing				
Gender	Borrowing (dummy)			Pearson χ^2
	0	1	Total	
Male	54.5%	45.5%	100%	
Female	64.3%	35.7%	100%	9.5482***
Total	60.4%	39.6%	100%	
Debit Card Holding				
Gender	Debit Card (dummy)			Pearson χ^2
	0	1	Total	
Male	88.4%	11.6%	100%	10.6190***
Female	94.2%	5.8%	100%	
Total	91.9%	8.1%	100%	
Possibility of coming up with emergency fund				
Gender	Emergency fund (dummy)			Pearson χ^2
	0	`1	Total	
Male	32.7%	67.3%	100%	
Female	41%	59%	100%	7.1408 ***
Total	71.3%	28.7%	100%	

The Effect of Customs and Administrative Procedures on Trade: A Gravity Model Analysis of Intra- COMESA Trade

Kefelegn Aragie Tesema[1]

Abstract

This paper measures the effect of Customs and Administrative Procedures for trade among COMESA Member states. The study mainly posits that NTBs of Customs and Administrative Procedures significantly influence international trade. The study used secondary data from World Bank Doing Business Report and, the export data from Commodity and Trade Database (COMTRADE). World Bank Development Indicator (WDI) and Centre d'Études Prospectives et d'Informations Internationales (CEPII) database also used as the source of data for the study. Trade facilitation indicators are time, cost and documents that are required to complete the import and export process when goods cross the border. The study used a gravity model with fixed effects regression over a panel data from 2008-2015.

The empirical results show that changes in variables of Customs and Administrative Procedures such as cost per container (cost) and the number of days goods delay at the border (time) in exporting countries, as well as both the number of days goods spent at the border and the number of documents required in importing countries have significant negative impact on the volume of intra-regional trade. It also shows that efficient Customs and Administrative Procedures are necessary to smooth the thickness of border between both the trade partners and it produces substantial effects on trade flow. So, improving the efficiency Customs and Administration Procedures such as implementation trade facilitation initiatives can facilitate the movement the volume goods across border and promote export.

Keywords: Customs and Administrative Procedures, Non-Tariff Barriers (NTBs), COMESA, Trade Facilitation, Gravity Model

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1. Introduction

In the past few decades, world trade has been growing faster than economic growth. The volume of goods moving across the border increased exponentially through gradual liberalization and efficient reduction of tariffs. Globalization has created the fragmentation of the production process[2] and the rise of countries interdependence on international trade, causing countries to interconnect and integrated through trade (Njuguna, 2011). Corresponding to the multilateral trade agreement, Regional Trade Agreements (RTAs) substantially eliminated tariff through the formation of Customs Union and creation of Free Trade Agreement (FTA) (WTO, 2013). Similar to other world regional countries, Africa countries have reduced and eliminated their tariff through multilateral and RTA trading system. However, Africa's share in international trade with the rest of the world has declined from 7.3 percent in 1948 to 2.2 percent in 2016 (WTO, 2017).

Intra-regional trade has a significant amount of contribution to international trade. For example, three-quarters of the trade within Europe is intra-regional and half of North America's trade occurs inside the continent, and the average intra-Africa trade stands at about 10 to 12 percent. Intra-African trade is also low when compared to that of other developing regions; intra-Latin America trade amounts to 20 % while trade within Asian developing countries represents 48 % (Dicken, 2011); (Njuguna, 2011); (UNECA, 2010); (Djoumessi and Bala,2017); (Ancharaz et al., 2011). In this regard, the African region countries' trade performance is too small and the intra-African trade is very low when comparing to other regions.

The growth of intra-regional trade mainly attributed to regional integration through the formation of the RTA. Following the independence of several African countries, formation RTAs became a fashion in different parts of the continent by the elimination of tariff to benefit from intra-regional trade. The aim of regional economic integration is to increase the participation of countries by creating a large market and to boost the welfare of member countries (ITC, 2017). RTA plays a vital role to increase international trade through intra-regional trade[3] and to increase market ease of access to member countries and allow for production facilities to be located in regions where scale economies can be utilized (Kamau, 2010); (Njuguna, 2011). However, intra-RECs of Africa exports generally registered an average growth rate of 15 percent, compared with overall growth in intra-Africa exports of

[2] Product sub components are manufactured in different locations
[3] Through the use of tariff, goods import from counties outside the RTAs are more expensive (Musila, 2005)

25 percent, the trade that is confined to the RECs is less optimal than Africa-wide trade. The analysis of Africa's trade flows and patterns: the EU and USA are major export destinations for Africa; however, Asia in general and China in particular, are also important export markets for Africa; as in the case of exports, the major sources of imports to Africa are outside the African continent (UNECA, 2010); (UNECA, 2012). RECs of African region have not been successful in promoting intra-REC trade compare with other regions. For example, the intra-regional trades of the European Union, NAFTA, and ASEAN in 2015 represent 63%, 24%, and 18% respectively. In relation to the growth of merchandise trade, the Gross National Incomes per capital of Africa considerably less than with the rest of the continent, for example, North America USD 55,497, Europe USD 23,140, Asia USD 9840, and Africa USD 1516. Thus, Intra-Africa trade has the potential to raise the level of the economy and welfare of the African population through fostering regional economic development (Longo and Sekkat, 2001; Alemayehu and Haile, 2008; Alemayehu and Edris,2015).

Despite RTA have various benefits; Non-Tariff Barriers (NTBs) have restricted the growth intra-regional trade in Africa. There are various NTBs such as inefficient border procedures, cumbersome rules and regulation, duplication of procedures, various document requirements at the border as additional implements for intra-RTA trade in Africa. These barriers, therefore, undermine the gain from trade improvement through the elimination or reduction of tariffs and create high trade cost with delays while goods crossing the border. In this situation, the business would become frustrated as a result of the rising trade cost and unnecessary waiting time at the border and ports. As a result, regional integration in the Africa region has not been successful in promoting intra-African trade as it has been in regions such as the European Union and NAFTA.

Post-independence in most African countries, with the objectives of promotion of peace and security as well as sustainable economic development in the Eastern and Southern Africa region Common Market for Eastern and Southern Africa (COMESA), was formed in December 1994. It replaced the former Preferential Trade Area (PTA) for Eastern and Southern Africa, established in 1980. It is the biggest REC in Africa, and it has 21 Member States.[4] The area it covers is 40% the African Continent with the geographical area of 12 million (sq km), with a

[4] Member States includes: Burundi, Comoros, D.R, Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Madagascar**,** Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia and Zimbabwe, Tunisia and Somalia

population of 520 million inhabitants. COMESA has launched a Free Trade Area in 2000 and established a Customs Union in 2009.

However, recently the trade performance of COMESA has declined in both inside and outside the region. In 2016, COMESA's Global trade declined by 8% from US$ 255 billion in 2015 to US$ 235 billion. Total exports dropped by 7% from US$ 76 billion in 2015 to US$ 71 billion in 2016 and imports dropped by 8% from US$ 179 billion in 2015 to US$ 165 billion in 2016. COMESA's trade with the EU, the most significant trading market for COMESA originating products, declined from US$ 21 billion in 2015 to US$ 17 billion in 2016. This fall reduced its market share from 26% in 2015 to 24% in 2016 (COMESA Annual Report, 2016/17).

Moreover, COMESA export products and their destinations are very limited; the share of intra-regional is very low. COMESA's major export products to the EU were petroleum oils and bituminous, crude and natural gas primarily exported by Libya and Egypt. The second major export market for COMESA originating products to the United Arab Emirates that sourced goods worth US$ 9 billion from COMESA in 2016. The third, export market for COMESA products was the COMESA region and accounted for 11% of total COMESA exports in 2016(COMESA Annual Report, 2016/17). According to the World Investment Report 2017, the inflow of FDI to the COMESA region decrease from US$18.9 billion in 2015 to US$18.8 billion in 2016. In 2016 COMESA recorded a 0.4% decline FDI inflow, even as inflows across Africa dropped by 3.4%.

COMESA Member States' share single border or has short geographical distances with each other than the Non-Member States that locate inside or outside the continent. However, being COMESA part of Africa, still most common Non-Tariff Barriers (NTBs) seen in Africa are also encountered in the region such as inadequate implementation of harmonized policies to address technical barriers to trade, cumbersome customs and quality inspection procedures, different interpretation of rules and regulation, and inefficient customs procedures and customs formalities have steady progress. As a result of this, still, the main trading partners of COMESA are developed and developing countries, which are found outside the continent that are increasingly becoming important export markets for COMESA (UNECA, 2010).

To facilitate the removal of Non-Tariff Barriers (NTBs), COMESA introduced comprehensive trade facilitation initiatives to raise the volume of trade between member states (UNECA, 2010). COMESA implements Simplified Trade Regime (STR) for Small Scale Cross-Border Traders (SCBT), it includes; a simplified customs document, a simplified Certificate of Origin, the Common List of products and a threshold for the value of the consignment. COMESA Member States use automated customs clearance system and sixteen of them use similar ASYCUDA-EUROTRACE (ASYCUDA ++ or ASYCUDA World) and the remained Member States, namely Egypt, Mauritius, and Kenya use other types of customs management systems. Harmonization of custom documents and standards (Single customs declaration document-COMESA CD) for export goods to an individual member state, a trader was required to file an administrative form declaring the exports with the customs authorities. In addition to these, COMESA established Virtual Trade Facilitation System (CVTFS) used as a single-window system where all the facilitation instruments. COMESA also introduces vehicle insurance scheme /yellow-card/, the customs declaration form, certificate of overload control to enable ease of access to traders. To simplify trade and reduce the cost of trade at the border currently, COMESA is working on the identification and reduction or removal of Non-Tariff Barriers (NTBs) to enhance economic development within the region. Despite COMESA efforts removed NTBs, still, a number of NTBs continue to affect trade flows in COMESA (Wanjiku, Ogada, Guthiga, Karugia, Massaw-e, & Wambua, 2012); (Njuguna, 2011); (COMESA Annual Report, 2015); (UNECA, 2013).

The aim of the study is to measure the relationship of Customs and Administrative Procedures with intra-COMESA trade. Particularly, the study is intended to measure the effect of Customs and Administrative Procedures on intra-COMESA trade. The study used a gravity model with fixed effects regression over 8-year periods of panel data from 2008-2015 to achieve the aim of the study. The paper uses secondary data from sources like the Commodity and Trade Database (COMTRADE), World Bank Development Indicators, World Bank Doing Business Report, and Centre d'Études Prospectives et d'Informations Internationales (CEPII) database. The study focuses on to look at the effect of Customs and Administrative Procedures on intra-COMESA trade, and measures the relationship of the while goods cross the border of Member states within the region. The hypothesis of the study is that the cost, time, and documentation required for importation and exportation, as well as weighted distance between bilateral trade parties have negative relationship with export trade. In contrast, both GDP of importer and exporter countries have positive relationship with export trade.

Customs and Administrative Procedures are necessary procedures while goods moving across the border. Many of COMESA Member States share common border or have short distance between them, however their main trade partners are developed and developing countries which are found outside the continent. This paper mainly focus to fill the gap the impact of Customs and Administrative Procedures (thickness of the border) of Member States' on Intra-Regional trade and to provide trade facilitation initiatives to promote Intra-COMESA Trade.

The remaining part of the paper is organized as follows: Chapter Two discusses conceptual Background. Chapter Three covers the Literature review including the definition of trade facilitation and previous research works on Customs and Administrative Procedures using the gravity model. Chapter Four presents the methodology used for the study and how the variables have been measured as well as the data sources utilized. Chapter Five provides empirical result and discussions. Finally, Chapter Six presents conclusion and recommendation.

2. Conceptual Background

2.1 The Effect of Customs and Administrative Procedures on Trade

In the last two decades, international trade has increased progressively. However, as a result of Non-Tariff Barriers (NTBs), the full benefit of the reduction and elimination of tariff has not accrued in developing countries. According to the East African Community (EAC), NTBs defined as "quantitative restrictions and specific limitations that are obstacles to trade." Based on this definition NTBs are laws, regulations, and practices other than tariff; trade policy and practices; customs and administrative procedures; other technical trade barriers. This paper specifically focuses on NTBs at the border of the exporting and importing countries. In this context, the prominent NTBs are Customs and Administrative Procedures. Customs has a strong link with border and greater effect on the flow trade across the border.

UNECA (2010) find that complexity of international trade environment and the steady growth of the volume of trade in recent years need efficient Customs and Administrative Procedures because it significantly reduces the cost of the transaction as well as enables to deliver goods quickly. From the firm's perspectives, appropriate trade-enabling environment based on an efficient trade and customs administration systems are critical for enterprises to compete effectively in the global economy. Moreover, in order to operate global trade efficiently while protecting society, customs has become a strong and flexible hub to facilitate the movement of goods across borders. Efficient Customs Administration and Procedures have a positive link with trade flow. Certainly, the inefficiency and poor Customs and Administrative Procedures are barriers to the growth of international trade across the border. Lisinge (2004) find that customs inefficacy hinder the integration of developing countries into the global economy and severely weaken the countries import-export competitiveness. Inefficient and poor customs procedures and administration also have a huge impact to limit the success of intra-REC trade performance.

A survey conducted by UNECA (2010) showed that on the average customs transaction in Africa, 20 to 30 actors were involved, 40 documents were prepared, 200 items of data were entered (30 of which are repeated at least 30 times) and the 60 to 70 percent of all data were entered at least once. In addition to these, most of the documentation requirements are not defined, and traders are not informed how to comply with them. Compared with other world regions, the level of intra-trade performance in Africa is too small.

2.2 The Role of Trade Facilitation in Intra-Regional Trade

Regional economic integration refers to agreements among countries in the geographical region to reduce, ultimately remove, tariff and NTBs to the free flow of goods and services between each other. It depends on different models and approaches to regional integration. However, trade is central to the regional agenda and addressing major trade barriers is the main regional concern in achieving success (ITC, 2017). Regional economic integration thus plays a vital role for better regional cooperation and expanding intra-regional trade flows to increase the welfare of the participating countries through the creation of the larger market. Regional integration by fostering competition and enabling economies of scale promotes innovation, reduction of consumer price, triggers specialization of economies and encourages the development of regional networks (Ginsberg, 2007). In developing countries and Least Developed Countries (LDCs) in particular regional economic integration is a key driver in reducing social instability, poverty, and economic divergence trade (Kweka and Mboya, 2004).

The key obstacles to intra-regional trade in RECs are the complexity of cross-border operations. It includes Non-Tariff Barriers, particularly Customs and Administrative Procedures such as inefficient customs procedures and formalities, unpredictable, less transparent, inconsistent document requirement, and administrative burdens related to regulations are the main challenges (ITC, 2017). To enhance the benefits of economic integration it is important to address and remove such barriers to intra-regional trade, which can be more significant impediments to trade than import tariffs (World Economic Forum, 2013). To improve intra-regional trade and foster regional economic integration, trade facilitation reform is vital to address 'border administration' challenges.

The main objective of trade facilitation in a regional context is harmonization and simplification of cross border trade through trade facilitation initiatives such as regional single window, regional one-stop border post, cross-border data exchange, regional trade facilitation program and regional transit framework. It creates a consistent, predictable, and transparent trade environment throughout the region while reducing the waiting days of goods at the border and transaction costs for traders. Implementation of comprehensive trade facilitation programs and cutting the red tapes of customs and other border procedures can significantly reduce the time and cost of doing business (ITC, 2017). In addition to this, implementation of regional trade facilitation, single uniform harmonized and standard trade procedures help to reduce trade barriers and attracting foreign direct investment, it also improves economic integration by boosting intra-regional trade flows.

Harmonization and simplification of customs procedures will facilitate obtaining the full benefit of tariff reduction as well as liberalization of trade by making the movement of goods across border quick, simple and predictable formalities (World Bank, 2015); (UNECA, 2010). In the issue of trade facilitation, the Regional Trade Agreement (RTA) expect to be focused from reciprocity to policy integration concerning on border enforcement as one policy of integration into the world market (World Bank, 2011). In this context the trade facilitation measures used as stepping stones to reduce the cost of trade, to decrease the number of day goods delayed at the border, and reduce the number of documents required for importation and exportation.

3. Literature Review

3.1 Introduction

This chapter provides the concept of trade facilitation and the review of previous literature. The structure of the literature review section 3.2 contains the definition and benefit of trade facilitation, and section 3.3 shows the work of previous studies were conducted using the gravity model.

3.2 The Concept of Trade Facilitation

Trade facilitation has received wide attention from the public and private sectors since the 1990s, with the growth of trade liberalization throughout the world. The ultimate objective of trade facilitation is the reduction of trade transaction costs and time through the elimination of Non-Tariff Barriers (NTBs), in particular, simplification, standardization, and harmonization of trade documents and formalities for smooth flow of traded goods across the border in timely and in a less costly manner (UNESCAP, 2009). There is no universal definition of trade facilitation in public policy discourse. In the broader sense, the definition includes all the measures that affect the movement of goods between buyers and sellers, along the entire international supply chain. In its narrowest sense, trade facilitation simply addresses systematic rationalization of customs procedures and documents. This includes transparency and professionalism of customs and regulatory environments, as well as harmonization of standards and conformance to international or regional regulations. International agencies and regional initiatives have various adopted definitions of trade facilitation. All definition emphasizes the need for coordination of border (integrated border management) and coordination between the border countries' exit and entry posts. The narrow definition of trade facilitation limited to simplification and standardization of customs formalities and administrative procedures and other border operations related to international trade (UNESCAP, 2016); (Wilson, Mann and Otsuki, 2004); (Portugal-Perez and Wilson, 2010).

The broadest definition of trade facilitation includes all costs, apart from the cost of production, incurred in getting good from a producer to a final consumer, such as transportation costs, policy barriers (NTBs), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs. The narrow definition of trade facilitation includes trade cost incurred at the border that has a significant impact by creating barriers for the movement of goods across the border. Trade costs not only have a financial impact on the trader, but also have a negative effect on the economic welfare of affected countries. (Anderson and van Wincoop, 2003); (UNESCAP, 2009).

The "iceberg" model by Samuelson (Samuelson, 1954) is a useful device to analyse the effect of trade transaction cost, even though it designed to transportation cost model. Inefficient trade procedures and Non-Tariff Barriers (NTBs) increase the cost of trade and drive a wedge between the price received by the producer of the good and the price paid by the consumer. This result in a pure loss or "deadweight loss" and is akin to the part of the iceberg's mass that is melted away as it moves through the ocean. Samuelson used iceberg model explicitly to the costs of transporting goods that take up some fraction of the actual value of the goods. Iceberg in this study used to analyse the impact of trade cost which arises due to inefficient trade procedures, customs fees and charges, port handling fees and indirect effects such as delays and unreliability of border transactions as a result of insufficient trade facilitation measures (WTO Report, 2015); (Novy, 2007)

International trade transactions are processed by customs and other border agencies. Delay in time takes to process the clearance procedures and requirement of excessive documentation have significant negative effect on the firm's export outcomes. The requirement of excessive documentation and delays in customs processing associated can be seen as trade costs accruing to each transaction.

Trade costs higher in developing countries than in developed countries. This barrier reduced or eliminated by using trade facilitation measures. Facilitating trade with the improvement of Customs and Administrative Procedures has a relevant impact to reduce the cost of transaction as well as the growth of international trade. One of the ultimate benefits of trade facilitation is the reduction of the trade transaction cost. Besides the reduction of trade cost, trade facilitation is also expected to reduce uncertainties in trade transactions and more inclusive participation of the private sector in international trade. To reduce transaction costs and uncertainties the role of trade facilitation is removing inefficiencies trade-related procedures and the process can delay the delivery of products to overseas markets and various Non-Tariff Barriers (NTBs).

3.3 Empirical Literature

Empirical studies concerning the effect of Customs and Administrative Procedures on trade are limited. For the purpose of this paper analysis, the study departs from previous papers that used gravity model to assess the effect of customs and administrative procedures on trade.

Wilson (2007) on the paper ''Examining the trade effect of certain Customs and Administrative Procedures'' shows that Customs and Administrative Procedures have a substantial effect on trade. The paper developed using three trade facilitation indicators of World Bank doing business (2005) trading across border report on import and export, in the context of the gravity model to compare the effect customs and administrative procedures of the OECD and Sub-Saharan African (SSA) Countries. The simulation suggested that improving customs and administrative procedures will generate the greatest benefits accrue for trading partners. Customs and Administrative Procedures are necessary for the movement of goods across borders. On the other hand, efficient customs and administrative procedures will reduce the thickness of the border between countries and increase the trade flow.

Finally, the paper shows that Sub-Saharan African (SSA) countries have relatively thicker borders than OECD countries.

Trpčevska and Tevdovski (2014) explain the effect of customs and administrative procedures on trade between Southern Eastern Europe using the augmented gravity model. In addition to liberalization and reduction of tariff, the full benefit of trade will be obtained by undertaking trade facilitation and reducing customs and administrative procedures. Furthermore, simplification and harmonization of customs and administrative procedures are important to make feasible trade between countries by reducing the cost, time and document requirements for the direction towards promoting export and growth of trade.

Njinkeu, Wilson, and Fosso (2009) using estimates from a gravity model states that the main obstacles of intra-trade in Africa are customs and regulatory environments. To boost the economy of African countries, improving their customs environment is one of the policy measures to generate positive spill-over. Portugal-Perez and Wilson (2010) using gravity estimate explains, addressing trade facilitation measure on transit, documentation, port, and customs delay economically and statistically significant effect on the export performance of Africa.

According to Wilson, Mann and Otsuki (2003a and 2003b) using an estimate from a gravity model shows improvement of customs environment and harmonization of regulation has a greater positive impact over members of the Intra-Asia Pacific Economic Cooperation (APEC) and Intra-ASEAN trade. In addition to these, their paper on "Assessing the Potential Benefit of Trade Facilitation: A Global Perspective (2004)" improvement Customs environment of the importer is positively related to trade and significant in pooled cross-sectional fixed effect regressions whereas the customs environment coefficient of the exporter is not significant.

Djankov, Freund and Pham (2006) based on the World Bank Doing Business survey using the gravity model. On average, each additional day of delay reduces trade by at least one percent. The delay of goods at the border has a great impact to increase the cost of trade (David Hummels, 2001). Djankov, Freund and Pham (2009) estimate that, one day delay at customs is equivalent to adding 85 kilometres between the trading countries. Customs driven delay of goods at the border of importer or exporter country has a significant negative impact on export trade flow. Jesus Felipe and Utsav Kumar (2010), using a standard gravity model of bilateral trade flows, customs efficiency has a positive impulse and statistically significant on the trade import side.

The concepts of trade facilitation and the empirical studies (were conducted using gravity model variables) are important to estimate the effect of customs and administrative procedures on trade flow. In addition to this, these studies show that improve of Customs and Administrative Procedures have significant contribution to promote export trade, however inefficiency and poor Customs and Administrative Procedures are barriers to the growth of international trade.

4. Research Methodology

4.1 Introduction

This chapter discusses the overview of the theoretical foundation of gravity models and statistical techniques that are used to measure the effect of Customs and Administrative Procedures on trade. It also shows the theoretical framework of gravity models, the specification of the empirical model, the method of the study and the data used for the study, estimation procedures and techniques, and measures the impact of diagnostic test.

4.2 Gravity Model Theoretical Framework

To estimate the effect of Customs and Administrative Procedures on trade, this study used the Gravity model. The Gravity model is a work-horse of international trade analysis, and it has an analogy with the Newtonian theory of gravitation. It is similar to planets are mutually attracted in proportion to their sizes and proximity, countries trade in proportion to their respective GDPs and proximity (UNESCAP, 2016). It is developed by Tinbergen (1962), Pöyhönen (1963) and Linnemann (1966) to explain bilateral trade flows by trading partners' GNP and geographic distance between countries, a gravity model is a common approach to modelling bilateral trade flows. The Gravity equation simply shows that the relationship between the size of economies, their distance between countries and bilateral trade flows.

The gravity model in this paper includes key variables such as GDP and weighted distance between corresponding pairs of exporting and importing countries. In addition to this gravity model specification, various indicators of trade facilitation are used. Gravity Model is one of the most empirically successful models in explaining various types of bilateral trade flows between countries. It has high explanatory power, data requirement that are easily accessible, simple and the established standard practices that facilitate the work of researchers. It has been successful and most popular in various types of flows such as foreign direct investment, migration, and international trade flow between the two countries. The advantage of a gravity model without a great deal of analysis regarding its econometric properties is simply on the basis of goodness of fit; i.e. a relatively high R2. In addition to these, the gravity model shows the effect of the exporter's production, the importer's consumption and the trade barriers between the two countries on the volume of trade. Because of these, Gravity Model is widely used by several scholars for estimation the impact of trade facilitation. These are: Limao and Venable, 2001; Longo and Sekkat 2004; Wilson et al., 2003a, 2003b, 2004; Portugal-Perez and Wilson, 2010; Njinkeu, Wilson, and Fosso, 2009; Wilson,2007; and Trpčevska and Tevdovski (2014)

Therefore, being an empirically successful model in bilateral trade flow between countries and acceptable in international trade research, this study uses a gravity model to measure the effects of time, cost and the number of documents needed in trading across borders on the export trade flow between COMESA member states

4.3 Empirical Model and Specification

The gravity model has six specifications. The first three specifications are therefore as follows:

$$lnEXPijt=\alpha+\beta 1lnCOSTexpit+\beta 2lnGDPexpit+\beta 3lnGDPimpjt-\beta 4ln(DisWij)+\varepsilon ijt \quad \textbf{(1)}$$

$$lnEXPijt=\alpha+\beta 1lnTIMEexpit+\beta 2lnGDPexpit+\beta 3lnGDPimpjt-\beta 4ln(DisWij)+\varepsilon ijt \quad \textbf{(2)}$$

$$lnEXPijt=\alpha+\beta 1lnDOCexpit+\beta 2lnGDPexpit+\beta 3lnGDPimpjt-\beta 4ln(DisWij)+\varepsilon ijt \quad \textbf{(3)}$$

Where αis the intercept, and the parameter β's are coefficients, i and j stand for exporter and importer respectively, and t denotes trading years (t =2008; . . . 2015). In the variables of the first three specifications EXPijt denotes the exports from country i to country j expressed in US dollars. GDPexpit is the gross domestic product of the exporter country expressed in US dollars, GDPimpjtis the gross domestic product of the importer country expressed in US dollars, DisWij is the geographical weighted distance between the main economic canters of countries i and j.

Other variables such as: DOCexptit, TIMEexpit and COSTexpit referring to customs and administrative procedures. The DOCexpit refers to the number of documents needed by the exporter country, TIMEexpit, refers to the number of days goods delay at the border of the exporter country, and COSTexpit refers to costs per container of the exporter country.

The second three additional specifications of the proposed gravity empirical models borrow from Trpčevska and Tevdovski (2014) and Wilson (2007). These are:

$$lnEXPijt=\alpha+\beta1lnCOSTimpjt+\beta2lnGDPexpit+\beta3lnGDPimpjt-\beta4ln(DisWij)+\varepsilon ijt \quad \textbf{(4)}$$

$$lnEXPijt=\alpha+\beta1lnTIMEimpjt+\beta2lnGDPexpit+\beta3lnGDPimpjt-\beta4ln(DisWij)+\varepsilon ijt \quad \textbf{(5)}$$

$$lnEXPijt=\alpha+\beta1lnDOCimpjt+\beta2lnGDPexpit+\beta3lnGDPimpjt-\beta4ln(DisWij)+\varepsilon ijt \quad \textbf{(6)}$$

The second three specifications use different measures of Customs and Administrative Procedures such as COSTimpjt, TIMEimpjt, and DOCimpjt. The variable COSTimpjt refers to costs per container of the importer country, the variable TIMEimpjt to the number of days goods delay at the border of the importer country, and the variable DOCimpjt refers to the number of documents required by the importer country.

In addition, there are different measures for the distance between two countries, a weighted distance variable DisWij, where geographical weighted distance between two countries. The geographical distance data are extracted from the Centre d'Études Prospectives et d'Informations Internationales (CEPII) data base (Mayer & Zignago, 2011). The distance data between two countries calculated based on bilateral distances between the biggest cities of those two countries, those inter-city distances being weighted by the share of the city in the overall country's population Head and Mayer (2002). The calculation of distance also uses latitudes and longitudes of the relevant capital cities. An important advantage of the CEPII database is that the same population weighted-average methods are used to construct consistent measures of intra-national and international distance, cf. Mayer and Zignago (2006) and Borchert and Yotov (2016).

4.4 Empirical Method and Data

4.4.1 Method

To estimate the effect of Customs and Administrative Procedures on the trade of the COMESA regional bloc, the paper used panel data gravity model for export trade. The estimates are made in STATA based on fixed effects. The study employs the fixed effects panel data model because it allows capturing for unobserved or mis-specified factors which are fixed over time. As a result of this, in this study fixed effect modelis that it eliminates the need to include dummy variables in the regression.

Estimating this study using fixed effects regression facilitate to measure the thickeners of the borders, to estimate the effect of Customs and Administrative Procedures on export trade, and to simulate the extent to which Customs and Administrative Procedures need to be changed to increase trade flows.

4.4.2 Data

COMESA comprises, 21 countries, among these 5 countries, namely Comoros, Djibouti, Eritrea, Libya, and Seychelles do not have significant intra-trade with COMESA Member States; 2 countries such as Tunisia and Somalia are new Member States of COMESA (they do not have intra-trade with COMESA Member States under the umbrella of the COMESA program from the year 2008-2015). As a result of this, the study chooses 14 COMESA member states that have significant intra-trade with regional bilateral partners. These are Burundi, Congo Democratic Republic, Egypt, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Sudan, Swaziland, Uganda, Zambia, and Zimbabwe.

The study used export data available at the Commodity and Trade Database (COMTRADE) of the United Nations Statistics Division from the year 2008-2015. The analysis is based on annual data, and the figures are expressed in US dollars. Importers' and Exporters' GDP variables are used to measure a country's economic size. Data on this was collected from the World Bank, World Development Indicators database from the year 2008-2015, and figures are expressed in US dollars. The exporter's GDP is used to measure a country's production capacity; on the other hand, the importer's GDP is used to measure the consumption capacity of the importer country.

Trade facilitation indicators used in this study such as cost, time and document data collected from World Bank Doing Business Report under the section of Trading across Borders from the year 2008-2015. These data are trade facilitation indicators variables relating to Customs and Administrative Procedures. The Cost of export and import were measured in terms of the cost per 20-foot containers in US dollars. The time is measured in terms of the numbers of days needed for the clearance of goods at the border in the exporter and importer country. The day counting start from the first day of exporting or importing start (document preparation) up to the completion of the export or import process (port and terminal handling). In each step of the completion of the export or import the activities of the process cannot take place simultaneously. The documentation, measured in terms the number of documents needed by the exporter or importer country, it indicates the number of documents needed by law or common practice of exporting or importing country Government Agencies, Customs Administrations, Port Authorities and other agencies.

The bilateral weighted geographical distances between countries are extracted from the Centre CEPII database. The basis of the inverse relationship is due to the fact that the distance between countries introduces trade costs.

4.5 Estimation Procedures and Techniques

The study employed panel data estimation for empirical gravity model to measure the effect of Customs and administrative procedures on Trade. Panel data analysis has several benefits to control heterogeneity of cross-section units such as individuals, states, firms, countries etc… over time (Baltagi, 2005) and (Teshome, 2018). It allows you to control for variables you cannot observe or measure and to get unbiased estimates. Besides these, panel data gives more variability, less collinearity among the variables, more degree of freedom and more efficiency (Teshome, 2018). Panel data analysis, most commonly has two estimation techniques which include fixed and random effects model.

4.5.1 Fixed Effects Model

Allows to capture for unobserved or mis-specified factors which are fixed over time and that are correlated with the volume of bilateral trade, then any changes in the dependent variable must be due to influences other than these fixed characteristics (Stock and Watson, 2015). Fixed effect equation below shows the estimation of fixed effects model regression.

$$\mathbf{Yit = \beta 1Xit + \alpha i + uit}$$

Where:

Yit: is the dependent variable (DV) where i = entityand t = time.
Bi: is the coefficient for the independent variable
Xit: represents one independent variable (IV),
αi: (i=1….n) is the unknown intercept for each entity (n entity-specific intercepts).
Uit: is the error term

In this respect, the contribution of Anderson and Van Wincoop's (2003) paper, Multilateral Trade Resistance (MTR) terms are functions of all bilateral trade barriers, which in turn are a function of "distance" and "barriers dummies". Omitting MTR induce potentially severe estimation bias due to omitted or misspecified variables. The fixed effects model allows capturing unobserved or misspecified factors that simultaneously explain trade volume between two countries such as geographical distance, the length of the border adjustment, colonial history, culture, and language that are constant over time, and that are correlated with the volume of bilateral trade (Cheng and Wall, 2005). Gravity models with fixed effects also widely used by Glick and Rose (2001); Pakko and Wall (2001); Millimet and Osang (2004); Egger (2002); Njinkeu, Wilson, and Fosso (2009); and Wall (1999). The fixed effects model for all time invariant differences between the individual, as a result the estimated coefficients of the fixed effects models cannot be based because of omitted time-invariant characteristics.

4.5.2 Random Effects Model

Random Effects Model assumes that unobserved heterogeneity is constant over time period and uncorrelated with independent variables. In random-effects model you need to specify those individual characteristics that may or may not influence the predictor variables. The following equation shows how to estimate the Random Effects Model regression coefficients:

$$\mathbf{Yit = \beta Xit + \alpha + uit + \varepsilon it}$$

Where:
Yit: is the dependent variable (DV) where i = entity and t = time.
Bi: is the coefficient for the independent variable
Xit: represents one independent variable (IV),
αi: (i=1….n) is the unknown intercept for each entity (n entity-specific intercepts).
uit: Between-entity error
εit: Within-entity error

In the fixed effects Model unobserved time invariant variables are absorbed by the intercept. Unlike fixed effect model, Random effect model is including time invariant variables.

4.6 Diagnostic Test

4.6.1 Hausman Tests

The Hausman test used in model selection and compare the estimators of the tested models. One of them is for testing and deciding to choose appropriate model between fixed or random effect you can run a Hausman test where the null hypothesis is that the preferred model is random effect vs. the alternative the fixed effect (Green, 2008). It basically tests whether the unique errors (ui) are correlated with the repressors; the null hypothesis is they are not.

4.6.2 Heteroskedasticity

The classical linear regression model assumption explains that the variance of conditional on independent variables of the unobservable errors, u, conditional on explanatory variable, x, is constant (Wooldridge,2012). Homoscedasticity, is the assumption of equal or similar variances in different groups being compared. Given the value of X, the variance of ui is the same for all observations. In contrast, heteroskedasticity or unequal spread, or variance, occur when the variance of the unobservable error u, conditional on explanatory variables, is not constant (Gujarati, 2003). Regarding to regression is unbiased and consistent, even if we do not assume homoskedasticity. The standard errors of the estimates are biased if the cross-sectional data has heteroskedasticity. If the standard errors are biased, the use of t statistics or F statistics will not valid.

4.6.3 Autocorrelation

The error terms are said to be autocorrelated if and only if the error term at one date can be correlated with the error terms in the previous periods in time series or the error terms may be correlated with each other in terms of socio and geographical distance such as the distance between towns and neighbourhood effects cross-section data. In the regression context, the classical linear regression model assumes that such autocorrelation does not exist in the disturbances ui. The disturbance term relating to any observation is not influenced by the disturbance term relating to any other observation. If there is autocorrelation, the estimated standard errors are biased, as a result of which the estimated t ratios are unreliable (Gujarati,2003)

5. Results and Discussions

This chapter presents the finding and analysis of the study. Firstly, this chapter describes the results of the diagnostic tests of Hausman test, heteroscdasticity test, autocorrelation test, and multicollarlity test. This chapter also presents results of the diagnostic test and the fixed effects estimation method of regression. The results of the study show the effect of customs and administrative procedures on trade, and the relationship between customs and administrative procedures and trade.

5.1 Hausman Test

Hausman Test result used in model selection and compare the estimators of the tested models. One of them is for testing and deciding to choose appropriate model between fixed or random effects. Table 1 indicated that the fixed effect is the preferred model test than random effects.

Table 1: Hausman Test for Random Effects and Fixed Effects

Model	Chibar2 (9) value	P-value
Random Effects	35.42**	0.0001
***p<0.05; H0: Random Effects model is preferred		

The above Table 1 shows that the p value is greater than 0.05 which implies the rejected the null hypothesis that states the Random Effects model is preferred. Alternatively, the study chooses to use the fixed effects model.

5.2 Heteroskedasticity Test

Table 2: Modified Wald test for Heteroscedasticity

Model	Chi2 (8) value	P-value
Fixed Effects	4.81	0.7779
***p<0.01; H0: Homoscedastic		

The study performs a Modified Wald test to detect for the existence of group wise heteroskedasticity in the residuals of our fixed-effect regression. From the summery result of Table 2 above, the p-value is greater than 1%, this leads to strongly accept the null hypothesis for any confidence level. So, a phenomenon of homoscedastic is present.

5.3 Autocorrelation

Table 3: Modified Wald test for Autocorrelation

Model F(1, 181)	P-value
Fixed Effects 8.957	0.0031
***p<0.01; H0: no first-order autocorrelation	

To check for this complication, the study runs a Modified Wald test where the null hypothesis assumes no first-order autocorrelation. Table 3 shows that the P value (<0.01) leads us to strongly reject the null hypothesis and validate the presence of autocorrelation of first order,

5.2 Fixed Effect Estimation Results

Table 4: Empirical Result of Gravity Model Specifications 1-3

	Dependent Variable ln(Export) in three specifications		
	Model 1	**Model 2**	**Model 3**
lnCOSTexpit	-1.3905***		
	(0.000)		
lnTIMEexpit		-1.8441***	
		(0.000)	
lnDOCexpit			0.6575**
			(0.058)
lnGDPexpit	1.0721***	1.1379***	1.2344***
	(0.000)	(0.000)	(0.000)
lnGDPimpjt	1.1492***	1.1537***	1.0898***
	(0.000)	(0.000)	(0.000)
lnDisWij	-3.4789***	-3.5132***	-3.0612***
	(0.000)	(0.000)	(0.000))
R2	0.3444	0.3590	0.3195
Adjusted R2	0.3394	0.3541	0.3143
Observation	1456	1456	1456

Note: p-values are given in brackets. Significance at 1% level=***, and at 5% level=**

The correlation of Cost of Export and Number of Days goods delayed at the border of exporter countries (0.6971), and Cost of Import and Number of days goods delayed at the importer countries (0.6797). The correlations between trade facilitation indicators are low compared to the correlations in the whole. There are two reasons explain this. First explanation stems from the fact that trade facilitation indicators are different facets of overall trade facilitation and secondly some elements of trade facilitation (administrative transparency, available resources to build quality ports, and so on) are more prevalent in higher income economies than in developing countries (Wilson, Mann, and Otsuki, 2004; and Njinkeu, Wilson, and Fosso, 2009).

Table 5: Empirical Result of Gravity Model Specifications 4-6

Independent Variable	Dependent Variable ln(Export) in three specifications		
	Model 4	**Model 5**	**Model 6**
lnCOSTimpjt	-0.2320		
	(0.149)		
lnTIMEimpjt		-0.4011***	
		(0.017)	
lnDOeimpjt			-1.3535**
			(0.004)
lnGDPexpit	1.2270***	1.2278***	1.2246***
	(0.000)	(0.000)	(0.000)
lnGDPimpjt	1.0628***	1.0575***	1.0329***
	(0.000)	(0.000)	(0.000)
lnDisWij	-3.1813***	-3.1892***	-3.1638***
	(0.000)	(0.000)	(0.000)
R2	0.3138	0.3205	0.3217
Adjusted R2	0.3136	0.3153	0.3165
Observation	1456	1456	1456

Note: p-values are given in brackets. Significance at 1% level=***, and at 5% level=**

Tables 4 and 5 present the regression results of specifications 1 to 6 of the gravity model. Trade facilitation indicators of Customs and Administrative Procedures variables such as cost per container (cost) and the days at the border (time) of the exporter, the days at the border (time) and number of documents needed for importer country, and the weighted distance between countries are statistically significant and negatively influence the volume of trade in regional intra-trade. On the other hand, the number of documents needed of exporter country and GDP of exporter and importer country have significant and positive influence on volume of trade in COMESA regional intra-trade.

Regarding other Customs and Administrative Procedures variables such as cost per container in the importer country, the study does not find any of them significant in these specification models. In a fixed effect regression model shows that, the number of documents required for exporter country has a positive sign and statistically significant. According to the result, the number document required for exporting countries are less than average. Because of this, the study excludes the number of documents required for the export from further discussion. This result could imply that the trade facilitation initiatives taken by COMESA to reduce Non-Tariff Barriers (NTBs) has led to loosening the observed customs and administrative procedures for export and import that these variables are no longer important constraints to COMESA regional intra-trade.

The study conducted by Trpčevska and Tevdovski (2014) in Southern Eastern Europe customs and administrative procedures of importing countries using gravity equations did not find a significant barrier on intra-regional trade. On the other hand, Wilson (2007), customs and administrative procedures of importing countries trade facilitation indicators such as the number of documents required and the number of days goods delay while cross the borders using gravity model have a significant negative effect on tade. Countries that have efficient customs and administrative procedures would have the greatest benefit accruing than countries that have less efficient customs and administrative procedures

6. Conclusion and Recommendation

COMESA is a big Regional Economic Community (REC) in Africa. To enjoy the economic benefit of being in one REC, COMESA member states have reduced tariff through Preferential Trade Agreement (PTA) to Free Trade Agreement (FTA) at different times. And they share a common border or have short geographical distances between them. However, Non-Tariff Barriers (NTBs) within the region create a challenge on the growth COMESA regional trade.

The aim of this paper was measuring the effects of Customs and Administrative Procedures in trading across borders on the export trade flow between COMESA member states. It mainly posits that Non-Tariff Barriers (NTBs) of Customs and Administration Procedures significant influence on the trade of goods in international trade. The study used the gravity model and the trade flows are panel data from 2008 to 2015 of 14 selected countries by running with a fixed effect model.

The result of this paper on the effect of Customs and Administrative Procedures on trade of COMESA, trade facilitation indicators of customs and administrative procedures variables such as cost per container (cost) and the days goods delayed at the border (time)of exporter countries, the days goods delayed at the border (time) and the number of documents needed for importing countries are statistically significant and negatively influence the volume of intra-regional trade. Hence, improving the efficiency of customs administration in terms the cost of export, the numbers of day goods delayed at the border of exporting countries, and the number of days goods delayed at the border and the number of documents needed for of importing countries have positive impulse to promote export and trade growth.

The result of the study is in line with the study made by Njinkeu, Wilson, and Fosso (2009); Portugal-Perez and Wilson (2010); and Wilson (2007) for African Countries found that improvement of Customs and Administrative Procedures are still important for the growth of volume of trade in Africa. Harmonization and simplification of customs procedures and documentation is the most feasible way to promote mutual trade. However, in the model specifications, 4 did not have statistically significant lower trade effect in the region, as a result of various trade facilitation initiatives carried out by COMESA, including a simplified customs document, a simplified Certificate of Origin, use automated customs clearance system, harmonization of custom documents and standards, Virtual Trade Facilitation System (CVTFS), one-stop border posts, and regional trade facilitation programs.

These measures have contributed to the reduction in inefficient customs and administrative procedures; as a result, the study did not find the significance of the cost of import of importing countries, to lower trade effect. However, still much effort is needed to expand existing trade facilitation initiatives best practices and implementation of addition comprehensive regional trade facilitation programs to reduce the negative effect of the cost of export and the number of days goods delayed at the border of exporting countries, as well as the number of days goods delayed at the border and the number of documents required for importing countries to increase and promote intra-regional trade.

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Appendix Diagnostic Test

Hausman Test

```
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
    lnexgdp  |   1.179587     1.098019        .0815683        .0122446
    lnimgdp  |   1.055347     .9692127        .0861343        .0128672
      lndis  |  -3.627357      -3.6652        .0378428               .
     lnexco  |  -.1530099    -.8362535        .6832435        .1465372
     lnexti  |  -2.250045    -1.506802       -.7432433        .1455283
     lnexdo  |   2.067328     2.023104        .0442245               .
     lnimco  |  -.0338625    -.6581639        .6243014        .1361605
     lnimti  |  -.4384925     .3110344       -.7495269        .1500023
     lnimdo  |  -1.006573    -1.456362        .4497885        .0727422
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       35.42
                Prob>chi2 =      0.0001
                (V_b-V_B is not positive definite)
```

Heteroskedasticity Test

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (8)   =          4.81
Prob>chi2 =        0.7779
```

Autocorrelation Test

```
. xtserial lnextf lnexgdp lnimgdp lndis lnexco lnexti lnexdo lnimco lnimti lnimdo


Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,     181) =      8.957
           Prob > F =      0.0031
```

Empirical Investigation of Debt Overhang and Debt Crowding out Hypothesis in Ethiopia: Autoregressive Distributed Lag (ARDL) Modeling Approach

Mulugeta Bekele Debelo[1]

Abstract

The purpose of the study is to empirically investigate the debt overhang and debt crowding out hypothesis in Ethiopia over the period 1991 to 2019 using an Autoregressive distributed lag (ARDL) modeling approach. The findings suggest that both the debt overhang (measured by external debt as a percentage of GDP) and debt crowding out (measured by debt service payment as a percentage of exports) apply in Ethiopia in the short run but not in the long run. Among the other variables included in the model of economic growth, foreign direct investment and inflation are found to have a statistically significant negative effect in the long run while population growth is found to affect economic growth in Ethiopia positively in the long run but negatively in the short run. On the other hand, unemployment is found to have a statistically significant negative effect on economic growth in Ethiopia both in the long run and short run. Therefore, creating a stable political system and formulating an effective external debt management system, among others, is the policy options that policymakers could work on to tackle the possible problems of external debt and pave the way for the prosperity of the nation.

Key Words: Debt Overhang; Debt Crowding out; External Debt; Economic Growth; Ethiopia.

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Conflict of Interest

I declare that no conflict of interest and no research funds are received for this paper.

1. Introduction

Debt is defined as an amount of money owed by a person, firm or government (the borrower) to a lender while debt service is defined as the payments due under debt contracts, thus, includes payment of interest as it becomes due, and redemption payments. Debt service ratio is the proportion of annual export earnings needed to service a country's external debts, including both interest payments and repayment of principal (Black et al., 2013).

Developing countries engage in external debt most likely to improve their economic growth (Wang, 2009), mainly through capital formation and increase the output (Hameed et al., 2008). In the neo-classical model, debt increases transitional growth since the model permits capital mobility and the ability to involve foreign sources in both borrowing and lending. This creates an opportunity for capital-scarce countries, where the marginal output of capital is greater than the global interest rate, an incentive to get a loan and invest (Pattillo et al., 2002).

However, after reaching a certain threshold level, the effects of additional debt on the economy will be negative. Since the capital in underdeveloped economies is limited, and especially that these nations see an encouragement to sign for foreign loans meant for investment in as much as the return on capital is above their cost of funds (Pattillo et al., 2004).

Debt overhang is defined as, where, the potentials of repayment of outstanding facilities fall lower than the signed value, being the anticipated current value of any potential resource allocation that is not up to its outstanding loan (Krugman, 1988). In theory, the debt overhang hypothesis asserts that public debt servicing depresses economic growth via a multiplier accelerator effect through various mechanisms. It drives up domestic interest rates, thereby increasing the cost of borrowing, which then crowds out private sector investment. It also causes a net flow outwards of domestic resources (comprising of external grants, aid, and foreign exchange resources) in the form of foreign public debt repayments. Besides, it presents future tax uncertainty and deterioration in domestic policies, which directly impact on real returns on investment. It also increases government participation in domestic capital and money markets, which can then lead to credit rationing, and it increases the government's appetite to borrow to service its debts, among other reasons (Patenio & Cruz, 2007).

Moreover, crowding out effects usually occurs due to excessive real interest charges while the terms of trades of an overly indebted country becomes worsen while foreign credit markets may no longer be available, simultaneously reduction in nation's capability of maintaining its debt resulting from the crowding-out effect, and therefore, as it strives to meet some of its obligations, leaving little capital for domestic investment (Patenio and Agustina, 2007). The crowding-out effects concept assumes that government debts expend a greater part of the national savings meant for investment due to increase in demand for savings while supply remains constant, and the cost of money therefore increases. The adverse effects of foreign borrowing on economic growth can be observed through debt stock and the flow of service payments facilities that most probably crowd out public investment (Clements et al., 2003). Moreover, it is deduced that debt-caused liquidity restraints are a resultant effect of a decline in government expenditure due to the continuous servicing of outstanding debt stocks over what the economy can contain (Taylor, 1993).

Both the debt overhang and the crowding-out effects appear to have affected SSA economies. For instance, the staggering rise in external liabilities in the early 1990s was accompanied by slow economic growth, while the increasing debt-service burden led to cuts in public spending on education and health services (Fosu, 2007; Quattri & Fosu, 2012). By the mid-1990s, it was increasingly clear that a bolder approach was needed to address excessive debt that was detrimental to the growth performance of SSA countries. The World Bank and the International Monetary Fund (IMF) adopted the Heavily Indebted Poor Countries (HIPC) initiative in 1996, which provided debt relief to reduce all public and publicly guaranteed (PPG) debt to sustainable levels and ensuring a permanent exit from repeated debt rescheduling (Fonchamnyo, 2009).

Most of the empirical works done so far that investigated the effect of external debt on economic growth are ended up by accepting the debt overhang and debt crowding out hypothesis (see, e.g. Din et al., 2020; Hermawan et al., 2020; Gachunga & Kuso, 2018; Nezhad, 2014; Muritala, 2012; Saungweme & Odhiambo, 2018; and Fosu, 2010, among others). However, Akram (2016) and others indicated a positive relationship by evidencing the way debt is managed as the core determinant.

Why this study? Despite inconclusive pieces of evidence on the effect of external debt on economic growth, empirical studies that investigated debt crowding out, and debt overhang hypothesis in Ethiopia are very scant, even though, the debt problem is a burning issue in the country. Moreover, some empirical studies done so far elsewhere lack to properly measure debt overhang and debt crowding out properly as external debt stock as a percentage of GDP and debt service payment as a percentage of exports, respectively which otherwise would be misleading.

Therefore, the study has tried to fill the gap stated above by answering the following research questions, these are

- Do debt crowding out and debt overhang hypotheses hold in reality in the case of Ethiopia?
- If debt crowding out and debt overhang hypotheses hold in reality, what are the long-run and short-run effects of debt crowding out and debt overhang in Ethiopia?

2. Public Debt and Debt Intensity in Ethiopia

According to IMF (2020) in 2019 Ethiopia's public debt was 53,449 million dollars, which was increased by 4,458 million since 2018. This amount means that the debt in 2019 reached 57.6 percent of Ethiopia's GDP, a 3.51 percentage point falls from 2018, when it was 61.11 percent of GDP. It was rising since 2009 in global debt terms, when it was 10,100 million dollars, and also in terms of GDP percentage when it amounted to 35.19 percent. According to the last data point published, Ethiopia's per capita debt in 2019 was 477 dollars per inhabitant. In 2018 it was 449 dollars, afterward it kept rising by 28 dollars, and in 2009 the debt per person became 124 dollars. See the table below for more detail.

Table 1: Public Debt and Debt Intensity in Ethiopia

Year	Debt (M.$.)	Debt (%GDP)	Debt Per Capita
2019	53,449	57.60%	477$
2018	48,991	61.11%	449$
2017	44,372	57.72%	417$
2016	39,583	55.83%	434$
2015	34,347	54.46%	383$
2014	25,749	47.55%	291$
2013	22,108	47.50%	254$
2012	17,796	42.18%	208$
2011	13,818	45.33%	164$
2010	10,641	39.61%	128$
2009	10,100	35.19%	124$

Despite significant progress in the GDP of the country the debt burden was very challenging.

3. A Brief Review of Empirical Literatures

Most of the empirical literature which investigate the effect of external debt on economic growth are ended up by accepting the debt overhang and debt crowding out hypothesis (see, e.g. Din et al., 2020; Hermawan et al., 2020; Gachunga & Kuso, 2018; Nezhad, 2014; Muritala, 2012; Saungweme & Odhiambo, 2018; and Fosu, 2010, among others). However, Akram (2016) and others have indicated a positive relationship by evidencing the way debt is managed as the core determinant.

Table 2: Summary of Empirical Literatures

Author(s)	Objective of the study	Econometric model	Measures for the major explanatory variable	Major findings
Muritala (2012)	Analyzed relationship between external debt and economic growth in Nigeria over the period 1980 to 2010	OLS technique	Debt service ratio	Findings indicate a negative relationship between external debt and economic growth while that of debt servicing confirms the priori expectation of positive relationship.
Hermawan et al. (2020)	Analyzed external factors with government and company policies that have an impact on the debt service coverage ratio of coal companies	2SLS method	Debt service coverage ratio	Findings indicate debt service coverage ratio which is a measure of the company's solvency performance is influenced by the principal payment ratio.
Rahaj (2018)	Examined the impact of external debt on economic growth in Nigeria between 1981 and 2016	ARDL Model	External Debt as % of Gross National Income	Indicated that debt can only be productive if properly managed through the process of making the rate of return higher than the cost of debt servicing
Din et al. (2020)	Investigated the impact of external debt on the economic growth of Pakistan over the period 1976 to 2018	ARDL model and Error Correction model	Debt service payment as a percent of exports for Debt servicing	The empirical results indicated that external borrowing and debt servicing hamper the economic growth in Pakistan.
Gachunga & Kuso (2018)	Uncovered the existent relationship between external	panel data econometric	External Debt % of GDP	Results indicated that economies of Sub-Saharan Africa are negatively affected by

	debt burden and economic growth for the period 1990 to 2016 in 38 selected Sub-Saharan countries	techniques of Generalized Method of Moments		external debt. Also, external debt was found to be more deleterious to middle income economies compared to their counterparts low-income economies.
Kohlscheen (2010)	Analyzed the incidence of domestic and external debt crises for a sample of 53 emerging economies between 1980 and 2005.	Bivariate and Multivariate Analysis	External/domestic Debt % of GDP	The results showed that while there is considerable evidence that external defaults trigger domestic defaults, evidence for the reverse link disappears when default propensities are estimated in a simultaneous equation model.
Fosu (2010)	The External Debt-Servicing Constraint and Public-Expenditure Composition in Sub-Saharan Africa over a five-year panel for up to 35 SSA countries over 1975–94	Seemingly Unrelated Regression	debt service ratio	While observed debt service is found to be a poor predictor of expenditure allocation, constraining debt servicing shifts spending away from the social sector, with similar impacts on education and health.
Akram (2016)	Examined the consequences of public debt for economic growth and poverty regarding selected South Asian countries, i.e., Bangladesh, India, Pakistan and Sri Lanka, for the period 1975–2010.	2SLS and GMM methodologies	Debt servicing of Public and Publicly guaranteed external debt as percentage of Exports	The results show that although public debt has a negative impact on economic growth, neither public external debt nor external debt servicing has a significant relationship with income inequality. However, domestic debt has a positive relationship with economic growth and a negative relationship with the GINI

				coefficient, indicating that domestic debt is pro-poor.
Nezhad (2014)	Examined the impact of external debt and debt service on labor productivity growth and convergence before and after the debt relief initiatives	Used both parametric and non-parametric techniques	Debt stock is expressed as percentage of GDP, while debt service is expressed as percentage of exports	Results confirmed the existence of a debt overhang in SSA which is reflected in a consistently negative and significant effect of debt on growth across different model specifications. On the contrary, no robust adverse effects of debt service on labour productivity growth.
Saungweme & Odhiambo (2018)	An Analysis of Public Debt Servicing in Zambia: Trends, Reforms and Challenges over the period from 1964 to 2015	Descriptive analysis		The paper showed that debt servicing in Zambia was the insistent economic crises that dogged the country during the study period, the exceptional rise in public debt servicing obligations in Zambia over the period under review was principally due to high domestic and foreign interest rates, frequent debt rescheduling at commercial rates, and capitalization of non-liquidated service obligations at commercial rates.

According to Daud (2020) the linkage between external debt and economic growth varies mainly due to variation in institutional quality. The finding of the study indicates that external debt has an adverse effect on a country's growth, while institutional quality improves it which implies that the effect of external debt on economic growth depends on the level of institutional quality. In addition, at a high level of external debt, the effect of institutional quality on growth is very small, suggesting that the adverse effect of external debt on a country's economic growth holds true.

Moreover, Abdelhafidh (2014) investigated the external debt effect on economic growth in Tunisia. Accordingly, in the long as well as in the short-run, the external debt harmed growth over the 1970-2010 period. The long-run effect was slightly higher in the period before Ben Ali's presidency than in the period after. However, during his period, the external debt short-run effect was double that observed during the period before.

Shkolnyk and Koilo (2018) examined the relationship between external debt and economic growth in emerging economies for the period 2006–2016. The study established that a high level of external debt, in conjunction with macroeconomic instability, impedes economic growth in such countries. The regression model also shows that there is a critical level of debt burden for emerging economies, where the marginal impact of external debt on economic growth becomes negative.

Hassan and Meyer's (2021) study aimed to determine the channels through which external debt transmits its impact on economic growth in sub-Saharan African (SSA) countries. The study identified public investment, private investment, and total factor productivity as channels transmitting the non-linear effect from external debt to economic growth. Furthermore, the interest rate was also confirmed as a channel but with a direct effect. Contrariwise, the estimate indicates that savings are not a channel of transmission from external debt to economic growth in SSA.

Ohiomu (2020) External Debt and Economic Growth Nexus: Empirical Evidence from Nigeria. The results showed that the external debt of the country depresses the level of investment. This adversely affects the economic growth in Nigeria.

4. Methodology

4.1 Theoretical Framework

In specifying the model of economic growth to be estimated the theoretical framework for the study closely follows the specification given in Din et al. (2020). The empirical specification in Din et al. (2020) captures the effects of external debt on economic growth based on a variant of the Solow growth model specified as:

$$y_t = \beta_0 + \beta_1 Z_t + \beta_2 EDSGDP_t + \beta_3 DSPEXP_t + \varepsilon_t \quad \textbf{(1)}$$

Where yt represents GDP per capita which measures economic growth, Zt denotes a vector of control variables for economic growth, $EDSGDP_t\ and\ DSPEXP_t$ represents external debt stock as percentage of GDP and external debt service payment as a percentage of exports which are proxies to measure debt overhang and debt crowding out effects, respectively, and $\varepsilon$is the error term that is assumed to be white noise.

4.2 Specification of the Dynamic Model

4.2.1 The Empirical ARDL Bounds Testing Approach

The ARDL bound test used in this study is specified as:

$$\Delta y_t = \alpha_0 + \beta_1 y_{t-1} + \beta_2 EDSGDP_{t-1} + \beta_3 DSPEXP_{t-1} + \beta_4 FDI_{t-1} + \beta_5 INF_{t-1} + \beta_6 PGR_{t-1} + \beta_7 UNEMP_{t-1} + \varepsilon_t \ldots \quad \textbf{(1)}$$

To test co-integration among the variables, the F-statistics for testing the joint null hypotheses (H0) has to be compared with the critical values.

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0 \quad \textbf{(2)}$$

The alternative hypothesis against the null is given as

$$H_1: \beta_i \neq 0 \quad \textbf{(3)}$$

If the null hypothesis of no cointegration is rejected, the error-correction model (ECM) will be estimated as it is specified as follows:

$$\Delta y_t = \alpha_0 + \theta ec_{t-1} + \sum_{i=1}^{p} \delta_1 \Delta y_{t-i} + \sum_{i=1}^{p} \delta_2 \Delta EDSGDP_{t-i} + \sum_{i=1}^{p} \delta_3 \Delta DSPEXP_{t-1_{t-i}} + \sum_{i=1}^{p} \delta_4 \Delta FDI_{t-i} + \sum_{i=1}^{p} \delta_5 \Delta INF_{t-i} + \sum_{i=1}^{p} \delta_6 \Delta PGR_{t-i} + \sum_{i=1}^{p} \delta_7 \Delta UNEMP_{t-i} + v_t \ldots eqn \quad \textbf{(4)}$$

Where, δ_s are the short-run dynamic coefficients of the model's convergence towards equilibrium, θ is the speed of adjustment from the short-run to the long-run equilibrium among the variables, and ec_{t-1} is the error-correction term.

4.3 Description of Variables and Source of Data

The dependent variable in the study is an economic growth which is measured by GDP per capita.

Table 3: Summary of Explanatory Variables

Variables	Measurement	Expected sign	Source of data
External debt stock as a percentage of GDP (EDSGDP)	Total external debt is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt which is measured as a percentage here.	Negative	WDI
Debt service payment as a percentage of exports (DSPEXP)	Debt service is the sum of principal repayments and interest actually paid in currency, goods, or services on long-term obligations of public debtors and long-term private obligations guaranteed by a public entity which is measured in percentage here.	Negative	WDI
Foreign Direct Investment (FDI)	This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors and is divided by GDP.	?	WDI
Inflation (INF)	Inflation, as measured by the consumer price index, reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.	Negative	UNCTAD
Population Growth (PGR)	The annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage	Negative	WDI
Unemployment (UNEMP)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment.	Negative	WDI

Note: Explanatory variables are selected based on either theory or empirics.

5. Results and Discussion

In this section, using STATA 14 software the data are analysed and presented.

5.1 Pre-estimation tests

5.1.1 Test for Unit Root

Even though the ARDL bounds test approach to co-integration does not need pre-testing for stationary of the variables included in the model, but still it is important to carry out stationary tests because it is not applicable if the order of integration is above I(1). Therefore, here the commonly used Augmented Dickey-Fuller (ADF) (1981) unit root test is applied. The unit root tests results are presented in table below.

Table 4: Unite Root Test: Augmented Dickey-Fuller Test

	Null Hypothesis		Unit Root	
	(With Intercept)		(With Intercept and Trend)	
	t-statistics	Decision	t-statistics	Decision
GDPCG	-4.156***	I(0)	-4.650***	I(0)
FDI	-6.293***	I(1)	-6.175***	I(1)
INF	-3.908***	I(0)	-4.407***	I(0)
PGR	-3.736**	I(1)	-4.362***	I(1)
UNEMP	-5.833***	I(1)	-5.770***	I(1)
EDSGDP	-4.133***	I(1)	-4.049**	I(1)
DSPEXP	-4.553***	I(1)	-4.659***	I(1)

Note: ***, ** indicates that the null hypothesis is rejected at 1 percent and 5 percent levels of significance, respectively.

The above table shows unit root results of the series at a level and first differences. The estimated values of these variables indicate that all of them are stationary either at level or at first difference (i.e. H0 is rejected).

5.2 ARDL Bound Test for Long Run Co-integration

For ARDL bounds, testing the existence of a long-run relationship among the variables is necessary. Here, the optimal lag is selected by the Akaike Information

Criterion (AIC) and the model is estimated. After estimation, an F-test is conducted on joint significance of the variables using ADRL bound Test the F-stat justifies the existence of long-run relationship at 1 percent, 2.5 percent, 5 percent, and 10 percent among variables included in the model.

Table 5: ARDL Bounds test

Co-integration test: ARDL F-Bounds Test		
Sample: 1991-2019		
Null Hypothesis: No long-run relationships exist		
Test Statistic	**Value**	**K**
F-statistic	31.354	6
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10 percent	2.12	3.23
5 percent	2.45	3.61
2.5 percent	2.75	3.99
1 percent	3.15	4.43

Note: The F-statistic tests the null hypothesis of no co-integration; k represents the number of non-deterministic regressors in long-run relationship Critical values from Pesaran/Shin/Smith (2001).

5.3 The Long Run and Short-Run Model

As the null hypothesis of no cointegration is rejected based on F-Test, the long-run model is estimated using the ARDL Bounds test approach and the error-correction model (ECM) is estimated to capture the short-run dynamics.

The discussion provided below focuses mainly on the major variables of interest. As is observed from Table 4 above, the empirical ARDL model shows foreign direct investment, inflation, population growth, and unemployment are found to be statistically significant in the long run at 5 percent, 1 percent, 5 percent, and 5 percent level of significance, respectively whereas the Error Correction Model result indicates External debt stock as a percentage of GDP, Debt service payment as a percentage of Export, population growth, and unemployment are found to be statistically significant in the short run at 5 percent, 1 percent, 5 percent, and 1 percent level of significance respectively.

Table 6: The long-run and short-run models

Dependent Variable: GDP per capita growth
Selected Model: ARDL (2, 1, 0, 2, 2, 2, 2)
Sample: 1991 to 2019

Long Run Estimates

Variables	Coefficient	t-Statistic	P-Value
External debt stock as a percentage of GDP	0.0069183	1.72	0.119
Debt Service Payment as Percent of Exports	-0.0000895	-0.07	0.943
Foreign Direct Investment	-0.8257213**	-2.40	0.040
Inflation	-0.1128062***	-3.51	0.007
Population Growth	0.0141366*	2.30	0.050
Unemployment	-0.1045103***	-2.87	0.021

Error Correction Model: Short Run Estimates

Variables	Coefficient	t-Statistic	P-Value
External debt as a percentage of GDP (-1)	-0.0153714**	-2.90	0.018
Debt service payment as percentage of exports (-1)	-0.0084951***	-4.11	0.003
Foreign Direct Investment (-1)	0.4576995	0.99	0.347
Population Growth (-1)	-0..4471004***	-2.80	0.023
Unemployment (-1)	-0.968902***	-48.20	0.000
Constant	-8.140784	-0.31	0.760
ECT (-1)	-0.940245	-11.01	0.000

Note: ***, **, and * indicates 1 percent, 5 percent, and 10 percent level of significance respectively

According to the empirical results even though external debt stock as a percentage of GDP is not statistically significant in the long run ARDL model, the Error Correction Model result indicates External debt has a negative and statistically significant impact on the Economic growth of Ethiopia in the short run. This supports the hypothesis in the debt overhang hypothesis literature, holding other things constant increase in external debt by 1 percent decreases economic growth approximately by 0.015 percent in the short run and statically significant at 5 percent level of significance. Thus, the option for boosting the economic growth process is to decrease the stock of foreign debt as it discourages the growth process significantly. This negative short-run effect of debt overhang is observed in the country because debt overhang is measured as an external debt stock. The percentage of GDP and the stock of external debt is currently close to 60 percent of the GDP. The finding is consistent with previous empirical works (Din et al., 2020; Gachunga & Kuso, 2018; Akram, 2016; Nezhad, 2014 and Muritala, 2012) among others that justify external borrowing discourages investment or gross capital formation and hampers the economic growth.

Similarly, the short-run coefficient of the debt servicing variable confirms the existence of the debt crowding-out dilemma as it affects the economic growth negatively and significantly. Holding other things constant, an increase in debt service payment by one percent decreases economic growth approximately by 0.009 percent in the short run and highly statically significant at one percent level of significance. The finding is consistent with previous empirical works (Hermawan et al., 2020; Din et al., 2020; Saungweme & Odhiambo, 2018; and Fosu, 2010) among others that justify debt service payment leads to discouraging the productivity of the debtor through crowding-out effect. However, in the long run, a negative but statistically insignificant relationship is observed, because in the long run there is a possibility to rule out those negative effects.

Among other explanatory variables included in the model of economic growth, holding other things constant, a one percent increase in population growth increases economic growth approximately by 0.014 percent in the long run while 1 percent increase in population growth decreases economic growth approximately by 0.447 percent in the short run and statistically significant at 5 percent and 5 percent, respectively. The finding is in line with the theories of Boserup and Malthus, respectively, in the short run population growth is a burden for the nation as creating new jobs and livelihoods is difficult whereas in the long run there is a possibility of intensification in the production process. Moreover, a one percent increase in unemployment decreases economic growth approximately by 0.105percent in the long run and by 0.969 percent in the short run and statistically significant at 5 percent and 1 percent respectively. In the long run, a one percent increase in foreign direct investment decreases economic growth approximately by 0.826 percent whereas a one percent increase in inflation decreases economic growth approximately by 0.113 percent and it is statistically significant at 5 percent and 1 percent, respectively. However, both foreign direct investment and inflation are not significant in the short run.

The ECT is statistically significant at one percent and negative (-0.940) as expected showing that the deviation of GDP per capita growth from equilibrium values is corrected by 94 percent in the following year. The negative sign of the parameters in the error correction model indicates that any sort of an economic shock that takes place in the short run will be adjusted in the long run.

5.4 Model Diagnostic Tests

The estimated model has a good fit as it can be seen from R-squared and adjusted R-squared and the model passes all diagnostic tests.

Table 7: Model Diagnostic Tests

Problems	Applicable Tests	Probabilities
Goodness of fit	R-squared	0.9734
	Adjusted R-squared	0.9233
Serial correlation	Breusch-Godfrey LM test for autocorrelation	0.6959
Functional form	Ramsey RESET Test	0.2453
Normality	Shapiro-Wilk W test for normal data	0.53908
Heteroscedasticity	White's test	0.3630

Note: The null hypothesis for the Shapiro-Wilk W test for normal data is that errors are multivariate normal. The null hypothesis for the Breusch-Godfrey LM test for autocorrelation is that there is no problem with serial correlation. The null hypothesis for White's heteroscedasticity test is that there is no problem with heteroscedasticity. The null hypothesis for the Ramsey RESET test is that the model is correctly specified. Thus, such tests indicate the acceptance of the null as their respective value is greater than 10 percent level of significance. Thus, there is no problem of non-normality, autocorrelation, and heteroscedasticity in the errors. In addition, the model is correctly specified.

6. Summary, Conclusion, and the Way Forward

6.1 Summary and Conclusion

The study has investigated the effects of external debt on the economic growth of Ethiopia over the period 1991-2019 by examining the debt overhang and debt crowding-out dilemmas of the external debt. External debt as a percentage of GDP is used as an indicator of debt overhang effect, whereas debt service payment as a percentage of exports is used as an indicator of debt crowding-out effect. The findings of the study have validated the co-existence of overhang and crowding out dilemmas for the external debt in Ethiopia. It means that external debt and debt servicing impede economic growth in the short run. One percent increase in the stock of external debt is found to bring a 0.015 percent fall in economic growth. Similarly, a one percent increase in debt servicing is found to hamper the economic growth by 0.009 percent in the short run. Among the other variables included in the model of economic growth, foreign direct investment and inflation are found to have statistically significant negative effects while population growth is found to affect economic growth in Ethiopia positively in the long run but negatively in the short run. On the other hand, unemployment is found to have a statistically significant negative effect on economic growth in Ethiopia both in the long run and short run.

6.2 The Way Forward

Based on the empirical findings the following policy options are provided.

- Creating a stable political system is essential to formulate appropriate and effective external debt management systems which might lead debt towards developmental goals.
- Strengthening policies and strategies focused on export diversification is necessary.
- The government of natural resource-dependent countries like Ethiopia should work on bargaining for debt service payment in terms of goods and services rather than the hard currency which leads to twins' outcomes by encouraging exports.
- Moreover, working on domestic resource mobilization through domestic saving and investment is vital.

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Can Ethiopia Reach a Lower-Middle-Income Status by 2025? A Framework of DSGE and VAR Models

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Abstract

Ethiopia has set the goal to be one of the Lower-Middle-Income (LMI) economies in the world by 2025. With that the target is to reach a GDP range of 147.5 to 578.4 BL US$ and a GDP per capita range of 1,137 to 4,458 US$ by 2025. The present study asks whether Ethiopia is likely to reach these targets or not if the trends, dynamics, and volatility that have been experienced during the last decades persist. The out-of-sample forecast was analyzed using DSGE and VAR models, and the data set used in this study underwent a structural break test. Based on 1990: q1-2018: q1 data, the Nominal GDP of the Ethiopian economy is predicted to be 130.86 BL US$ by the VAR model and 131.52 BL US$ by the DSGE model in 2025. The 2004-2018 data gives a higher predicted value of 164.84 BL US$ and 169.69 BL US$ for the VAR and DSGE models, respectively. Using the 2004-2018 data, the 2025 Nominal GDP in US$ is forecasted to be more than 164 BL, and the GDP per capita between 923 to 1,123 US$. Even though Ethiopia may surpass the target set in terms of Nominal GDP and come close to the GDP per capita target, still a lot must be done to make the goal of reaching the LMI status credible. Therefore, fostering industrialization, increasing the role of the private sector, financial and economic reforms are among the policy measures that must be taken to achieve a resilient LMI status by 2025.

Keywords: Ethiopia, LMI economy, 2025 forecast, DSGE, VAR
JEL Classification: C53; E37

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Acronyms and Abbreviations

ARIMA	Autoregressive Integrated Moving Average
BL	Billion
BM	Bayesian Methods
CB	Central Bank
CPI	Consumer Price Index
DSGE	Dynamic Stochastic General Equilibrium
ETB	Ethiopian Birr
FMLE	Full-information Maximum Likelihood Estimation
LMI	Lower-Middle-Income
NGDP	Nominal Gross Domestic Product
NK	New Keynesian
PPP	Purchasing Power Parity
RBC	Real Business Cycle
SOE	Small Open Economy
TR	Trillion
US$	United States Dollar
VAR	Vector Autoregression
WB	World Bank
WDI	World Development Indicator
WDR	World Development Report

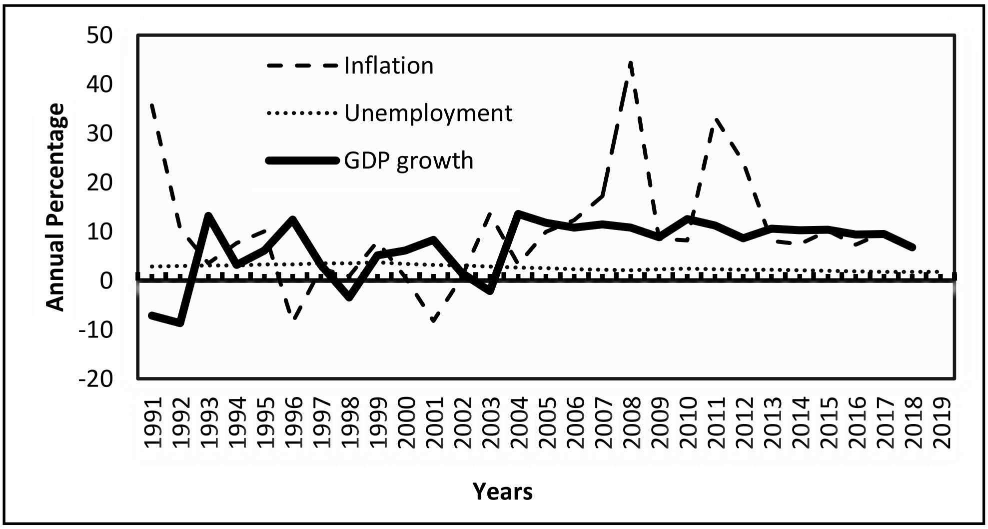
1. Introduction

Ethiopia was the second poorest country in the world at the beginning of the century. However, the country has registered an encouraging continuous growth over the last decades, facing but standing various shocks and macroeconomic difficulties and moved to the 17th poorest in 2018 (WB, WDI, 2018). The country is one of the fastest growing economies in the world with an average growth rate of 10.5 percent from 2004-2018, registering a record growth rate of 13.6 percent in 2004 (WB, WDI, 2020[4]). Figure 4.1 presents the inflation, unemployment and Gross Domestic Product (GDP) growth trends in the economy. As reported in WB, WDI (2020) inflation reached an extremely high value of 44.4 percent in 2008, when the global economic downturn moderately hit the Ethiopian economy. After two years of single digit inflation, prices skyrocketed again to 33.3 percent in 2011, due to the Ethiopian currency devaluation of 2010. The unemployment level in Ethiopia remained high after the downfall of the Derg military regime in 1991 and increased further in the mid 1990's (WB, WDI, 2020). It showed a tendency to rise again in 2009-2010 following the global financial crisis. Since 2004, with the continuous achievement of double-digit economic growth, the employment rate slightly improved. The overall performance of the economy persuaded many that Ethiopia could achieve the Lower-Middle-Income (LMI) economy status by 2025 as mentioned by MoFED (2010), WB (2013) and NPC (2016). According to UNDP (2018), the unprecedented sustained economic growth led some economists to assert that Ethiopia can achieve the aim to become LMI country by 2025.

Hence, upon the impressive performance of the economy relative to not only Africa at large, but also the world, Ethiopia has officially set the target to be listed in the LMI category by 2025 with a GDP in the range of 147.5 to 578.4 BL US$ or 9.3 to 36.5 TR ETB and a GDP per capita in the range of 1,137 to 4,458 US$[5]. By achieving this goal, Ethiopia is expected to pull millions of people out of poverty, improve life expectancy and reduce child and infant mortality.

[4] The numerical figures and sentences referred to WB: WDI, 2020 are either taken directly or calculated indirectly from the report of the World Bank (WB).
[5] Own computation based on the GNI/GNP (Gross National Income/Gross National Product) per capita calculation of WB Atlas method data report from 1987 to 2018

Figure 4.1: Trends of macroeconomic variables in Ethiopia



Source: WB, WDI, 2020

When trying to forecast Ethiopian GDP in 2025 from available data, we think it is appropriate to have more than one forecasting technique. Hence results from two or more methods should be evaluated for a more reliable and robust overall prediction. This study has employed a form of structural Vector Autoregression (VAR) and Small Open Economy (SOE) Dynamic Stochastic General Equilibrium (DSGE) models to predict and evaluate the gross output level and income per capita projections of Ethiopia by 2025.

The first and second growth and transformation plans of Ethiopia from 2010 to 2020 (GTP I and GTP II) and the ensuing Homegrown Economic Reform Agenda all aim to transform the country from the low-income category to the next category of LMI by 2025. This study is meant to predict and evaluate the realization of the 2025 goal. More precisely, the present study inquires if Ethiopia is likely to meet its 2025 target if the trends, dynamics and volatility that have been experienced during the last decades endure. To the best of our knowledge, this question has not been investigated in detail. In fact, long run projections and estimations using DSGE and VAR models for Ethiopia are hardly available, but would seem to provide important guidance for policy interventions with appropriate measures. Recent outstanding, but potentially highly important events such as the expensive cost of living mainly caused by the climbing up of inflation to 20.16 percent in 2020 the first time since 2012, the COVID-19 crises, the unrest in different parts of the country and the disagreement with neighbouring countries may affect the prospects for Ethiopia's development in ways that are obviously not incorporated in this study's forecasts.

2. Literature Review

A wide range of methods are available to predict macroeconomic variables. A popular classification of forecasts is into judgment-based (qualitative) forecasting methods and model-based (quantitative) forecasts. The first group of methods mainly relies on a specific forecaster's ability to observe empirical regularities and irregularities in the economy which makes it difficult for an outsider to observe the model and data used (Robertson and Tallman, 1999). Such methods include executive opinions, Delphi methods, sales force estimates and consumer surveys. The second category relies on a statistical approach which paves the way to tracking sampling errors and to model performance evaluation. It includes VAR and DSGE models and many others like, exponential smoothing, trend projection, Autoregressive Moving Average (ARMA), and Autoregressive Integrated Moving Average (ARIMA) models. These quantitative forecasting methods are often classified into structural and non-structural ones, depending on how much "structure" is provided by economic theory. These theoretical foundations may differ according to their view of the economy based on the assumptions they use and the components of the economy they emphasize. Some models focus only on the demand side of the economy, while others capture the supply constrained nature of developing economies, or are based on macroeconomic models such as the Real Business Cycle (RBC), New Keynesian (NK), or Computable General Equilibrium models. In what follows this study briefly review the literature on DSGE and VAR.

2.1 Evolutions of DSGE Modeling

Until the mid-1970s the dominant paradigm in macroeconomics was Keynesian, in which short run fluctuations in economic activities are considered as caused by variations in aggregate demand. However, it was difficult to explain the stagflation that was closely linked to the oil price shock in the mid-1970s within the Keynesian paradigm, and thus contributed to the fading of this school and the rise of a new paradigm characterized by microeconomic foundations and supply side shocks.

The idea DSGE was pioneered by Kydland and Prescott (1982) and Long and Plosser (1983) in their seminal contribution on the RBC model and it marks the rise of DSGE modeling. The typical RBC model is based on the neoclassical framework with “microeconomic foundations” in the sense of optimization behavior of economic agents under flexible prices and the assumption of rational expectations. Being based on micro foundations has helped these models to overcome the criticism of Keynesian economics which does not had such foundations, whereas the rational expectations assumption enables them to address the Lucas critique, which says that estimated parameters may not be policy invariant such that using them for the future is invalid. The RBC models assume that markets always clear and economic fluctuations are the results of optimal inter-temporal decisions by economic agents and monetary variations cannot explain the fluctuations in aggregate variables. This has led to the conclusion that money is neutral and there is no need to use economic policy to correct the fluctuations (Snowdon and Vane, 2005). But the neutrality of money has faced serious challenges based on empirical evidence. The non-neutrality argument implies that prices and wages are not flexible, which led to the development in DSGE modeling that incorporate these issues.

Thus, Keynesian short-run features were included into DSGE models. The new extended models have features of the RBC model, but include the NK assumption of imperfect competition. In NK economics prices are rigid because of menu costs, aggregate demand externalities, coordination failure and staggered price contracts (Snowdon and Vane, 2005). Similarly, wages are also rigid because of efficiency wages, union power and staggered wage contracts. NK economists have thus given microeconomic foundations for rigidities introduced by J.M. Keynes (1936). Combining both households’ and firms’ optimization problems coming from the RBC approach with nominal and real rigidities, has provided a plausible explanation of short-run dynamic macroeconomic fluctuations and made macroeconomic models more realistic. The paper that first introduced this framework was Rotemberg and Woodford (1997). Remarkable changes have also been made in the specification and estimation of DSGE models (for example, Goodfriend and King, 1997; Clarida, Gali and Gertler, 1999; Woodford, 2003; Mankiw, 2006; Goodfriend, 2007 and Gali and Gertler, 2007).

According to Tovar (2009, pp. 1) “DSGE models are powerful tools that provide a coherent framework for policy discussion and analysis. In principle, they can help to identify sources of fluctuations, answer questions about structural changes, forecast and predict the effect of policy changes, and perform counterfactual experiments”. Tovar further states that “Central Banks (CBs) have become increasingly interested in their usefulness for policy analysis. Aside these rapid advances, the use of DSGE models remain in the periphery of the formal policy decision making process in most CBs. It remains in CBs to be seen whether these models will be adopted in the core process of forecasting and policy analysis frameworks, or whether they will only be employed as a supplementary tool outside the core framework".

Since the DSGE models that are estimated from actual data have performed well, they have become popular in developed countries where they are now the dominant macroeconomic models used to analyze monetary policies (Regassa, 2011 and Tovar, 2009). Today there is a large literature that tries to improve DSGE models by incorporating new assumptions, by linking the model with data and by extending it to developing countries. The progress can also be seen from the aphorism quoted in Chari (2010, pp. 2) "If you have an interesting and coherent story to tell, you can tell it in a DSGE model. If you cannot, your story is incoherent". Even though advancement of conventional macroeconomics has been attained in the last thirty years, the proponents of these models do not seem to be convinced and shaken by the criticisms. The tone of dissatisfaction regarding the progress is shared by many (for example, Chari and Patrick, 2006; Chari and Patrick, 2008; Woodford, 2009). Simultaneously, a considerable progress has been made in the past two decades which addresses few of the criticisms on DSGE.

DSGE Models can be estimated using various methods: for instance, the Generalized Method of Moments (GMM) has been employed by Clarida, Gali and Gertler (2000) for analysis. This method controls endogeneity, omitted variable bias, error in measurement and heterogeneity potential (Caselli, Esquivel and Lefort, 1996; Bond, Hoefler and Temple, 2001). It also improves the effectiveness and consistency of simulations by Monte Carlo methods (Blundell and Bond, 1998). Orphanides (2001) and Ball and Robert (2002) used Ordinary Least Squares methods and made implausible identification assumptions in order to avoid an endogeneity bias. Full-information Maximum Likelihood Estimation (FMLE) has been employed by Fuhrer and Moore (1995), Leeper and Sims (1994) and Kim (2000). One problem in estimating DSGE models by FMLE, however, is that estimates of FMLE structural parameters are often at odds with additional information or observations. Recently, DSGE has also been estimated by Bayesian Methods (BM) since, they fit "the complete, solved DSGE model", avoid "the dilemma of absurd parameter estimates," and "the weighting of the likelihood with the prior densities adds sufficient curvature in the posterior distribution to facilitate numerical maximization and identification" (Griffoli, 2010). Bayesian estimates of DSGE models based on likelihood have begun with the studies of Landon-Lane (1998), DeJong, Ingram and Whiteman (2000), Schorfheide (2000) and Otrok (2001). An and Schorfheide (2007) carried out analysis and estimation of a DSGE model by BM in a closed-economy framework. Lubik and Schorfheide (2007) used BM in a SOE framework to see the effects of exchange rate movement on CB's monetary policies, i.e., to investigate the hypothesis that CBs respond to exchange rates. de Walque and Wouters (2004), Lubik and Schorfheide (2006) and Rabanal and Tuesta (2006) used BM for multi-country DSGE estimates. The models can also be estimated using Moment Simulated Method (Francisco, 2011) and Indirect Inference Method (Le *et al.*, 2012; Meenagh *et al.*, 2019).

2.2 VAR Models

VAR is a linear time-series technique that models the interrelationships between macroeconomic indicators assuming some variables as endogenous and others as exogeneous. One of the advantages of VAR modeling over DSGE is that, while a DSGE model provides an entire stochastic multivariate process, it places so many constraints on certain time series and are mostly rejected against less restrictive models such as VAR. VAR models became popular since their first use by Sims (1980) for macroeconomic analysis and are trying to achieve what Stock and Mark (2001) refers to as policy analysis, structural inference, forecasting and data description. Sims (1980, pp.16) identified the over-parameterization problem associated with scale macro models when he argued that "if every variable is allowed to influence every other variable with a distributed lag of reasonable length, without restriction, the number of parameters grows with the square of the number of the variables and quickly exhausts degrees of freedom". Over-parameterization is severe when the model has many variables with short time dimension. As Koop and Korobilis (2010) explain, all the solutions developed so far to overcome the problem of over- parametrization have one thing in common; that is, they are all based on the idea of shrinkage, i.e., restricting some of the elements of the coefficient matrix of the VAR model and the associated variance-covariance matrix to zero.

Furthermore, as Sims (1980), VAR is a stochastic process technique that can be used to display the linear interdependence of multivariate time series variables. This model generalizes the univariate auto regressive model by permitting many evolving variables. If the data are stationary in a level, estimations of the models proceed using the variables in a level. However, if the time series variables are non-stationary, problems of using it are avoided by taking the difference of the variable depending on the results of unit root test. Then, a VAR model is used to forecast each variable from the lagged values of its own and the lagged value of other variables.

Therefore, VAR expresses each variable as a linear function of its own past values, the past values of all other variables being considered, and a serially uncorrelated error term. One application of VAR in time series forecast is to test whether the lags of included variable has useful predictive content above and beyond others variables in the model. The lag length for the VAR model is determined using model selection criteria (Akaike, 1973; Lütkepohl, 2005).

2.3 Studies on Forecasting

It is worth reviewing studies that have been conducted on GDP forecasting. As presented below some of them are one-step ahead (static) forecasts and did not emphasize dynamic forecasting. Also, most studies which grounded their forecasts on the VAR technique do not compare and evaluate their results against predictions by the DSGE technique.

Abdul Razak, Khamis and Abdullah (2017) compare performance of ARIMA and VAR models in the forecasting of Malaysian economic growth and suggest the best time series model from the two. The indicators used to measure economic growth are currency in circulation, exchange rate, external reserve, and reserve money. The forecast performances were appraised based on out-of-sample forecasts, using as error measurement the mean absolute percentage error. The study found out that the VAR model outperforms the ARIMA model based on the assessment of forecasting accuracy.

The study by Bekana and Deressa (2017) has employed a VAR model to forecast the GDP of Ethiopia. However, their prediction is limited to a one-period-ahead (static) forecast. In the study out-of-sample forecasts were produced for the Ethiopian GDP using the fitted model. The results for mean squared error, mean absolute error and Theils U statistic indicate that the estimated model is good enough to describe the data set.

The paper by Trevor and Thorp (1988) presents three VAR models of the Australian economy. The forecasting performance of 1986-87 outcomes (on an ex-ante basis) is compared against three sets of private sector forecasts, the 1986-87 budget forecasts and the actual outcomes from the same period. The VAR forecasts perform at least as well or better than comparable forecasts of the private sector. Among their conclusions, the detrending process is a key component of the quality of forecasting.

The study objective of Patrick (2009) was to forecast GDP growth for the Baltic States Estonia, Latvia, and Lithuania. The forecasts were made based on a reduced VAR model which provided good results for horizons up to t+8 (Eight periods a head). Based on the findings it is possible to conclude that the model provided reliable estimates of future values of GDP for the assessed countries. The study suggests that the model should be appropriate to be applied to other countries of interest.

3. Materials and Methods

3.1 Data and Variables

The analysis was based on the seasonally adjusted quarterly time series data set for different indicators of the economy. Two time periods of the Ethiopian economy, i.e., 1990q1[6]–2018q1 and 2004q1–2018q1, have been used for forecast analysis of the 2025 goal. The structural break test reveals that 2002q2 and 2003q2 mark structural changes in the economy. These structural break points have been taken care of by incorporating dummy variables. Even though the first data set contain more observations, the period is also accompanied by structural changes in 2002q2 and 2003q2. Thus, doing the projection based on the 2004-2018 data set might better reflect the economic growth dynamics in the upcoming period.

Data[7] for the variables were collected from the National Bank of Ethiopia, the World Bank's World Development Indicators (WB, WDI), the International Monetary Fund, and the United Nations. The study also uses data from relevant publications, such as books, journal articles and working papers that provide evidence for DSGE and VAR modeling. The variables used in this study follow the definition given by Salvatore (2013), Mankiw (2013), Dornbusch, Fischer and Startz (2011) and Romer (2012) and are described as follows:

[6] 'q' is measurement of time/date interms of quarters.

[7] In this study various sources of data were consulted to acquire facts. The data compiled by the datasets such as WB: WDI, IMF and UN contain most comprehensive set of data on national, regional, and global estimates/indicators. The data series by this organizations are coming primarily from official national sources (Such as the NBE, CSA, MoFEC, NPC as they report to the international organizations). Following the acquisition of data from national/official sources, international data sources go through several standardized procedures before publishing the data/information.

Table 3.1: Description of variables used to forecast the 2025 LMI target of Ethiopia

Variable	Description	Measurement Unit
Nominal GDP (NGDP, y)	The monetary value of economic output/income.	Currency[8]
GDP per capita	Mean income (output) averaged for the whole population of a country.	Currency
Nominal exchange rate (e)	Several units of the domestic currency that can purchase a unit of a given foreign currency.	Currency
Inflation rate (π)	A sustainable increase in the general (average) price level of goods and service over a period.	%
Nominal interest rate (r)	The amount of interest due per period, as a proportion of the amount lent, deposited, or borrowed.	%
Terms of trade (ToT, q)	The ratio between a country's export prices and its import prices.	%

3.2 Theoretical Model

The out-of-sample forecasts for 2025 were analysed and compared between DSGE and VAR models. VAR is a multivariate time series model, in which all the variables are considered as dependent. On the other hand, as Blanchard (2009) indicated the basic components of the *standard open economy NK DSGE* model comprises:

- the preferences of the households which capture intertemporal utility maximization,
- the technology capturing the relationship between different inputs and the output produced by profit maximizing monopolistically competitive firms,
- the monetary authority that employs different monetary policy instruments, and
- the economy's integration and interaction with international financial/asset markets.

[8] Currency unit is measured in ETB or US$

3.3 Model Specification

3.3.1 VAR Model

A comprehensive p-th order VAR model is given by Equation (1) (Robertson and Tallman, 1999):

$$y_{i,t} = \alpha_i + \beta_1 \gamma_{i,t-1} + \cdots + \beta_p \gamma_{i,t-p} + \varepsilon_{i,t} \qquad \textbf{(1)}$$

Where i is list of variables, α is constant, y at a given time depends on past values of y up to a lag length of p, β_ps' are coefficients of the lags and ε is an error term.

3.3.2 The Small Open Economy Model

This study as well employed a SOE version of a DSGE model, in the NK framework (Woodford, 2003). The model was developed by Gali and Monacelli (2005) and is increasingly used across the literature after its humble application by Lubik and Schorfheide (2007). The households, firms and CB decision-making processes that make up the DSGE model are listed as follows:

- The first order condition of the households' intertemporal utility maximization issue provides the economy's IS curve (demand or output gap Euler equation).
- The NK Phillips curve (or supply), which represents inflation dynamics, derived from the optimal price-setting decisions by profit maximizing monopolistically competitive firms.
- The Taylor-type interest rate rule is adopted from the target of fiscal and monetary authorities as a reaction function.

It's indeed possible to integrate the decision-making process and the optimal choices of these economic agents to provide the basic model framework that describes the economy. In this study, the SOE model used is as follows:

Households: the consumption Euler equation showing the supply side of the economy can be rewritten as an open economy IS-curve:

$$y_t = E_t y_{t+1} - (R_t - E_t \pi_{t+1} - z_t) \qquad \textbf{(2)}$$

Where y is aggregate output, R is the interest rate, π is the inflation rate measured by the Consumer Price Index (CPI), and z is the growth rate of an underlying non-stationary world technology process. As usual, E is the expected value operator.
Firms: optimal price setting of domestic firms leads to an open economy Phillips curve:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa y_t \qquad \textbf{(3)}$$

Where the coefficient κ is a function of underlying structural parameters, such as labor supply and demand elasticities and the parameters capturing the degree of price stickiness.
Central Bank: monetary policy is represented by a Taylor-type interest rate rule which says that the CB adjusts the interest rate in response to the inflation rate (Taylor, 1993).

$$R_t = \psi \pi_t + u_t \qquad \textbf{(4)}$$

Where Ψ represents monetary policy coefficient and u_t is an error term.
Nominal Exchange Rate: the nominal exchange rate e is included in the model based on the definition of CPI by assuming that comparative Purchasing Power Parity (PPP) holds:

$$e_t = \gamma \Delta e_t + \pi_t^* \qquad \textbf{(5)}$$

Where π* is an unobserved world inflation shock, and may also be interpreted as the misspecification, or deviations from PPP and Δ shows a change in the value of e.
Terms of Trade: q can be determined as the relative price which clears the international goods market and Δq is a change in the value of q. It is as follows:

$$\Delta q_t = \sigma q_t + \varepsilon_t \qquad \textbf{(6)}$$

The five equations (2) to (6) above form a linear rational expectations model. It can be solved by different methods and a linear approximation a very common one. The log-linearized DSGE model is set in a state-space form, so that the observed variables are connected to model variables by measurement equations. Simultaneously, the state equations provide the reduced form of the DSGE model by relating current variables to their lags and the independent and identically distributed (i.i.d.) shocks. Therefore, the DSGE model is completed by specifying the process how the state variables evolve. As the standard specification, the first-order autoregressive processes for z_{t+1}, u_{t+1}, π^*_{t+1} and ε_{t+1} are given as follows:

$$z_{t+1} = \rho_z z_t + \xi_{t+1} \quad \textbf{(7)}$$

$$u_{t+1} = \rho_u u_t + \phi_{t+1} \quad \textbf{(8)}$$

$$\pi^*_{t+1} = \rho_{\pi^*} \pi^*_t + \theta_{t+1} \quad \textbf{(9)}$$

$$\varepsilon_{t+1} = \rho_\varepsilon \varepsilon_t + \delta_{t+1} \quad \textbf{(10)}$$

The reduced form was obtained by solving the expectation terms in the structural form of the model using a suitable numerical technique. The mostly used methods include Anderson and Moore's (1985) AiM (Anderson-Moore Algorithm) (Blanchard and Kahn, 1980; Klein, 2000; Sims, 2002 and Christiano, 2002) and the Kalman filter method to compute the value of the log-likelihood function in case the solution shows a unique convergence (Kalman, 1960).

3.4 Pre- and Post-Estimation Tests

The pre- and post-estimation tests applied in this study include the serial correlation test (Breusch 1978; Godfrey 1978) to observe the interdependence of adjacent items, the Jarque-Bera normality (Jarque and Bera, 1980) test to check the data distribution, the Chow breakpoint test: the structural break tests have been done to identify any break inside the data series (Chow, 1960), and the cumulative sum test for parameter stability (Brown, Durbin, and Evans, 1975). The DSGE model must linearize using deviations from steady state. Structural parameter test was performed to place nonlinear restrictions. Additionally, the data series went through a stationarity test and optimal lag length determination (Dickey and Fuller, 1979, 1981; Phillips and Perron, 1988; Akaike, 1973).

4. Results and Discussion

To estimate this study's DSGE model and make it computationally operational, a value must be assigned to the parameters. The calibrations of the parameters presented in Table 4.2 are standard assigned values in the DSGE literature.

Table 4.1: Calibration of parameters

Parameters	Description	Value	Source of calibration
Β	Discount factor	0.97	Gibbs, Hambur and Nodari (2018)
Ψ	Monetary policy coefficient	1.23	Author's calculation[9]
Κ	Elasticity and degree of price stickiness	0.15	StataCorp. (2019)
Σ	Coefficient of nominal exchange rate equation	0.25	Author's calculation
Γ	Coefficient of terms of trade equation	0.24	Author's calculation

DSGE introduces a check for linearity in the model equations and not reports any non-linearity. All the data series in DSGE and VAR models must contain zero mean and be weakly stationary to appropriately use them in the analysis. Furthermore, to conduct the analysis, the optimal lag length has been determined for each model estimation.

Table 4.2: Classification by income group and Ethiopia's expected GDP and GDP per capita by 2025

Income group[10]	GNI per capita[11] (2025 - US$) (World Standard)	NGDP[12] (2025 – BL US$) (In Ethiopia)	NGDP[13] (2025 – TR ETB) (In Ethiopia)
Low Income	≤ 1,137	≤ 147.53	≤ 9.31
Lower-middle Income	1,138 – 4,458	147.54 – 578.42	9.32 – 36.5
Upper-middle Income	4,459 – 13,952	578.43 – 1,810.26	36.6 –114.23
High Income	> 13,952	> 1,810.26	> 114.23

Source: Own computation, 2020

[9] It is computed according to the instructions below: DSGE's solve option puts the model without estimating parameters in state-space form; it is like iterate (0) but faster because it does not calculate standard errors. The use of solve for your model's different parameter values is a valuable way to explore the theoretical properties of the model (StataCorp., 2019).

[10] "In terms of income, the WB divides the world's economies into four income groups, i.e., high, upper middle, lower-middle, and low. The income classification is based on a measure of national income per person, or GNI per capita, calculated using the Atlas method. In 1978, the first World Development Report (WDR) introduced groupings of "low income" and "middle income" countries using $250 GNI per capita as threshold between the groups. In the 1983 WDR, the "middle income group" was split into "lower middle" and "upper middle" groups, and in 1989 a "high income" country definition was introduced. Since then, the thresholds to distinguish between the income groups have been adjusted for prices over time and the classification is updated each year on July 1st." (WB, WDI, 2019).

[11] Own computation and prediction based on the GNI per capita calculation of WB Atlas method data report from 1987 to 2018.

[12] The population of Ethiopia is projected to reach 129,749,455 in 2025 (United Nations, 2019).

[13] Exchange rate (US$/ETB) was own prediction based on the VAR and DSGE analysis of this study. Accordingly, 1 US$ is expected to be exchanged by 63.10 ETB by end of 2025.

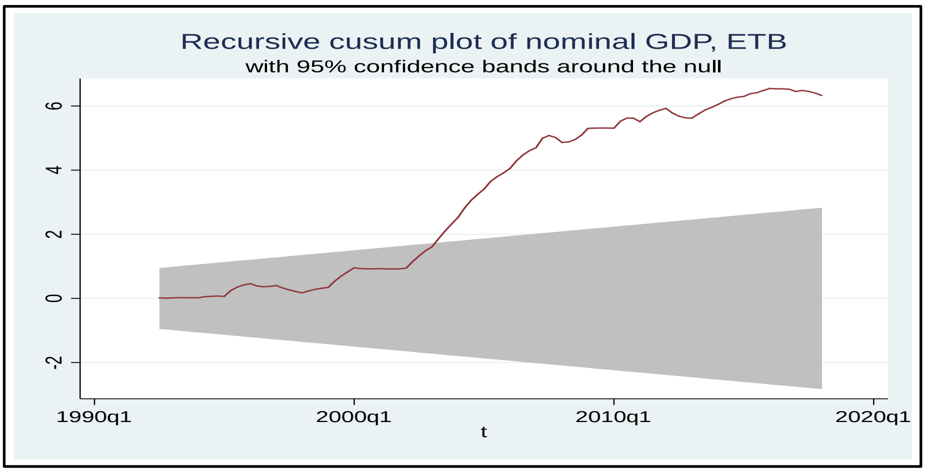
Column one in Table 4.2 shows the WB's income group classification of countries in the world as four groups and column 2 to 3 the corresponding Ethiopia's goal measured by GDP. Ethiopia's target in 2025 is to be one of the LMI countries by achieving the income level between 1,138 US$ to 4,458 US$ (or 71,745 ETB to 281,300 ETB). In other way, the lower bound of LMI country in terms of nominal GDP is 147.53 BL US$ or 9.31 TR ETB.

4.1 Predicting Nominal Gross Domestic Product (NGDP)

The DSGE and VAR models were estimated and quarterly prediction results were attained. Table 4.4 shows the predicted values of the Ethiopian NGDP measured in local currency (ETB) and US$.

The two data sets used in this study were subjected to a structural break test. The structural break test for the period 1990-2018 reveals breaks on the dates 2002q2 and 2003q3. However, the specification, diagnostics and goodness-of-fit analysis for structural breaks show no breaks for the data runs from 2004 to 2018. The structural break test in Figure 4.2 reveals a data break on 2002q[2] in the model where NGDP (ETB) considered as dependent variable. Therefore, during the analysis the structural break point date has been taken care of by incorporating dummy variables, i.e., an extra variable has been added in the right-hand side of the equation which contains a value of '0' before the break date and a value '1' after the break. The structural break test has also been conducted for the model of GDP per capita as dependent variable and the date 2003q3 was found as a breakpoint.

Figure 2: Structural breakpoint test for the model NGDP (ETB) as dependent variable



```
Full sample:                  1991q2 - 2018q1
Trimmed sample:               1995q3 - 2014q1
Estimated break date:         2002q2
Ho: No structural break
```

Test	Statistic	p-value
swald	120.6500	0.0000

```
Sample: 1991q2 - 2018q1                      Number of obs =       108
Ho: No structural break
```

Statistic	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
recursive	2.3389	1.1430	0.9479	0.850

Table 4.4 shows that the NGDP of the Ethiopian economy is predicted to reach 8.36 TR ETB for the VAR model and 7.78 TR ETB for the DSGE model in the q4 of 2025. Furthermore, the uses of 2004-2018 data in Table 4.5 gives a higher predicted value of 8.52 TR ETB and 12.14 TR ETB for the VAR and DSGE models, respectively. For the 1990-2018 data, the values in US$ were 130.86 BL and 131.52 BL for VAR and DSGE models, respectively. Using the 2004-2018 data, the NGDP values in US$ increased to 164.84 BL and 169.69 BL, respectively. The VAR and DSGE modeling are performing alike in terms of producing a robust predicting value of NGDP (ETB) against the 2025 targets of the country. Based on the prediction results for the period 1990-2018 and compared them against the Ethiopia's expected nominal GDP by 2025 in Table 4.3, all show the target of the country in 2025 will not be fulfilled.

The results in Table 4.4 and Table 4.5 show that the target for Ethiopia to reach 9.31 TR ETB by 2025 appears not to be achieved except for some scenarios results using the 2004-2018 data. In those cases, it is expected that the NGDP measured in the ETB exceeds 12 TR and the NGDP measured in the US$ to exceed 164 BL. The year 2004 marks the time when the Ethiopian economy has been turning around for more than a decade to take on the growth truck of double-digit economic growth. This could therefore be the reason why the data set for 2004-2018 provides better predictive values than other data sets, such as 1990-2018. If this sustainable economic growth has repeated itself in the Ethiopian economy in recent years, it guarantees the achievement of the 2025 target of the LMI group.

Table 4.3: NGDP prediction using 1990-2018 data[14]

Model	VAR		DSGE	
Quarterly date	NGDP (TR ETB)	NGDP (BL US$)	NGDP (TR ETB)	NGDP (BL US$)
2018q2	2.29	84.69	2.29	85.09
2018q3	2.38	84.99	2.39	85.90
2018q4	2.48	85.43	2.49	86.79
2019q1	2.59	86.08	2.60	87.74
2019q2	2.71	86.93	2.70	88.76
2019q3	2.83	87.96	2.82	89.84
2019q4	2.96	89.15	2.94	90.97
2020q1	3.10	90.46	3.06	92.16
2020q2	3.25	91.88	3.18	93.40
2020q3	3.40	93.37	3.32	94.69
2020q4	3.56	94.92	3.45	96.03
2021q1	3.73	96.51	3.60	97.41
2021q2	3.91	98.11	3.75	98.84
2021q3	4.09	99.72	3.90	100.31
2021q4	4.28	101.33	4.06	101.83
2022q1	4.48	102.94	4.23	103.38
2022q2	4.68	104.54	4.41	104.98
2022q3	4.88	106.15	4.59	106.62
2022q4	5.10	107.78	4.78	108.30
2023q1	5.32	109.43	4.98	110.02
2023q2	5.54	111.10	5.19	111.78
2023q3	5.78	112.82	5.40	113.57
2023q4	6.02	114.58	5.62	115.41
2024q1	6.27	116.40	5.86	117.29
2024q2	6.54	118.27	6.10	119.20
2024q3	6.81	120.20	6.35	121.16
2024q4	7.10	122.20	6.61	123.15
2025q1	7.39	124.26	6.89	125.18
2025q2	7.70	126.39	7.17	127.26
2025q3	8.02	128.59	7.47	129.37
2025q4	8.36	130.86	7.78	131.52

Source: Own computation, 2020

[14] All values are in the 95 percent confidence bound.

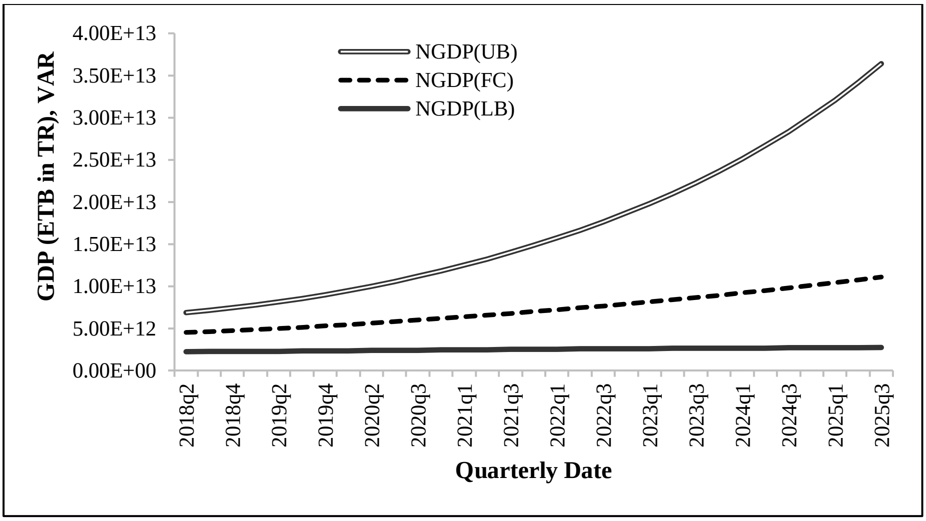
Table 4.4: GDP prediction using 2004-2018 data[15]

Model	VAR		DSGE	
Quarterly date	NGDP (TR ETB)	NGDP (BL US$)	NGDP (TR ETB)	NGDP (BL US$)
2018q2	2.29	84.94	2.30	85.37
2018q3	2.39	85.67	2.42	86.66
2018q4	2.50	86.69	2.55	88.18
2019q1	2.60	87.96	2.69	89.87
2019q2	2.72	89.38	2.83	91.70
2019q3	2.84	90.89	2.99	93.66
2019q4	2.97	92.48	3.16	95.72
2020q1	3.10	94.15	3.34	97.88
2020q2	3.23	95.93	3.53	100.13
2020q3	3.38	97.83	3.74	102.46
2020q4	3.54	99.87	3.95	104.87
2021q1	3.70	102.04	4.18	107.35
2021q2	3.87	104.35	4.42	109.91
2021q3	4.06	106.79	4.67	112.55
2021q4	4.25	109.34	4.94	115.25
2022q1	4.45	112.00	5.23	118.04
2022q2	4.65	114.76	5.53	120.89
2022q3	4.87	117.61	5.85	123.83
2022q4	5.09	120.55	6.19	126.84
2023q1	5.31	123.58	6.54	129.93
2023q2	5.55	126.71	6.92	133.10
2023q3	5.79	129.95	7.32	136.35
2023q4	6.05	133.30	7.74	139.69
2024q1	6.31	136.77	8.19	143.12
2024q2	6.59	140.36	8.66	146.63
2024q3	6.88	144.09	9.16	150.23
2024q4	7.18	147.96	9.69	153.93
2025q1	7.49	151.96	10.25	157.72
2025q2	7.82	156.11	10.85	161.61
2025q3	8.16	160.40	11.47	165.60
2025q4	8.52	164.84	12.14	169.69

Source: Own computation, 2020

[15] All values are in the 95 percent confidence bound.

Figure 4.3: The VAR model prediction[16] values of GDP (in ETB) in a 95 percent CI



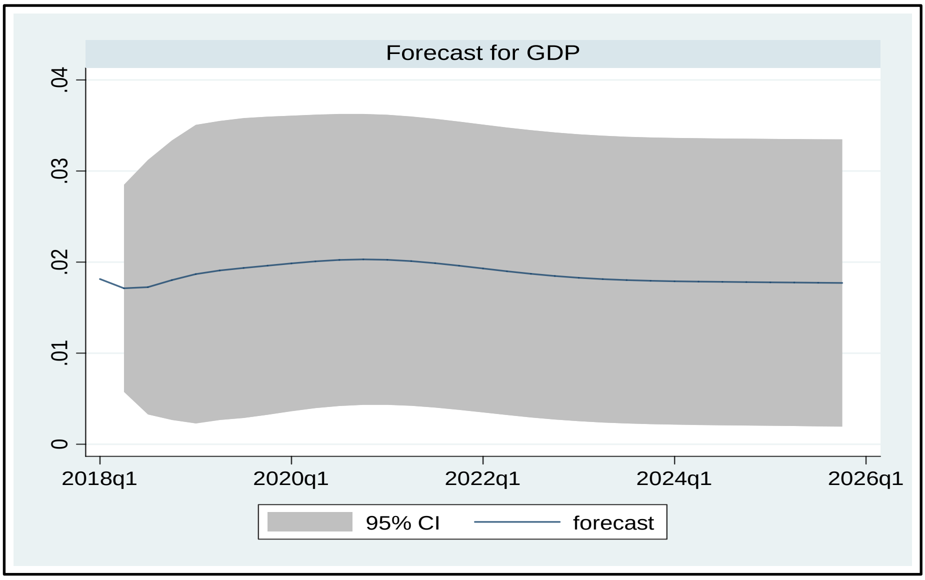
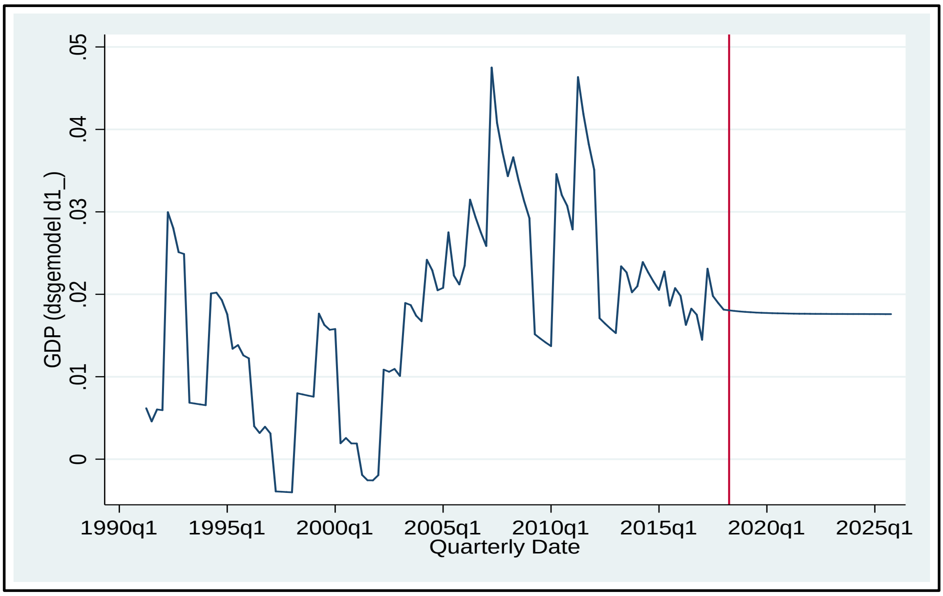


Figure 4.3 confirms that the out-off sample forecasts based on the VAR model entirely fall inside the 95 percent confidence interval. It indicates that the predicted results of GDP will be in this interval with a 95 probability, if the assumptions of the model hold. The dynamic forecast in Figure 4.4 begins in the q2 of 2018. It shows the out-of-sample forecast for nominal GDP that employs a DSGE modeling.

[16] Based on 1990-2018 data series

Figure 4.4: The DSGE model forecast values of GDP (ETB)



This study has also performed post-estimation diagnostics for the estimates. The autocorrelation, normality and stability test results are presented in Figure 4.5. The Lagrange-multiplier test prevails the absence of autocorrelation in the estimation process. The Jarque-Bera test confirms normality in the data distribution. Regarding the stability of the VAR, all eigenvalues of the dynamic matrix lie inside the unit circle, which confirms the stability of the estimation procedures.

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	15.5771	25	0.92684
2	7.6192	25	0.99967

H0: no autocorrelation at lag order

Jarque-Bera test

Equation	chi2	df	Prob > chi2
y1	8.979	2	0.01123
p	17.053	2	0.00020
R	47.950	2	0.00000
e	81.592	2	0.00000
q	25.994	2	0.00000
ALL	181.569	10	0.00000

Eigenvalue stability condition

Eigenvalue	Modulus
.94365 + .05127133*i*	.945042
.94365 - .05127133*i*	.945042
.782795 + .3464764*i*	.856046
.782795 - .3464764*i*	.856046
.6384549	.638455
.3994643 + .1392167*i*	.423028
.3994643 - .1392167*i*	.423028
.1702788 + .3497572*i*	.389005
.1702788 - .3497572*i*	.389005
.06497133	.064971

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

Figure 4.5: Autocorrelation, normality and stability diagnostics tests for NGDP - US$

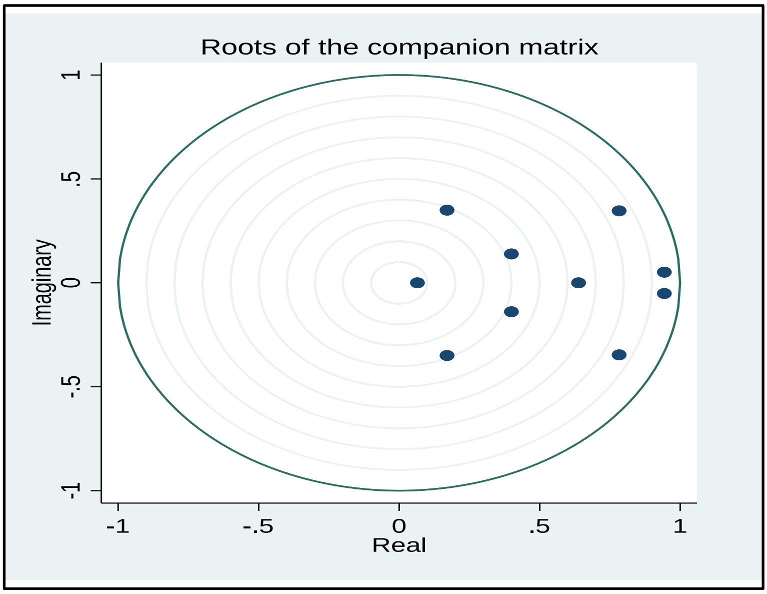
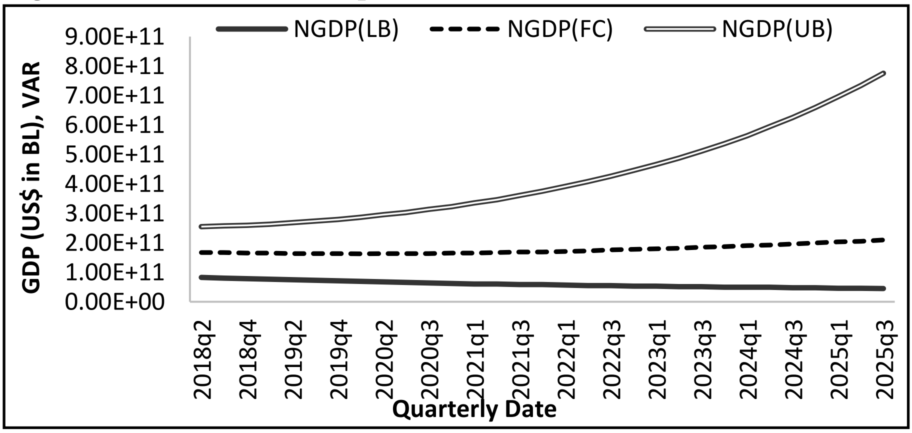
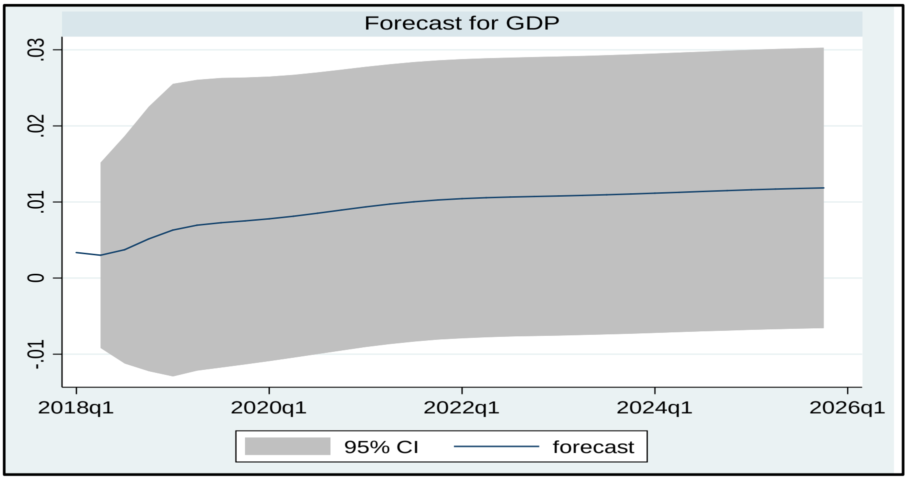


Figure 4.6 confirms that out-off sample forecasts for the VAR estimation in 2018-2025 period entirely fall inside the 95 percent confidence bound. However, the results found are close to the lower margin of the LMI group. Thus, it requires a structural and sustainable growth in the economy to reliably apprehend the GDP range of the LMI category.

Figure 4.6: The VAR model prediction[17] values of GDP (in US$) in a 95 percent CI





4.1 Predicting GDP Per Capita for 2025

The predicted GDP per capita earning capacity of individuals for 2018-2025 in Ethiopia are presented in Table 4.6. Accordingly, the 2025 GDP per capita values using the 1990-2018 data series are 1072.3 and 923.2 US$ for the VAR and DSGE models, respectively. The 95 percent confidence band in the period 2004-2018 produces GDP per capita values of 1,122.57 and 1093.08 US$ for the VAR and DSGE models. The estimates based on the 2004-2018 period produced a better predicted value compared to the 1990-2018 period. Even though the GDP per capita value of 1,122.57 US$ was relatively close to the lower LMI margin of 1,138 US$, none of the predicted values confirms the country will achieve the goal of the LMI status before the end of 2025.

[17] Based on 2004-2018 data series

Table 4.5: GDP per capita prediction – US$[18]

Period	GDP pet capita (1990-2018)		GDP pet capita (2004-2018)	
Quarterly date	VAR model	DSGE model	VAR model	DSGE model
2018q2	773.6	773.86	773.97	775.81
2018q3	776.11	775.92	777.18	781.2
2018q4	780.56	778.44	782.76	788.03
2019q1	786.97	781.36	790.6	795.95
2019q2	794.94	784.64	800.17	804.7
2019q3	804.02	788.25	810.86	814.07
2019q4	813.8	792.13	822.19	823.93
2020q1	823.96	796.27	833.81	834.16
2020q2	834.33	800.64	845.53	844.67
2020q3	844.78	805.21	857.29	855.4
2020q4	855.29	809.96	869.09	866.29
2021q1	865.87	814.86	880.99	877.31
2021q2	876.54	819.91	893.04	888.43
2021q3	887.33	825.09	905.29	899.62
2021q4	898.24	830.38	917.75	910.87
2022q1	909.28	835.77	930.42	922.16
2022q2	920.4	841.25	943.25	933.49
2022q3	931.58	846.81	956.2	944.83
2022q4	942.75	852.44	969.21	956.2
2023q1	953.89	858.13	982.23	967.58
2023q2	964.95	863.88	995.22	978.97
2023q3	975.92	869.67	1,008.15	990.37
2023q4	986.78	875.51	1,021.02	1,001.78
2024q1	997.56	881.38	1,033.81	1,013.19
2024q2	1,008.27	887.29	1,046.55	1,024.60
2024q3	1,018.93	893.23	1,059.25	1,036.01
2024q4	1,029.58	899.19	1,071.92	1,047.42
2025q1	1,040.22	905.17	1,084.58	1,058.84
2025q2	1,050.89	911.17	1,097.24	1,070.25
2025q3	1,061.58	917.18	1,109.90	1,081.67
2025q4	1,072.30	923.21	1,122.57	1,093.08

Source: Own computation, 2020

[18] The values are presented in 95 percent confidence bound

As the Ethiopian economy fails to reach even the bottom margin of the LMI range which is still quite low as compared with the upper margin of 4,458 US$, a strengthened growth and development are a head for Ethiopia to be in a reasonable interval of the LMI group.

5. Conclusion and Policy Implications

Ethiopia has moved from the 2nd poorest country in the world at the beginning of this century to the 17th poorest in 2018[19], and the overall predictions of this study show that it will get closer to the goal of reaching the LMI status by 2025. DSGE & VAR models have been used, based on the quarterly time series data b/n 1990q1–2018q1, to evaluate, predict, & compare NGDP & per capita GDP values of the country by 2025. The prediction results in this study, particularly using the 1990-2018 prediction period, made clear that the 2025 goals of Ethiopia to reach a GDP of 147.5 US$ (or 9.3 TR ETB) and a per capita GDP of 1,137 are not easily achievable with the current dynamics and trends of the economy. According to the predictions of this study Ethiopia's economy by 2025 will not reach even the lowest margin of the LMI range by many of estimation measures. The year 2004 is a reference point for the Ethiopian economy, as the average growth rate of the economy was persistently more than 10 percent thereafter. But, even though the 2004-2018 data set produced better predicted values than the 1990-2018 data set, the prospects of achieving a reasonable LMI value of GDP & GDP pet capita (as a minimum an average US$ of 2797.5) by 2025 are not realizable.

To acquire lessons for the future, authorities and policy makers should focus on the driving factors behind the forecasting scenarios that reports higher values in this study. Ethiopian economy must improve its all-encompassing performance to realize the goal of LMI status by 2025. The work to be done includes fostering agriculturally-based industrialization and accelerating the role of the private sector. Besides, measures such as infrastructural investments, generating sustainable finance, structural reforms, nurturing macro-economic balance may certainly contribute to further growth of GDP and GDP pet capita.

Singular, but potentially highly important events such as the peace accord with neighboring Eritrea and Sudan, but also the COVID-19 disasters and the 2020 state of Tigray crisis may also affect the prospects for Ethiopia's development in ways that are obviously not incorporated in this study's forecast. It also must be

[19] WB, WDI, 2018

recognized that GDP and GDP pet capita are not be the sole and only measures of a country's level of development. Other criteria such as those of the human development index, economic vulnerabilities (measured by a country's initial macroeconomic fundamentals), the degree of a country's integration into the global financial system, the distribution of wealth and income, and the ecological footprint all need to be considered for an overall assessment a country's development. E.g., a reduction of poverty may be accomplished by a better distribution of income rather than a growth of GDP, and building a climate resilient green economy may not so much require growth of GDP, but rather a change of its composition. Such considerations and criteria, however, are beyond the scope of this study and it must be left to future to incorporate them.

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Foreign Exchange Reserves vs. Import Demand in Ethiopia

Ashebir Tsegaye Gelaw[1]

Abstract

The study estimates the demand for import under foreign exchange constraint for Ethiopia using a time series data for the period 1991/92-2019/20. Both the simple descriptive analysis and the Johansen's co-integration approach are employed to see the impact of foreign exchange constraint on the import demand of the nation. The quantitative results from co-integration and error correction specifications show that imports of the country are sensitive to changes in foreign exchange reserves both in the long run and in the short run. The result of the study also indicates the existence of an underlying long-run stationary steady state relationship between import demand and relative import price index, real income and policy dummy in Ethiopia. Moreover, all the explanatory variables of interest i.e. foreign exchange constraints, relative import price index and real income significantly cause import demand in the short run. Lastly, the estimated Vector Error Correction Model of import is stable over the sample period that it can be used for a policy purpose. The lower short run income elasticity of import shows the room available for import substitution industrialization strategy in Ethiopia and the higher long run income elasticity provides evidence infavor of product diversification.

Keywords: Import Demand, Co-Integration, VEC, and Foreign Exchange Constraints
JEL Classification: F31, F41, B17, G15, E44

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Acronyms

ADF	Augmented Dickey- Fuller
CSA	Central Statistical Authority
DSGE	Dynamic Stochastic General Equilibrium
ECM	Error Correction Model
EEA	Ethiopian Economic Association
EIA	Ethiopian Investment Agency
ETB	Ethiopian Birr
GDP	Gross Domestic Product
IMF	International Monetary Fund
LM	Langrage Multiplier
MoFED	Ministry of Finance and Economic Development
NBE	National Bank of Ethiopia
PP	Phillips Perron
SSA	Sub Saharan African
VAR	Vector Auto Regression
VEC	Vector Error Correction
VECM	Vector Error Correction Model

1. Introduction

In a global network no country is self-sufficient. There is mutual interdependence among countries. The less developed countries particularly depend on the developed countries for finance, technology, and even technical work force while the advanced countries depend on the less developed countries especially for their raw materials (Lardy, 2003). Hence the economic literatures have identified illustrious channels through which international trade can have an effect on economic growth of participating nations. Naturally, the process of economic growth sets to sustain the expansion in the motion of a growing demand for capital and consumer goods as well as for raw materials. Clearly, sustainable development particularly economic growth necessitates the provision of additional resources as it occurs (Wing, 2014). However, the stipulation of these extra resources cannot be sustained out of domestic supplied resources alone rather it is a necessity to import foreign resources to fill the gap between a growing aggregate domestic demand and a limited supply of economic resources.

However, the determination of the import behavior of a given countries has required to taking into account the availability of foreign exchange reserves in central bank account (Bastourre, 2009). Accordingly, the linkage between the availability of foreign exchange reserve and the pattern of import are intuitively palpable, in such way that countries which have limited access to foreign borrowing ought to take into account the estimated time path of their future export earning in deciding about how much import today. Otherwise, they will expose themselves to the threats of fluctuation in export earning in turns the need to crucial imported items (Reed, 2015).

Consequently, in the historical skeleton till now, there is a growing cogitation on the issue. Do developing countries need to accumulate much reserve? The question has divided economists in to two camps. The first, being pessimists in their thought have pointed out that the accumulation of more reserves is costly. For instance, the reserves held in the pocket of central bank will earn a modest return which far below countries' own cost of borrowing from domestic and foreign sources either in local currency or in dollars (Augustine & Thomas, 2007). So, why do those countries hold more cash in the bank and pay high interest on outstanding liabilities? The second ones, being optimists, holding more foreign reserve makes the cost of holding more reserve is undersized when it is compared with the vast economic consequences of having depreciation in the value of the domestic currency which upshot by financial crises in developing economies. Besides, the advocates have narrated that the accumulation of more foreign reserves is a psychic policy which has a paramount importance for those defending the value of the currency.

Like other developing countries, the explicit bottleneck that has been observed in Ethiopian economy currently is that the shortage of foreign exchange reserve to financing needed imports for development and its various ambitious programs which it undertakes. This activity requires heavy imports of capital goods, essential raw materials and in some cases food grains have also been imported. Besides, imports of oil on a large scale are being made. On account of all these imports, import expenditure of the country has been rapidly and hugely increasing. Due to the relative low competitiveness of export items and imposed restrictions, the growth of exports in the economy has been significantly low. As a result of the low exports and mounting imports, the economy has been facing a balance of payment difficulties and shortage of foreign exchange which at times have assumed crisis proportions.

The problem of import under foreign exchange constraint has been investigated in various economic literatures by different authors using different models. Generally, it is possible to scrutinize those empirical literatures in two rivulets. On one hand, economists employed traditional import model by incorporating relative income and price to determine the import demand behavior. For instance, Khan and Ross (1977) and Thursby (1984) have been examined the income and price effect of import demand by applying the traditional import model. However, the model becomes questioned to explain the sag of import in developing countries with shortage of foreign exchange reserves. On the other, Hemphill (1974) have applied extended model for import which slot in foreign exchange receipts and international reserves in to the traditional import model. Moran (1989) have employed the general import model to analysis the demand for import under foreign exchange constraint, in such way that import will best explain with a foreign exchange constraint by incorporating the ideas of Hemphill model and the traditional one.

In the study, in turn, the researcher attempts to contribute to the existing body of literature via considering, the reserve tranche position in international monetary fund and special drawing right as a part of foreign exchange receipts in to the current import decision. Besides, since the specification issues in the import demand model is prone to bias and errors and structural shifts are not considered, the effect of import liberalization has capture by including dummy variable which was not included in the investigation of the above articles. Finally, the researcher tries to update the work by Moran (1989) by including the latest data on all variables under consideration. This, as such, a unique contribution on the study which uses representative agent model at the national level with a binding foreign exchange constraint assumption that represents the volume of import in Ethiopian economy.

To summarize, having the importance of foreign exchange reserve to import in one hand and the above knowledge gap which wraps the area of interest under consideration the study answers the following research questions.

- What are the significant factors that affect the behavior of import demand in Ethiopia?
- What will be the price and income elasticity of import demand in Ethiopia?
- What will be the effect of foreign exchange reserves on the import demand in Ethiopia?

2. Literature Review

The economic literatures on the effect of foreign exchange availability on the demand for import and its policy implications in Sub-Saharan Africa are very scant, especially in Ethiopia. However, there are a few studies that look at the issues of import demand and foreign exchange reserves in developing countries using various methods with different foci (for example, Moran 1988; Faini, et al., 1988; Lopez and Thomas 1990; Lensink (1995), Angelos & Simone (1998) Egwaikhide 1999; Ooskooee (2005); Stiglitz et al. (2006), Wodon and Zaman 2008; Bayo and Bernard 2012; Huppe, et al., 2013; Sissay, 2011 and Manitra, et al., 2011). To delve the state of the existing literature on demand for import and the availability of foreign exchange reserves especially in Sub-Saharan Africa, it needs a closer scrutinizing on these literatures. Commonly in the reviewed literatures, one can observe that those earlier studies which investigate the demand for imports, lays its foundations in the traditional models of import developed by Hemphill (1974). Afterward Moran (1988) has revised the Hemphill (1974) and sets the newly extended model, which is later empirically investigated by Sun- Dararajan (1986), and Faini, et al (1988). Following these authors, almost all of the empirical investigations have laid on demand for import modeling in developing countries espoused and prolonged the traditional demand import models of Hemphill (1974).

The intention behind Hemphill (1974), he alleges that the demand for import is chiefly determined by foreign exchange availability, and the liaisons of short-term reaction to disequilibrium are based on the specification of the import-exchange rate equation**.** Moreover, he argues that most “the theoretical and empirical investigations on the demand of import shows that the pour of imports to be gritty largely by aggregate economic activity and prices of imported items relative to prices of locally produced items” (Hemphill, 1974, p. 637). However, Hemphill signifies for developing countries, this liaison is indecisive and it leaves a lot of critiques due to the costs of international trade and exchange barriers. However, one can understood from this is that, these anomalies and critiques stressed on the import functions are barely valid for developed economies where the structures of import is highly characterized by importing of semi-final goods, producer goods and capital kits which is hardly to substitutes on domestic competing resources whatsoever.

Another ground-breaking study was conducted by Moran shows that “The traditional demand for import model which merely looks GDP and real import prices as explanatory variables, have failed to foresee and elucidate the demand for import in developing countries’ in the early 1980s” (Moran, 1998, p. 2). His result shows that the importing behaviors of most developing countries were pessimistically affected by the fall in the inflows of foreign exchange reserves and have experienced significant drop in imports which, in turn, led to a wear and tear of investment and a drop or stagnant per capita output growth. Similarly, an investigation conducted by Dash (2005) on the aggregate import demand function for India by using yearly time series data and by applied the Johansen Juselius multivariate co-integration technique from the period 1975 to 2003. To integrate the dynamics of the short run (changes) with long run (levels) adjustment process, the study used co-integration and error correction model (ECM). The variables used were gross domestic product, unit value of import prices, prices of domestically produced goods and foreign exchange reserves. Their study suggested that import demand in India is largely explained by price of domestically produced goods, GDP, lag of import and foreign exchange reserves.

On the analogous issue but with a macroeconomic framework Lensink (1995) has investigated the effect of exchange rate reserve on overall macroeconomic performance with an emphasis on economic progress. Under Lensink simulation analysis, one can observe that SSA countries are highly hit by the global financial crisis. According to him, ceteris paribus, the progress of the economy in low-income countries heavily depends on foreign exchange reserves to import those capital and intermediate inputs. In the same fashion, a recent study by Sissay (2011) also examined the same concerns but with a standard small open economy New Keynesian DSGE model by introducing foreign exchange availability as an additional constraint faced by firms, suggests that low-income countries were heavily relied on imported capital and intermediate inputs. These imported items, in turn, chiefly depend on the stock of foreign exchange on the disposal of the economy. Hence, the feat of the external sector in generating foreign exchange is decisive to boost the piece of the rest macro-economy of home countries. As a result, in the event of a global financial crisis, these countries are expected to be hard-hit (Sissay, 2011, P. 34).

Having the above point in mind, the issue of foreign exchange reserves of a given country can have a significant effect on the adjustment of noteworthy macroeconomic variables. Therefore, a broader policies and empirical investigations have to make closer watch on the import structures of developing economies and its importance can be rationalized within different economic scenarios. It is possible to triangulate those implications in three peculiar reasons. On production side, in most economic activities foreign exchange constraint is considered as factors of production to the economy, in the case that productions of goods and services heavily depend on imported inputs such as fuels, chemicals, raw materials, intermediate inputs, and capital. But the availability of those inputs in turns depends on the amount of reserves that monetary authority holds. Hence, the stock of foreign exchange in the pocket of central bank to import these inputs influences the level of production. For example, the recent global financial crisis that entailed a fall in inflows of foreign exchange into low-income countries from export revenues, remittances and other sources, led to foreign exchange rationing. This, in turn, resulted into significantly reduced production or complete suspension of production by imported-input intensive firms in some countries.

As a signaling indicator, analyzing the importance of the availability of foreign exchange can serve as a proxy to capture the vulnerability ratio of domestic economy through external financing such as aid, loan, and remittance. Indicators of ability to repay foreign debt and for currency defense are used to determine credit ratings of nations, and as an insurance against financial shocks which has momentous implications on macro- economic recital of a given country since it creates confidence. Thus, most empirical evidences use total external debt as a percent of gross international reserves, as a percent of broad money, as a percent of short-term external debt and a as percent of short-term external debt on residual maturity basis plus current account deficit. Therefore, countries with similar characteristics would accumulate reserves to avoid negative assessment by the financial market and to filling the national resource gap; which plays a role that cannot be substituted by domestic savings (McKinnon, 1964).

Finally, some countries see accumulation of foreign exchange reserves as exchange rate policy. The argument is that since reserves are the most vital component in the monetary base (high power money), central banks can boost the value of their domestic currencies by selling reserves. For instance, when central bank selloff its reserves in exchange for its domestic currency, it decreases the prices of whatever selling and shrinks the money supply by taking the proceeds from the sale out of circulation. Implying that, if central bank sells gold, it reduces the price of gold by increasing the supply in the market and the values of dollars it receives in exchange for the gold are removed from the money supply. Theoretically, anything that the central bank can sell in exchange for its currency can be considered as foreign exchange reserve. Thus, central banks around the world sell off their reserves which are mostly dollars, to boost their currencies and slow their domestic food inflation. As a result, most often the monetary authority uses foreign reserve accumulations as a policy instrument to manipulate the strength of domestic currency. In some cases, this could improve welfare, since the lowering of inflation and boosting of currencies would compensate the costs for accretion of more foreign currencies.

Succinctly, though price and income effects are extremely important to analyze the behavior of import in developing countries, the import models which take in to account foreign exchange constraint in the macro dynamics of low- income countries become a trendy way to investigate how the demand for import responds to global financial shocks explicitly for the availability of foreign exchange reserves.

3. Methodology

3.1 Data

The study utterly employs a national level secondary data. The variables included in the analysis are economic growth proxied by import of goods and services (It), income proxied by real GDP (Yt), the relative price of imports (Pt), foreign exchange reserve constraint (Ft), effect of policy changes in external sector (Dm).The annual bulletins of the National Bank of Ethiopia (NBE), and the Central Statistical Authority (CSA), the current Ministry of Finance and Economic Development (MoFED), the Ethiopian Investment Agency (EIA), Ethiopian Economic Association's Database 2020, and World Economic Outlook's Database 2020 and IMF's International Financial and Direction of Trade Statistics are the sources of data for the study. Books, Journals and Magazines have also served as supplementary sources of data.

3.2 Model Specification

The foremost intention of this theoretical model is to investigate impacts of accumulated foreign exchange reserves on import behavior in Ethiopia. Following the analysis employed by Ceglowski (1991), Clarida (1994) and Emran (2008) incorporate the idea of a rational expectation in permanent income model of a representative agent to derive the import demand function. Representative agents assumed to maximize their satisfaction by consuming two composite goods (domestically produced (Dt) and imported items (It)). This optimization problem has constrained with its dynamic budget which reflects the accumulation of asset, and with foreign exchange reserve constraint. Now, let’s denote $Pt\ as$ the relative price of imports at prevailed exchange rate, $At\ as$ assets, $\hat{Y}t$ as labor incomeFt as the amount of foreign exchange reserve and r as the constant real interest rate. The researcher also has assumed that representative agents discount the future with subjective rate of time preference δ (this is calibration and its need some baseline source).

Accordingly, the optimization problem of the representative agent is:

$$Max(Dt, It, At)V = E\int_{t=0}^{\infty} e^{-\delta t}\ U(Dt, It)dt$$

Subject to

$$\frac{dAt}{dt} = rAt + \hat{Y}t - Dt - PtIt\text{..... (1)} \qquad And \qquad PtIt \leq Ft \qquad \textbf{(2)}$$

In line with this, the current value Hamiltonian of the above optimization problem can be written as:

$$H = U(Dt, It) + \lambda t\big(rAt + \hat{Y}t - Dt - PtIt\big) + \mu t(Ft - PtIt)$$

Where¸ λt is the co-state variable, interpreted as the marginal utility of money and μt is the Lagrange multiplier associated with the foreign exchange constraint. Thus, for the above optimization problem it is possible to drive the following the first order conditions:

$$\frac{dH}{dDt} = \lambda t \qquad \textbf{(3)}$$

$$\frac{dH}{dIt} = Pt(\lambda t + \mu) \qquad \textbf{(4)}$$

$$\frac{d\lambda t}{dt} = (\delta - r)\lambda t \qquad \textbf{(5)}$$

$$(Ft - PtIt) \geq 0\ \ and \mu t * (Ft - PtIt) = 0 \qquad \textbf{(6)}$$

Tag on the empirical frameworks of Emran (2008); it is possible to assumed that (*3) and (4)* is an additive log utility function then:

$$U(Dt, It) = Ct\frac{Dt^{1-a}}{1-a} + Bt\frac{It^{1-\gamma}}{1-\gamma}$$

Where, Ct and Bt are random and strictly stationary shocks to preference. From the above utility function, it is possible to derive the following first order conditions:

$$\frac{dU}{dDt} = CtDt^{-a} = \lambda t \quad \textbf{(7)}$$

$$\frac{dU}{dIt} = BtIt^{-\gamma} = Pt\lambda t(1 + \mu_t^*) = \lambda_t P_t^* \quad \textbf{(8)}$$

Where, $\mu_t^* = \frac{\mu t}{\lambda t}$ is the scarcity premia, and P_t^* is the scarcity price at which transactions occur at the shop floor in the secondary market. Now let's eliminate λ_t from equation (8) by substituting its figure in Equation (7) and logarithm of the end result, can be obtained the following mathematical structure:

$$lnBt - \gamma lnIt = lnCt + lnPt - alnDt + ln(1 + \mu_t^*) \quad \textbf{(9)}$$

In order to derive the long -run demand for import functions, we have to impose the steady state conditions of variables as $\frac{dAt}{dt} = \frac{d\lambda t}{dt} = 0$ and as $Pt = P_t^*$. Hence total household income is, a composite of both labor and asset income which evaluated at the equilibrium price vector, denoted by Y_t^*. As a result, the steady state solution implies that:

$$Y_t^* = Dt + P_t^* It \quad \textbf{(10)}$$

Using the steady state condition and taking logarithm, the following expression can be found for

$$lnDt.\ lnDt = \ln(Y_t^* - P_t^* It)\ lnDt = \ln(Yt - PtIt) \quad \textbf{(11)}$$

Where, $Yt = Y_t^* - \mu_t^* P_t^* It$ is the observed income in the regime where foreign exchange is constrained likewise *Pt is* the observed price. Now let's use last equation to eliminate $lnDt$ from Equation (9) and if we solve for $lnIt$ we can obtain the following equation:

$$lnIt = \frac{a}{\gamma}\ln(Yt - PtIt) - \frac{1}{\gamma}Pt - \frac{1}{\gamma}ln(1 + \mu_t^*) + \varepsilon_t \quad \textbf{(12)}$$

Where, $\varepsilon_t = \frac{1}{\gamma}(lnBt - lnCt)$ is a random and strictly stationary shock of preferences, *Y* is the total expenditure by domestic consumers on both domestically produced goods and imports and the scale variable $\ln(Yt - PtIt)$ in the right-hand side of equation defined as GDP minus exports. When the foreign exchange constraint is binding, the Kuhn-Tucker theorem requires that μt>0, and hence μ_t^*>0. For most of the developing countries time series data on the scarcity premia on imports, are not available. In order to make the estimating procedure easy, a theoretically consistent parameterization of μ_t^* is needed in terms of the observed variables. Since μ_t^* represents the scarcity premia on foreign exchange, it should be, *ceteris paribus*, a negative function of the amount of foreign exchange available. So, one would tend to think that a good proxy for μ_t^* can be the foreign exchange receipts (Ft), thus providing an *ex-post* rationalization of the widely used foreign exchange availability approach. To capture the effect of policy changes in external sector dummy variable has to be included in the model.

Taking in to account the above information, it is possible to straight forwardly recapitulate the demand for import function which can be estimated with the data available in Ethiopia as follow:

$$lnIt = \frac{a}{\gamma}\ln(Yt - PtIt) - \frac{1}{\gamma}Pt - \frac{1}{\gamma}lnFt + Dm + \varepsilon_t$$

$$lnIt = \beta 1\ln(Yt - PtIt) - \beta 2Pt + \beta 3lnFt + \beta 4Dm + \varepsilon_t \qquad \textbf{(13)}$$

Noted that, all variables which are employed in this study with exception of the dummy variable are elucidated in logarithm form and this logarithmic formulation of the variable allows us to make a direct estimation of import elasticity.

4. Discussion and Results

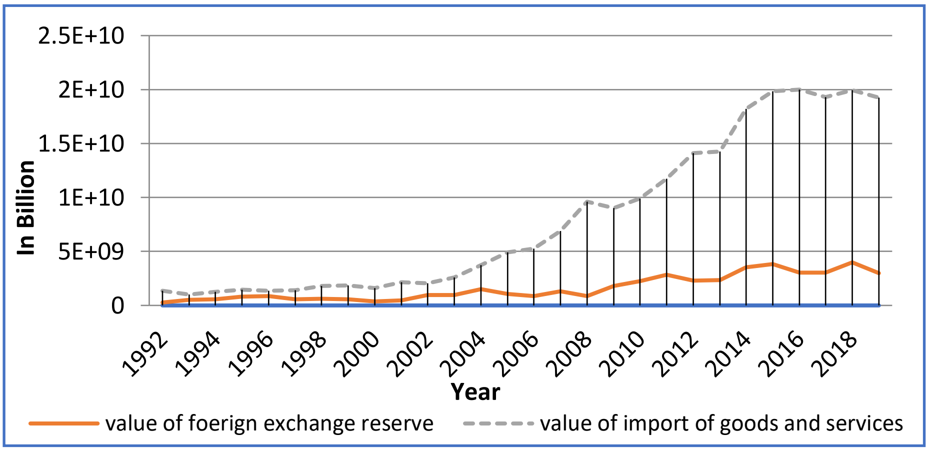
Descriptive Statistics

Imports of Ethiopia have generally been increasing since 2002 and it declines in 2015 onwards (Figure 4.1 below). This can mainly be attributed to the relative openness of the economy, the fast economic growth over the past decade and the relatively rising foreign exchange reserves of the county. With regard to international trade, foreign currency is often a necessary requirement to finance imports of goods and services. In this sense, foreign reserves play the role of an international liquidity constraint and any increase in reserves should thus have a positive impact on import demand.

A positive correlation is expected between foreign exchange reserves of a country and its demand for imports for the desired level of import could not be actualized in the absence of sufficient level of FOREX reserves. Figure 4.1 above supports this fact that the rise in the import of goods and services of Ethiopia is closely related with foreign exchange reserves of a country. In support to this, Sultan (2011) argued that foreign exchange is the only medium of exchange in the international market and acts as a constraint for developing countries to import necessary inputs for the domestic production process.

To sum up, the simple descriptive analysis shows that the imports of the country have been increasing over the past two decades. This is mainly attributed to the positive effects of the rise in the domestic income level and foreign exchange reserves.

Figure 4.1: Trends of import and foreign exchange reserve in Ethiopia 1992-2019



Source: World Development Bank and International Monetary Fund

Pair wise correlation test

The pair-wise correlation matrix is adopted in the study to determine the exact relationship between the five variables used in the study. Results from the pair- wise correlation matrix are presented in Table 4.2 below.

Table 4.2: Pair-wise Correlation Results

Variable	Mt	Yt	Ft	Dm	Pt
Mt	1.000				
Yt	1.767	1.000			
Ft	0.642	0.241	1.000		
Dm	-0.323	-0.425	-0.262	1.000	
Pt	-0.272	-0.762	0.1861	0.824	1.000

Source: Own table with data from E views 7 iterations.

From the pair-wise correlation results shown above Yt and Ft are positively correlated with the dependent variable Mt. Yt is highly correlated with Mt than Ft. The positive correlation of both variables is in line with previously stated theoretical underpinnings. Theory suggests that an increase in net income and foreign exchange reserve causes an increase in import bill expenditure. This emanates from increased consumption expenditure, investment, employment and capital outlay amongst several other positive effects (Caporale and Chui (1999).

Dm and Pm are negatively correlated with Yt. This confirms theoretical suggestions, which propose that the increment in the import price discourages investment. This translates into low levels of demand for import. On the same note, a change in Dm has a negative long run relationship with demand for import. The logic lies for instance, in control of capital, since all payments abroad require permits and all transactions in foreign exchange must be carried out through authorized dealers supervised by the national bank of Ethiopia. The national bank of Ethiopia has delegated most of the foreign exchange transaction functions to the commercial banks but strictly dictates margins. Importers and exporters can obtain import/export permits through the commercial banks. This suppresses the coffers that could have been channeled for further development and leads foreign exchange shortages due to weak export performance and high demand for foreign currency that continue to present significant market challenges (Bertola and Faini (1990).

In using the Johansen test, there is a need to determine optimal lag length which eliminates serial -correlation in the residuals as well as determining the deterministic trend assumptions for the VAR model. To select the lag order for the VAR the information criteria approach is applied as a direction in choosing lag order. A maximum of 3 lags is utilized in order to permit adjustment in the model and accomplish well behaved residuals. Table 4.3 confirms the lag lengths selected by different information criteria. Appendix 3 shows that all the criteria selected 1 lag. Therefore, the information criteria approach produced agreeing results and a decision to adopt 1 lag can be made. Subsequently, the Johansen co-integration test is conducted using 1 lag for the VAR.

Unit Root Test

The co-integration test among the variables that are used in the model requires the existence of a unit root for each variable. The Augmented Dickey- Fuller (ADF) and Phillips Perron (PP) tests have been applied to test unit root of the variables. The results of the ADF and PP tests are presented in Appendix 1.

The results reported in the Appendix 1 were carried with both intercept and trend. Under the assumptions of no intercept and trend in all cases and trend no intercept in some of the cases, the test statistics were insignificant, hence only the ones that produced better results were reported. The unit root tests using intercept and trend suggests that all series are non-stationary in level and becomes stationary after differencing. Thus, the variables become integrated of order one, I (1).

Co-Integration Test

The study employs the Johansen's (Johansen and Juselius, 1990) maximum likelihood approach to test for co-integration.

The Johansen co-integration based on the trace test is shown in Appendix 4 (a). The trace tests the null hypothesis that the number of co-integrating equations is greater than the number of variables involved. The null hypothesis fails to be rejected if the test statistic is smaller than the critical values of the trace tests.

Likewise, Appendix 4(b) shows the results of the Johansen co-integration tests based on the maximum Eigen value. The maximum Eigen value test is conducted on the null hypothesis of the number of co-integrating equations (r) against the alternative hypothesis of number of co-integrating equations plus one (r + 1). The null hypothesis cannot be rejected if the test statistic is smaller than the maximum Eigen value test critical value.

The trace test has reflected that at least two co-integrating equations exist at 5 percent significance level. The null hypothesis of no co-integrating vectors and at most 1 is rejected since the trace (test) statistic of 84.24 and 48.27 is greater than the 5 percent critical value of approximately 69.82 and 47.86 respectively. Hence the trace statistics specified 2 co-integrating relationship at 5 percent significance level.

The maximum Eigen value test in Appendix 4 (b) reveals that at least one co-integrating equation exists at 5 percent significance level. The null hypothesis of no co-integrating vectors is rejected since the Eigen value of 35.97 is greater than the 5 percent critical value of about 33.88. Using the same analysis, the null hypothesis that there is at most one co-integrating vector cannot be rejected since the test statistic of 21.98 is less than the 5 percent critical value of 27.58. Therefore, it can be concluded that there are two significant long run relationships between the variables using the trace test. Since variables can either have short or long run effects, a Vector Error Correction Model (VECM) was used to disaggregate these effects.

A summary of the results in Appendix 4 (a) shows the existence of two co-integrating equations. Trace test and the maximum Eigen value test evidently generate conflicting results. In such a situation Johansen and Juselius (1990) advises the examination of the co-integrating vector and base the decision on the interpretability of the co-integrating relations.

Luintel and Khan (1999:32) reiterated that, it is essential to use results of both tests. In this regard, the choice of the co-integration rank should be guided by prior theoretical information. Batchelor (2000:12) in turn suggests that, in the presence of two co-integrating equations, there is need for normalization of the co-integrating coefficients. The normalization process yields one co-integration equation and one co-integration vector. Bartchelor's approach is adopted in the study.

The co-integration vector represents the deviations of the endogenous variable from its long run equilibrium level. Figure 4.1 suggests that from 1992 to 2019 the deviations of EPT from equilibrium were stationary. This is critical for its use as an error correction model.

Vector Error Correction Model

The VEC has co-integration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics. The co-integration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. This allows us to distinguish between the short and long run effects of variables so as to establish the effect of foreign exchange reserve on import demand.

Long Run Terms

Summary of the long run parameters in the model is reported in Table 4.5 below.

Table 4.5: Results of Long Run Co-integration Equation

Variable	Coefficient	Standard error	t-statistic
Constant	4.660	-	-
$\boldsymbol{Mt}$	1.00	-	-
$\boldsymbol{Yt}$	1.539	0.113	-4.776
$\boldsymbol{Ft}$	0.782	0.181	4.325
$\boldsymbol{Dm}$	-2.799	0.424	-6.604
$\boldsymbol{Pt}$	-0.544	0.091	-5.959

Source: Own computation under VECM assumption 3

The long run impact of the explanatory variables on Mt as shown by table 4.5 is illustrated using Equation 4.1:

$$\mathbf{Mt} = 4.660 + 1.539\boldsymbol{Yt} + 0.782\boldsymbol{Ft} - 2.799\boldsymbol{Dm} - 0.544\boldsymbol{Pt} \qquad \textbf{(4.1)}$$

Equation 5.1 shows that **Dm** and **Pt**, has a negative long run relationship with **Mt**. **Yt** and **Ft** has a positive impact on **Mt**. All the explanatory variables are statistically significant in explaining **Mt** since they have absolute t-values greater than 2.

A unit increases in $\boldsymbol{Pt}$ causes a decrease in **Mt** by 54.4 percent. This is portrayed by a t value of -5.96 at 5 percent level of significance. This is compatible with theory. In theoretical suggestions, **Pt** causes a decrease in import demand schedule. This emanates from the spill-over effects in low demand for capital and technology and a decrease in production. As a result, there is impediment in the flow of imported items.

A unit increase in foreign exchange reserve results in an increase in **Mt** by 78.2 percent. The relationship is consistent with theory as foreign exchange reserve can be defined as deposits of a foreign currency held by the central bank of a country; it has been curtailed by the ease of currencies availability from the financial sector. This has implications of increased foreign exchange reserve. This is emanating from the fact that the more foreign exchange reserve that the country has the more capacity to import its desired raw materials. Hence a positive relationship between foreign exchange reserve and **Mt** was ensued (Bougrine and Seccareccia (2004).

Real income has a positive long run relationship with demand for import in the model. The result is plausible since it is compatible to the theoretical suggestion of the marginal propensity to import (MPM) which implies the amount imports increase or decrease with each unit rise or decline in disposable income. The marginal propensity to import is thus the change in imports induced by a change in income. Thus, an economy with a positive marginal propensity to consume is likely to have a positive marginal propensity to import. This is because a portion of goods consumed is likely to be imported (Emran and Shilpi, 1996). A unit increase in real income will result in 15.4 percent increase in import demand profiles.

A dummy variable as proxy policy variation between Derg (pre-1991) and the EPRDF[2] (post-1991) on international trade is found to be significant and negatively related to demand for import. The t-value, -6.60 is significant at 5 percent level. A

[2] Ethiopian People's Revolutionary Democratic Front

change in trade policy regime reduces demand for import by 27.9 percent. This is compatible with economic theory. In theoretical suggestions, developing countries have somewhat relied on capital control to adjust economic activities. This has a negative implication on demand for import in the long run as it scarify the interest payment that mount up from foreign and hence it reduces the investment bills.

Speed of Adjustment and Short Run Terms

The speed of adjustment is indicated by the coefficients of the error correction terms. Results from the error correction model are presented in Table 4.6.

Using results from Table 4.6, the coefficient of D ($\boldsymbol{Mt}$) is reported as -0.285 which shows that the speed of adjustment is approximately 28.5 percent. The implication is that, if there is a deviation from equilibrium, only 28.5 percent is corrected in one year as the variable moves towards restoring equilibrium. Thus, there is no strong pressure on $\boldsymbol{Mt}$ to restore long run equilibrium whenever there is a disturbance. The speed of adjustment is statistically significant with a negative t-value of -1.168. The low speed of adjustment by $\boldsymbol{Mt}$ may reflect the existence of some factors affecting $\boldsymbol{Mt}$ in Ethiopia other than$\boldsymbol{Yt}$. These factors include level of education connoted as human capital, consumer price index, exports, amongst others.

Table 4.6: Vector Error Correction

Variable	Coefficient	Standard Error	t-statistic
$\boldsymbol{Mt}$	-0.285	0.146	-1.168
$\boldsymbol{Yt}$	0.863	0.643	-1.765
$\boldsymbol{Ft}$	-0.756	0.701	-1.078
$\boldsymbol{Dm}$	0.449	0.204	2.195
$\boldsymbol{Pt}$	-0.667	0.402	-1.658

The lag of L$\boldsymbol{Yt}$ is found to have a positive effect on $\boldsymbol{Mt}$ in the short-run. However, the t- value of -1.765 is insignificant. The coefficient shows that current $\boldsymbol{Mt}$ can increase by 86.3 percent if L$\boldsymbol{Yt}$ is increased by 1 percent. This shows that the exogenous component of $\boldsymbol{Yt}$ exerts a reliable, positive impact on demand for import. The error term, which has been included to take into account all factors that affects $\boldsymbol{Mt}$ but were not taken into account explicitly, was found to be insignificant.

Despite its insignificance, the usage of the error term made rightful contribution in determination of the co integrating relationship in the model. Thus, a model with an error term is preferred to a model without an error term.

Diagnostic Tests

The fitness of the model was tested in three main ways. Firstly, heteroscedasticity was tested using White's test with no cross terms. This was followed by Jarque-Bera's normality test. Finally serial correlation was tested using the Langrage multiplier (LM) test. The Diagnostic test results are shown in Appendix 5.

Heteroscedasticity

Results from Appendix 5 shows that, the test for heteroscedasticity using White test with no cross-terms produced a Ch-sq of 319.086 at a probability of 0.215. The presence of heteroscedasticity means the model has some misspecifications hence conclusive results cannot be derived from such a model. The null hypothesis of no heteroscedasticity or no misspecification will thus not be rejected. This implies that the model has no misspecifications and can be relied on.

Residual Normality Test

Normality tests were carried using the Jarque –Bera (J-B) test. The J-B statistic follows the chi-square distribution with 2d.f. If the computed p value of the J-B is sufficiently low, which will happen if the value of the test statistic is different from 0, one can reject the hypothesis that the residuals are normally distributed. If the p value is high, that is when the value of the test statistic is close to 0; we do not reject the normality assumption (Gujarati, 2004:148). Based on results from Appendix 5, the Jarque- Bera statistic of 13.779 with a probability of 0.083 indicates that the null hypothesis fails to rejection at 5 percent significance level. This shows that residuals are normally distributed. According to Harris (1995:83), normality in the residuals is specifically looking for skewness and kurtosis that is different from that of the normal (it squares the standardized deviations and sums them) and will tend to be significant when skewness and kurtosis deviating from the values at the normal are present.

Autocorrelation Langrage Multiplier (LM) Test

The problem of serial correlation arises when a variable has relationships with itself in a manner that the value of such a variable in past periods has an effect on its future values (Gujarati, 2004:680). The results reported in Table 4.7 show that the test for serial correlation produced an LM statistic of 30.623 with a probability of 0.702. This suggests that it is not possible reject the null hypothesis of no serial correlation due to high probability. The diagnostic checks have all revealed the suitability of the model. Thus, compelling conclusions on the effect of foreign exchange reserve on demand for import can be deduced and applicable policies can be safely formulated.

Variance Decomposition Analysis

Variance decomposition analysis indicates the proportion of the movements in a sequence due to its own shocks versus shocks to other variables. It shows the fraction of the forecast error variance for each variable that is attributable to its innovations and innovations in the other variables in the system. The results of the variance decomposition analysis are presented in Appendix 2 shows the proportion of the forecast error variance in $\boldsymbol{Mt}$ explained by its own innovations and innovations in explanatory variables.

The variance decomposition analysis in Appendix 2 covers a period of 10 years in order to ascertain the effects when the variables have been allowed to affect $\boldsymbol{Mt}$ for a relatively longer time. In the first year, all of the variance in $\boldsymbol{Mt}$ is explained by its own innovations. For the fifth year ahead forecast error variance, $\boldsymbol{Mt}$ explains about 77 percent of its variation. Explanatory variables account for 23 percent of the error variance. Yt, explains 6 percent, Ft about 1 percent, Dm about 8 percent and Pt 8 percent.

After a period of 10 years, $\boldsymbol{Mt}$ explains about 57 percent of its own variation. Explanatory variables explain the remaining 43 percent. The influence of Yt increases substantially to about 14 percent. **Ft** remains at 1 percent. **Dm** increases to about 18 percent. This explains the largest component of the 43 percent variation in $\boldsymbol{Mt}$ that is explained by the explanatory variables. **Pt** increases slightly to 10 percent. The variance decomposition analysis results are compatible with economic theory.

5. Conclusion and Recommendation

The study estimates the import demand function under foreign exchange constraint for Ethiopia for the period of 1992 - 2019. Co-integration approach was implemented. While the error correction term in the estimated VEC model was evaluated for long run causal relationship, the short-term coefficients have been gauged for short term causal relationship between the explained and the explanatory variables. The co-integration result shows that there is the long run equilibrium relationship between the real import, the real income, the relative price of import and the foreign exchange reserves signifying the relevance of including foreign exchange reserves in the model. Analysing the size of the coefficients, it is found that the domestic income turns out to be the most important factor determining the volume of import in the long run as well as in the short run. The empirical estimate shows that long run import is elastic with respect to income and inelastic with respect to relative price of import and foreign exchange reserves. This implies that the import volume would grow faster rate than the growth in income of the country and would deteriorate the trade balance of the country if the growth in income is not accompanied by growth in exports.

Foreign exchange reserves turn out to be statistically significant factor affecting import demand both in the short run as well as in the long run. However, its economic impact is relatively small in particular to the size of estimated income elasticity but close to price elasticity.

With respect to price also, Ethiopians' import is found to be significantly related to, both in the long and in the short run. However, the low coefficient implies that its import is non-competitive in nature and import substitution industrialization strategy has not been able to successfully provide the domestic substitutes to these products to compete with these imports. Since the price elasticity is very low even depreciation may not be an effective policy to reduce the trade deficits. This is also evident from the fact that despite the continuous depreciation of the Ethiopian Birr, the trade deficits continue to rise.

Recognizing the nature of imports, controlling import without providing adequate domestic substitutes may not be desirable as it may have an adverse impact on the growth of economy. Since, the sign of foreign exchange reserve is both expected and its magnitude is high, the estimated result implies that accumulation of foreign currency increases import demand and further deteriorates balance of payment. Therefore, policy makers should care when using it as exchange rate policy for trade balance adjustment purpose.

Thus, the government and other concerned bodies have to take a certain action on several factors that explain how much foreign exchange reserves a country wants to hold. They must have a close watch on the volatility of international receipts and payments, since in so far as reserves are intended to help cushion the economy. That is, reserve holdings are likely to increase with more volatility in a country's export receipts. Vulnerability to external shocks since reserve holdings are likely to increase with a country's average propensity to import, which is a measure of the economy's openness and vulnerability to external shocks. A country's tolerance for greater exchange rate flexibility should reduce its demand for reserves, because its central bank would not need a large reserve stockpile to manage a fixed exchange rate. Therefore, reserve holdings are likely to be lower the more variable the country's exchange rate is.

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Where is the Dynamics of Export Diversification in Ethiopia?[1]

Birhan Eshetu Kebede[2]

Acronyms

AGOA	African Growth and Opportunity Act
CSA	Central Statistical Agency
EBA	Everything but Arms
EAC	East African Community
ECX	Ethiopian Commodity Exchange
ESL	Ethiopian Shipping Lines
EU	European Union
FOB/CIF	Free on Board
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
HS	Harmonized Commodity Classification System
LDC	Least Developed Country
LLDC	Landlocked Least Developed Country
NBE	National Bank of Ethiopia
NPND	New Product New Destination
NPOD	New Product Old Destination
OPND	Old Product to New Destination
OPOD	Old Product to Old Destination
ROW	Rest of the World
SADC	Southern Africa Development Community
FTA	Free Trade Area
UNCTAD	United Nation Conference on Trade and Development
UNDP	United Nation Development Program
WITS	World Integrated Trade Solutions
WTO	World Trade Organization

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Abstract

Ethiopia formulated different strategies, undertook policy changes and committed itself in trade integration to expand and diversify its export products. The export basket is dominated by coffee but its share is shrinking because of increased share of few new export items such as cut flowers, textile products and some processed goods. This study employs product-destination descriptive matrix to analyze export diversification and identify the relevant factors that practically influence Ethiopia's export performance. Based on the analysis, top 20 export commodities are contributing more than 80% of the export earnings. The performance of the new export items such as textile and textile articles are promising. Among the fastest growing exports, most of them are value added products such as spare parts of vehicles and the respective export earnings have grown by multiple times in 2013 compared to the value in 2004. At Harmonized Commodity Classification System (HS) 6-digit level, among 316 New Product Old destination (NPOD), 84 are from textile and textile articles. Though the values per each export are low, there are also 74 new exports in the vehicles, aircraft, vessels and associated transport equipments. The major destinations of these dynamic products are EU, North America, China, Middle East, Africa and India. Thus, the major factors that play pivotal role in the export performance and diversification of Ethiopia are institutional and structural changes, trade facilitation and export priority, infrastructures improvements, foreign firm participation, trade promotion and preferential market access, stretched objectives and declining bilateral trade costs.

Key words: Export, Diversification, Ethiopia, Product, Destination.

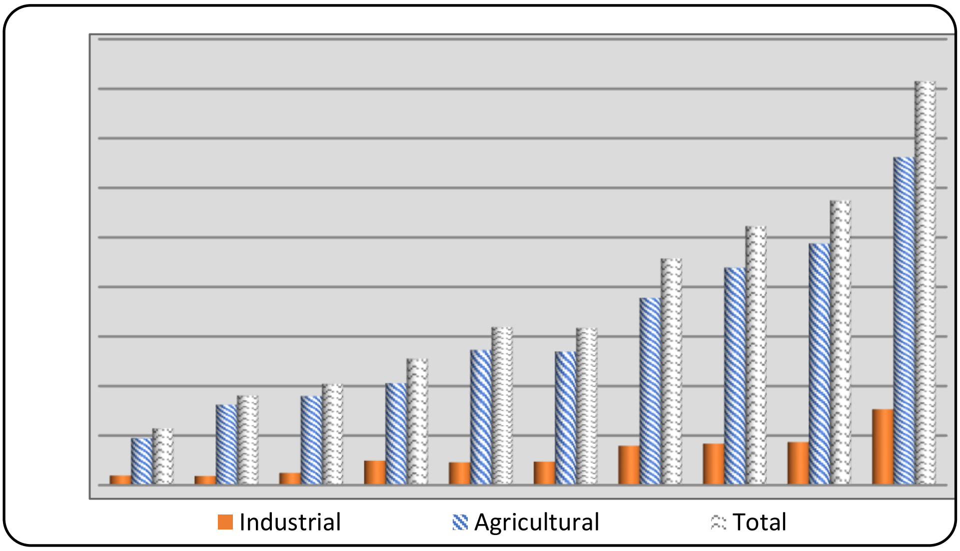
1. Background

Industrial development and trade policy of Ethiopia has given emphasis to labor intensive agricultural development led industrialization[3] and export diversification. Though its integration to the world economy is weak, its commitment is being revealed by existing trade negotiations. Currently, Ethiopia is an observer in the World Trade Organization (WTO) and undergoing regional and bilateral negotiation with different trading blocs (Ministry of Trade, 2011/2012). Relative to the past, with such motives and objectives to increase export, Ethiopia has made different trade

[3] Ethiopian government portal: www.ethiopia.gov.et

facilitation activities and this has increased the quality and quantity of export to the world market which motivate investment in value addition. Accordingly, the value of export of agricultural commodities and industrial products has shown an increasing trend, as indicated in Figure 1, but the growth of agricultural export is by far more than the industrial products in the ten years period (2004-2013).

Figure 1: Trends of Agricultural and Industrial Export



Source: World Integrated Trade Solutions & Authors Computation

In the history of Ethiopia's export, coffee is the leading contributor to export earnings; but its share is declining due to new commodities joined the export bundle such as cut flowers and some processed products. As stated by Abay and Zewdu (1999) as cited in Tekaligne (2009), from 1966 to 1996 the share of export earning of coffee is 59%, on average and declined to 36.3% in 2007 while the non-coffee agriculture and industrial sector increased to 63.7% (Tekaligne, 2009). However, still export is dominated by agricultural commodity (Appendix 1) which is mostly confronted by price fluctuations in the international market; among the top ten exports except two the remaining are agricultural commodities.

Though the export value of industrial products did not surpass share of agricultural commodity, Ethiopia has dramatically diversified export from 52 in 2005 to 148 in 2013 as indicated in Table 1. UNCTAD (2014) stated the diversification index[4] (modified Finger-Kreinin measure of similarity in trade) as whether the structure of exports by product of a given country or group of countries differ from that of the world, taking 1995 as a base year. The index value closer to 1 indicates a bigger difference from the world average (improvement). Thus, compared to 2005, Ethiopia's diversification index is showing improvement in 2013 and in comparison, to LLDC, LDC and East African countries' average (value closer to 0 means 'traditional' export). Besides, the concentration index (Herfindahl-Hirschmann index)[5], as per UNCTAD (2014), is a measure of the degree of market concentration. An index value that is close to 1 indicates a very concentrated market and a value of 1 implies only one product is in the export basket while values closer to 0 reflect a more equal distribution of market shares among exporters and a value of zero means high diversification. Therefore, the concentration index of Ethiopia has slightly reduced in 2013 from 2005 value and thus, it is better compared to LLDC and LDC average, Rwanda and Somalia. This could imply that Ethiopia has done better in diversifying export.

Table 1: Export Concentration and Diversification Index

Countries/ Region	2005			2013		
	No. of Export	Diversification Index	Concentration Index	No. of Export	Diversification Index	Concentration Index
Ethiopia	52	0.644	0.379	148	0.773	0.331
Kenya	226	0.714	0.211	237	0.642	0.193
Rwanda	39	0.757	0.451	99	0.849	0.463

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$$I_i = \frac{\sum_{j=1} \left| S^1_{ij} - S^0_{ij} \right|}{2}$$ *where,*

I_i – Value of structure index for product i

S^0_{ij} – Share of trade of product i for country j in 1995

S^1_{ij} – Share of trade of product i for the country j in the concerned year

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$$H_i = \frac{\sqrt{\sum_{j=1}^{n} \left(\frac{x_{ij}}{X_i}\right)^2} - \sqrt{\frac{1}{n}}}{1 - \sqrt{\frac{1}{n}}}$$

where

H_i – Value of concentration index for product i

x_{ij} – Value of exports or imports for country j and product i $X_i = \sum_{j=1}^{n} x_{ij}$ *, n= nō of products*

Countries/ Region	2005			2013		
	No. of Export	Diversification Index	Concentration Index	No. of Export	Diversification Index	Concentration Index
Somalia	42	0.776	0.564	33	0.750	0.616
Uganda	142	0.750	0.265	204	0.724	0.183
Tanzania	173	0.759	0.231	217	0.748	0.191
LLDC*	259	0.623	0.297	258	0.621	0.373
LDC*	257	0.690	0.458	258	0.657	0.403

Source: UNCTAD Statistical Handbook
*LLDC is Land Locked Developing Country and LDC is Least Developing Country.

The main objective of regional trade agreements such as COMESA (Common Market for Eastern and Southern Africa) is to increase trade between countries in the region; however, Ethiopia's import origin and export destination are the rest of the world than countries of Africa. As illustrated in Table 2, the share of Europe as the origin of import and destination of export decreases while the respective share of Asia increases and that of Africa slightly remains the same.

Table 2: Trade Direction of Ethiopia

Year	Trade Type	Trade Direction (%)				
		Europe	Asia	Africa	USA & ROW	Total
2009/10	Export	41.1	31.2	22.8	4.9	100.0
	Import	21.0	68.0	3.0	8.0	100.0
2010/11	Export	49.9	26.5	18.0	5.6	100.0
	Import	21.3	67.0	5.9	5.8	100.0
2011/12	Export	47.1	30.0	18.9	4.0	100.0
	Import	23.0	65.4	5.2	6.4	100.0
2012/13	Export	43.6	30.3	21.3	4.8	100.0
	Import	19.3	72.6	2.7	5.4	100.0
2013/14	Export	37.7	34.5	22.6	5.2	100.0
	Import	20.0	70.6	3.0	6.4	100.0

Source: National Bank of Ethiopia (NBE) & Own computation

Generally, countries are not self-sufficient and productive in all sectors of their economy and thus, international trade is crucial for these countries. In order to be successful in international trade, market access is the priority agenda for exporters after producing the right product (standardized product with right quality). Commonly after World War II, accessing foreign market is accomplished through concessions between and among countries for economic and non-economic benefits (Finger et al, 1999). Without being a member of any free trade area and multilateral trading system, WTO, Ethiopia has shown remarkable progress in export, especially in the 2000s after the economic policy change in the 1990s. The volumes and values of export have increased dramatically (Semunigus, 2015). Therefore, such facts about Ethiopia motivates the researcher to answer questions such as what pattern of export diversification in Ethiopia does exist and what are the factors influencing that pattern. With new way of looking at export performance (product-market 2 by 2 matrix), identifying plausible answer is vital to complement trade policy makers and help investors to identify potential investment areas in Ethiopia.

2. Diversification and Export Performance

2.1 Conceptual Framework on Export Diversification

Exports of countries may be new to export market or old (traditional) and the same is true for market/destination; thus, export diversification considers both dimensions. Diversification of export products and markets is important to reduce the challenges of development and deficit trade which again increases employment opportunities (Samen, 2010). According to the author, diversification is an export led strategy and is defined as a progression from traditional to non-traditional exports which improves the export base and increases market sophistications. The author classified diversification as horizontal and vertical; the former entails increasing the country's existing export basket by including new products in the same sector, while the latter involves the conversion of the primary sector to secondary or tertiary sector by value adding steps such as processing, marketing and other services.

Amurgo-Pacheco and Pierola (2008) defined diversification based on intensive and extensive margin in such a way that intensive margin refers to growth of existing goods export (old products) and the extensive margin implies the growth of exports in new categories or new products. They classified products as new and old based on certain reference year, example before and after 1995. It is believed that this classification system best suits, in terms of product classification, to accomplish the objective of this research; however, the geographic dimension remains to be defined. Amurgo-Pacheco and Pierola (2008) twisted the geographic definition to the product definition in that intensive margin contains old products exported to the old destination (OPOD) while extensive margin consists of any combination of new either product or destination or both. That is, old products exported to new destinations (OPND), new products exported to new destinations (NPND) and new products to old destinations (NPOD). They summarized that there are two versions of diversification; product diversification consists of NPOD and NPND whereas geographic diversification consists of OPND and NPND.

2.2 Determinants of Export Performance

Export diversification is the concern of Ethiopia since the mid of the 20th century where the first five years development plan (1957-1961) crafted by the Emperor Haile Silase, which recognized the persistent domination of two-three commodities (Lakew, 2003). However, the domination of agricultural commodities in general and coffee in particular is still not changed to a major extent and concentration of export of few commodities is continuing to be a challenge. According to Lakew (2003), export performance could not fill the fiscal gaps to imports and it has shown lower export to GDP ratio and declining terms of trade.

Ezezew (n.d) has analyzed the determinant of export performance using time series data and arrived at insignificant contribution of exchange rate devaluation and volume of imports. According to him, the effect of devaluation of the exchange rate did not reduce the deficit trade balance due to income effect and other factors. However, this could be a short run problem and importantly, there are other factors that could have offsetting impacts such as structural and supply side problems. For instance, there is a supply of only little containers that existing factories are capable of exporting to foreign markets per month (ESL, 2010). The challenges of Ethiopia's export performances are rather institutional and structural such as lack of access to the sea, slow move to regional and multilateral integration, low technological progress and dependant on commodities export (Ciuriak & Preville, 2010; Ezezew, n.d).

In general, the relevance of export to economic development is undoubted; however, the answer for what factors determine export performance and diversification is different for different researchers. For instance, Agosin et al (2011) studied the factors that determine export diversification, using generalized method of moments (GMM), and found that human capital accumulation (positively), economic distance (negatively), trade openness (negatively), improvement in terms of trade[6] (negatively) affect diversification or export concentration while financial development and exchange rate volatility has no effect on export concentration. Other researchers (Martinez, 2003; Marquez, 2007; Armstrong, 2007; Butt, 2008; Yohannis, 2014) have used the gravity model to distinguish factors that determine trade and listed out factors ranging from micro (import demand and export capacity)

[6] But this effect is less pronounced for those countries with higher levels of human capital.

to macro (GDP, population size and geographic distance) elements. Tripathi and Carlos (2013) have also agreed with the positive impact of political globalization and cultural proximity to the bilateral trade between countries. However, the weakness of such researches is that the gravity model could not be the right methodology to analyze the dramatic increase in export which is currently the case in Ethiopia. The gravity model is intended to analyze the amount of bilateral trade between two parties; it could not be the right way to identify the factors affecting export performance using this model especially with Ethiopia's data.

2.3 Overview of Trade Policy Environment

After the end of the civil war which lasted for about two dicades, Ethiopia has embarked different economic policy changes starting from 1992 (UNCTAD, 2002). Among those changes, liberalization of trade policy, deregulation of prices and exchange rate, abolishing non-tariff barriers, progressive reduction of import tariff are increasingly important in boosting export performance. While formulating economic policy, trade especially export is a priority area and this is stressed in Ethiopia's Growth and Transformation Plan (GTP) (Ciuriak & Preville, 2010). However, its integration into the world economy remains weak as its application for accession to the WTO before 13 years is not completed (UNDP, 2012) and it is not a member of any regional FTA except COMESA PTA. According to Federal Negarit Gazet proclamation number 249/2001, exporters have many incentives; no export tax except on few commodities, exemption of payment of custom duties and other taxes on imported and locally purchased raw materials for the production of goods for export, Franco valuta (no foreign currency is required from the bank), permit for imports of raw materials and export credit guarantee and so on. Generally, Ciuriak and Preville (2010) also noted that Ethiopia is undergoing changes and availing different benefit schemes to improve Foreign Direct Investment (FDI) and its export performance; however, there are technical challenges in aligning different economic policy mixes.

The Ministry of Foreign Affairs of Ethiopia (2007), in its trade promotion manual, stated that the international trade policy of Ethiopia has three core objectives; the first is to develop and ensure export destinations for agricultural commodities. The second is to generate foreign currency so as to import capital goods, intermediate goods and services which are vital for economic growth and the third is to improve the competitiveness of domestic firms in the global market. The ministry has also put three trade promotion strategic pillars that are important to accomplish the desired objectives. The first pillar has focused on a limited number of exportable products while the second and the third have focused on providing any relevant support to exporters and engaging in export promotion activities respectively. However, the weakness of this trade promotion manual is that the second trade policy objective could not be met with the first core objective; that is, exporting agricultural commodities could not sustain and improve the terms of trade of Ethiopia where there are huge capital-intensive imports for accomplishing the country's vision becoming a middle income. Thus, value addition could not be left out in any trade promotion of the country. Besides, the first strategic pillar of export promotion has also focused on a limited number of commodities or products, but the other way round works better while promoting because of economies of scale advantage and importance of diversification.

Though its trading environment is vulnerable to higher logistics, trade and institutional costs, Ethiopia has moved remarkable steps to streamline its policy and regulatory procedures and comply with the WTO trading principles (WTO, 2011). As a growing economy, it is required to accommodate fundamental changes in the global economy so as to boost competitiveness (UNCTAD, 2002). Moreover, Ethiopia has different bilateral agreements with many countries such as India; non-reciprocal market access to the EU market under EBA and the US market under AGOA and it is undertaking different multilateral trade negotiations with COMESA FTA, Tripartite FTA (TFTA) and the WTO. According to Ciuriak and Preville (2010), however, it did not utilize the existing opportunities that make its export performance bigger than the existing volumes due to factors such as problems in the macroeconomic policy mix; high trade cost, lower level of private sector participation, inefficient service provision, thick borders and high tariff rates from African partners.

2.4 International Market Prices for Commodities and its Impact

The major exports of Sub-Saharan African countries such as Ethiopia have concentrated primary on agricultural commodities which are mostly affected by price fluctuations in the international market (Deaton & Milliner, 1995). Such problems induce many subsequent problems to these countries' budgets and income of households who are directly and indirectly employed by the exporting sectors. According to Deaton and Milliner, appropriate response mechanism to price shocks is required to stabilize and adjust the shocks either permanently or temporarily. The important remedy for the problem, as suggested by many authors is diversification of products rather than ‘sending’ primary commodities.

The boost in the commodity prices from 2004 to 2008 has increased the revenue of exporting countries, but concerned different countries since commodity price fluctuations easily affect their budget; that is, after the budget is risen up, it is difficult to lower it when commodity prices are lower or expected to decline and has many economic, social and political implications (Medina, 2010). Raddatz (2007 as cited in Medina (2010), argued that among external shocks, commodity price fluctuations are the most crucial sources of challenges that low-income countries are facing. UNCTAD (2015) also stressed that due to a strong appreciation of the dollar, commodity market witnessed a decline in the prices of commodities from its peak in 2011-2012 till the first half of 2015. The report stated that the investment response to the commodity price boom in 2000s and lower oil prices has a great impact on the declining trend of commodity prices due to the fact that as oil price declines, it reduces the cost of production and increased supply of commodities which finally reduces prices. UNCTAD (2015) notes that developing countries in Africa are the victims of slowing down of commodity prices since the trade structure of these countries is concentrated on primary commodities. In this regard, the challenges to Ethiopia are not exceptional rather very intense, especially on its trade balance.

3. Methodology and Data Sources

In this research, in order to answer the research questions, descriptive approach is used. This approach is important in explaining the dramatic increase in Ethiopia’s export and assessing the factors influencing the existing patterns of export diversification. That is, descriptive method is employed to understand the patterns of export and identify the factors that influence the patterns of export performance. The important area of descriptive analysis is made on the export diversification and growth of Ethiopia which has two parts. The first is an analysis of the export of old products to old/traditional and new markets/destinations, while the second is an analysis of the export of new products to old/traditional and new markets/destinations (Steenkamp et al, 2009). The descriptive approach used to understand the new-old export product versus market relationship is based on Table 3.

Table 3: Product – Destination Matrix

		Foreign Destination (Market) for Exports	
		Old/traditional	New
Products in the export market	Old	List of old products in old destination/markets (OPOD)	List of old products in new destination/markets (OPND)
	New	List of new products in old destination/markets (NPOD)	List of new products in new destination/markets (NPND)

Based on this matrix, there are four possible analyses that can be done.

i. Export of old/traditional products to old/traditional destinations,
ii. Export of old/traditional products to new destinations,
iii. Export of new products to old/traditional destinations and
iv. Export of new products to new destinations,

The exports of Ethiopia to neighboring countries such as Djibouti, Somalia and Gulf States may not be the final destination for some products and there are expected re-exports and this research identified the possibility of re-export from some of these countries. After proving for the existence of re-exports, the possible reason for the exiting situations is proposed. Besides, description of some of the major export commodity production levels and the export performance analysis is made.

The data sources for the research are WITS, NBE and Central Statistical Agency (CSA) and other web-based sources. The data types used in this research are time series and cross-sectional data from 2004 to 2013 based on data availability (available from 2004 onwards for HS 2002). Since the data available for the years before 2007 are of HS 2002 classifications, data are extracted using the HS 2002 at 6-digit level.

4. Data Analysis

4.1 Export Trend and Share of Major Commodities

Ethiopia's export performance in the 2000s can be explained by existing changes in the number, volume and value of export. Its export volume has dramatically increased by sevenfold from $570.6 million in 2004 to 4,064.2 million USD in 2013 and it has increased by an average of 26% annually. However, from Table 4, it is clear that only 20 products/commodities are contributing 88.3% of the export earnings in 2005 while it is 84.8% in 2013. The export values for the 20th commodity in 2013 is greater than that of the 7th commodity in 2005 implying export performance was better in terms of commodity in 2013. Besides, some export commodity earnings have increased dramatically, such as kidney beans and meat of goat while some commodities decrease in rank for instance, oil seeds, chickpeas and broad beans.

Table 4: Change in rank of export products at HS 6-digit level

Rank	Code	Product	2004 Export Earning	Code	Product	2013 Export Earning
1	090111	Non decaffeinated coffee	185,662.96	090111	Non decaffeinated coffee	770,315.00
2	710813	Precious metal	71,212.32	070990	Other Vegetables	558,764.61
3	120740	Sesamum seeds	61,913.65	060310	Fresh Roses (flower)	518,101.09
4	090190	Other Coffee	51,520.92	120740	Sesamum seeds	493,927.85
5	140190	Other Vegetables	27,830.00	010290	Other (Live Animal)	215,035.62
6	120799	Oil Seeds	20,050.88	710813	Precious metal	157,354.72
7	071320	Chickpeas (garbanzos)	12,850.26	071333	Kidney beans, incl. white pea	147,427.58
8	410229	Raw Skins	11,375.53	271019	Other (mineral Oil/fuel)	89,165.53
9	520300	Cotton, carded or combed	9,995.60	010619	Other (Live Animal)	72,928.04
10	071333	Kidney beans, incl. white pea	9,946.14	411200	Leather further prepared	65,267.96
11	100890	Other cereals	7,039.05	020450	Meat of goats	63,640.11
12	180610	Cocoa powder	6,993.47	060210	Unrooted cuttings and slips	62,548.49
13	140490	Vegetables Materials	3,807.58	010410	Sheep	47,489.63
14	071350	Broad beans	3,694.40	071320	Chickpeas (garbanzos)	39,770.24
15	130190	Gums & Other Vegetables	3,642.71	120799	Oil seeds	31,266.20
16	091010	Ginger	3,527.41	070190	Other Vegetables	30,915.78
17	020450	Meat of goats	3,426.74	411310	Raw Hides & Skins (of goats)	25,728.42
18	261590	Other (ores)	3,235.48	071350	Broad beans	24,118.46
19	901110	Stereoscopic microscopes	3,033.87	071390	Other Vegetables, edible	18,548.38
20	010290	Other (Live Animal)	2,983.53	842890	Other machinery	15,800.82
Total			503,742.50			3,448,114.53

Source: WITS

Looking at the rates of growth, some products are growing faster than others though such exports have lower share in export earnings. As shown in Table 5, at 2-digit level, products under salt and sulphur (average annual growth of 174.3%); furniture and others (average annual growth of 152.4%) are achieving higher growth rates and export earnings of these products have increased from $230,000 in 2005 to 22 million dollars in 2015 but these products have lower share in total export. On the other hand, the most important export commodities such as coffee have high export shares but with lower growth rates as export earnings from coffee and tea only increased with an annual average growth of 18%. Generally, the growth of export earnings of the top 51 commodities (at HS 2002 2-digit level) has shown better performance in 2015 compared to the level in 2004 but with fluctuating growth rates. Among the top growing exports, most of them are processed and value-added goods which signify improvement in export diversification.

Besides, as referred in the Appendix 1b, most of the top 30 export products (HS 2002 6-digit level) in value terms, are row commodities, traditional exports. However, looking at the top 30 fastest growing exports, as illustrated in Appendix 1c, mostly are exports with value additions and this clearly indicates that though the export of traditional commodities takes the lion's share in export earnings, new export products are joining the market rapidly. As indicated (Table 5), the percentage increase for some of the exports is huge due to the fact that these exports start from nearly zero to higher export values. The pushing factors for this dynamism are particularly the export priority given by the government such as construction of industrial zones, favorable environment to attract foreign investors to invest exclusively for export (an exporting firm receives enormous advantages from the government) and some improvements in supply side infrastructures. Generally, these rapidly growing products are exported mostly to Middle East (Kuwait, UAE, Saudi Arabia, etc), Africa (Djibouti, Somalia, Sudan, Egypt, Kenya, etc), EU (UK, Netherland, Italy, Germany, France, etc), USA, Canada, China and India. Above all, exports such as leather (411200 and 411310) and vehicles of cylinder capacity exceeding 1 and 3 (870323 and 870324) have wider destinations to new and traditional markets, whereas many African countries are destinations to the latter. Still, most of vegetables (06-15) and animal (01-05) products are exported to Middle East countries.

Table 5: Growth Rate (%) of Selected Export (Dynamic) Products

Products (at HS2002 2-digit level)	Value in '000' $		Average Annual Growth in %
	2005	2015	
25. Salt; sulphur; earth & stone; plaste	230	22,096	174.3
94. Furniture; bedding, mattress, matt	54	2,312	152.4
85. Electrical mchy equip parts thereof	135	24,566	151.1
39. Plastics and articles thereof.	54	2,312	147.6
44. Wood and articles of wood; wood ch	65	3,828	117.3
73. Articles of iron or steel.	151	1,246	101.9
06.Live tree & other plant; bulb, root	2,745	737,486	92.9
20.Prep of vegetable, fruit, nuts or o	1,954	7,712	87.1
84. Nuclear reactors, boilers, mchy & m	158	16,559	80.3
61. Art of apparel & clothing access,	738	21,033	74.5
96. Miscellaneous manufactured articles	74	1,298	72.0
01. Live animals	4,540	332,180	70.5
64. Footwear, gaiters and the like; par	412	8,284	69.9
63. Other made up textile articles; set	1,208	6,660	55.4
42. Articles of leather; saddlery/harne	94	1,703	53.3
88. Aircraft, spacecraft, and parts the	214	32,779	51.9
19. Prep. of cereal, flour, starch/milk;	295	12,483	42.0
07. Edible vegetables and certain roots	37,016	897,448	38.2
02. Meat and edible meat offal	8,291	106,860	34.1
22. Beverages, spirits and vinegar.	458	5,238	30.3
04. Dairy prod; birds' eggs; natural ho	399	2,996	28.2
12. Oil seed, oleagi fruits; miscell gr	87,637	531,370	24.2
05. Products of animal origin, nes or	553	2,361	19.6
09. Coffee, tea, matï and spices.	247,610	1,049,201	18.1
15. Animal/veg fats & oils & their clea	1,383	5,448	15.3
08. Edible fruit and nuts; peel of citr	1,985	7,423	15.1
87. Vehicles o/t railw/tram w roll-stock	42	14,678	4.5

Source: WITS

As explained in the influencing factors section of this research, the main drivers contributing for the existing dynamics in export are different but importantly the transformational mind set of the government which brought different structural and institutional changes that played pivotal role. Besides, ending the civil war, the country has built and sustained peace and security (though bordered by conflict zones) which have attracted different investors since the end of 1990s. Specifically, due to the medium-term plan of the government to transform to industry led economy, manufacturing sector is given different benefits and priorities. For instance, an investor investing in manufacturing for export benefits from franco valuta import of raw material, credit grantee and loss carry forward.

Table 6: Rank of Major Export Commodities

Rank	1999/00	2009/10	2013/14
	Coffee	Coffee	Coffee
	Chat	Oilseeds	Oilseeds
	Leather & its Products	Gold	Gold
	Gold	Chat	Chat
	Oilseeds	Flower	Pulses
	Pulses	Pulses	Flower
	Fruits &Vegetables	Live Animals	Live Animals
	Meat Products	Leather & its Products	Leather & its Products
	Sugar	Meat Products	Textile & its products
	Live Animals	Fruits &Vegetables	Meat Products
	Bee's Wax	Textile & its products	Fruits &Vegetables
	Textile & its products	Bee's Wax	Bee's Wax
	Flower	Sugar	**Sugar (no export)**

Source: NBE

In a nut shell, on an aggregate level, as Table 6 indicates, most of the export commodities are agricultural and some of these commodities decrease persistently from export performance rank in 1999/2000 to 2009/2010 and 2013/14 while some others increase their rank in export earnings. Besides, those commodities whose rank declined in 2009/2010 have either remained in that rank or further declined in 2013/2014 but not survived back to their rank in 1999/2000. As illustrated in Table 6, flower emerged as a new major export commodity in the export market while sugar has left the export market after 2009/2010.

In both aggregate and disaggregate level of analysis, it is clear that the increase in export is due to more of horizontal diversification in the sense that most of the increase in export value are in the agricultural sector; however, looking at the HS-6-digit level, more dynamic exports are being recorded in the manufacturing sector. More generally, the diversification in export is inclined more to the intensive margin than to extensive margin. That is, the growth in export is due to increase in the export of same products mostly to the same destinations.

Due to the emphasis given to promote export such as trade facilitation, banking, establishment of commodity exchange (ECX) and other incentive schemes, there are some commodities which improved their share in the export earnings. As depicted in Table 7, while the export share of coffee decreased from 34.2% in 2002/2003 to 21.9% in 2013/2014, the share of other commodities such as oil seeds, pulses and live animals increased. The declining share of the commodities such as coffee and leather is due to the increase in the number and volume of export of some other products, but not due to the decline in the export of coffee and leather products.

Table 7: Export Share of Major Export commodities (% of values)

Commodity	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Coffee	34.2	37.2	41.0	35.4	35.8	35.8	26.0	26.4	30.6	26.4	24.2	21.9
Oilseeds	9.5	13.8	12.5	21.1	15.8	14.9	24.6	17.9	11.9	15.0	14.4	20.0
Gold	8.7	8.1	6.4	6.5	8.2	5.4	6.8	14.0	16.8	19.1	18.8	14.0
Chat	12.0	14.7	12.2	8.9	7.8	7.3	9.6	10.5	8.7	6.7	8.8	9.1
Pulses	4.1	3.8	4.3	3.7	5.9	9.8	6.3	6.5	5.0	5.1	7.6	7.7
Flower	-	-	-	2.2	5.4	7.6	9.0	8.5	6.4	6.2	6.1	6.1
Live Animals	0.1	0.3	1.6	2.8	3.1	2.8	3.6	4.5	5.4	6.6	5.4	5.7
Leather & its Prod.	10.8	7.3	7.8	7.5	7.6	6.8	5.2	2.8	3.8	3.5	3.9	4.0
Meat & its Prod.	0.5	1.3	1.8	1.9	1.3	1.4	1.8	1.7	2.3	2.5	2.4	2.3
Fruits & Vegetables	2.0	2.1	2.0	1.3	1.4	0.9	0.8	1.6	1.1	1.4	1.4	1.4
Others	18.0	11.5	10.4	8.8	7.7	7.2	6.3	5.6	8.0	6.6	7.0	7.6

Sources: CSA, NBE and Appendix 1.

4.2 Export Performance and Unit Value of Major Commodities

The increase in the export performance can be attributed to either the increase in the price of export in the international market or to the increase in export volume or both. To prove this, it is better to compare the export earnings per major export commodities (ratio) and arrive at the unit value of each export commodity. Therefore, from Appendix 1a, there are some improvements in unit values for some commodities in 2013/2014 compared to 2005/2006 though it is not to the extent that discredit the improvements in the volume of export because export volume has dramatically increased from 709, 064 tons in 2005 to 1.3 million tons in 2013 and every major export commodity has increased in volume. Moreover, the huge increase in unit value of leather and leather products (4.9 in 2005/2006 to 23.3 in 2013/2014) is merely associated to the improvement of quality (i.e. value addition). However, the unit value of gold has increased due to improved world price for gold in the last ten years. Generally, the recorded export performance in Ethiopia is due to the growth in quantity and quality of exports rather than improvement in the international prices.

4.3 Production Level of Major Export Commodities

The performance of export is largely determined by existing productions. As indicated in Table 8, the trend and the export share of three major commodities from production has been fluctuating. In the last 13 years, on average, 40.2% of oil seeds, 10.2% of pulses and 47.7% of coffee were exported from total production. In absolute terms, export of oil seeds, pulses and coffee have increased from 76,604 tons, 109,228 tons and 116,354 tons in 2001/2002 to 313,527 tons, 353,022 tons and 182,667 tons in 2013/2014 respectively.

Table 8: Share of Export from Production of Some of the Export Commodities (ton):

Year	Oilseeds			Pulses			Coffee		
	Production	Export	Exp/Prod. (%)	Production	Export	Exp/Prod. (%)	Production	Export	Exp/Prod. (%)
2001/02	208,136	76,604	36.80	1,026,327	109,228	10.64	242,654	116,354	47.95
2002/03	196,547	82,801	42.13	823,173	66,154	8.04	245,634	136,614	55.62
2003/04	312,863	105,946	33.86	1,042,147	73,280	7.03	263,623	142,423	54.03
2004/05	526,396	170,798	32.45	1,349,579	121,653	9.01	312,777	157,197	50.26
2005/06	486,350	265,649	54.62	1,263,760	110,438	8.74	286,769	162,149	56.54
2006/07	512,800	234,976	45.82	1,561,800	158,752	10.16	333,044	166,184	49.90
2007/08	666,400	152,091	22.82	1,782,740	233,021	13.07	358,001	168,341	47.02
2008/09	655,700	286,987	43.77	1,964,630	137,969	7.02	296,939	112,079	37.74
2009/10	643,614	287,000	44.59	1,898,047	225,663	11.89	415,872	174,252	41.90
2010/11	633,999	299,000	47.16	1,953,194	224,482	11.49	450,023	181,343	40.30
2011/12	730,880	254,700	34.85	2,316,201	226,158	9.76	407,905	169,945	41.66
2012/13	726,660	283,854	39.06	2,751,000	357,519	13.00	373,980	189,960	50.79
2013/14	711,260	313,527	44.08	2,858,900	353,022	12.35	391,647	182,667	46.64

Average	539,354	216,456	40.2	1,737,808	184,411	10.2	336,836	158,424	47.7

Sources: CSA & NBE Statistical Report

Taking coffee as the major export commodity, Table 9 shows how important domestic consumption is and its implication in times of price fluctuations. Referring to Table 9, the share of domestic consumption from production in Ethiopia is higher compared to the rest of the countries listed and it has increased, with fluctuating trends of 47.6% in 1999/2000 to 52.3% in 2013/2014. The inference is that when there is a price crisis abroad, domestic market can consume the surplus and minimize possible impacts. Above all, Ethiopia's coffee production has increased from 3.8 million 60kg in 1999/2000 to 6.5 million 60kg in 2013/2014. Export has also increased from 1.98 million 60kg in 1999/2000 to 3.1 million 60kg in 2013/2014 but export has not increased with the same rate with the production and the share of export which was 52.4% in 1999/2000 but declined to 47.8% in 2013/2014.

Table 9: Coffee Production, Consumption and Export

Crop year	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Total Production in '000' 60kg bags															
Brazil	47,578	31,310	31,365	48,480	28,820	39,272	32,944	42,512	36,070	45,992	39,470	48,095	43,484	50,826	49,152
Ethiopia	3,784	3,115	4,044	4,094	4,394	5,213	4,779	5,551	5,967	4,949	6,931	7,500	6,798	6,233	6,527
Kenya	1,502	1,002	991	945	673	736	660	826	652	541	630	641	757	875	838
Uganda	2,862	3,401	3,158	2,890	2,599	2,613	2,175	2,894	3,490	3,335	2,894	3,267	3,115	3,914	3,633
Export of all forms of coffee in '000' 60kg bags															
Brazil	18,016	23,172	27,982	25,711	26,478	26,198	27,369	28,184	29,510	30,369	33,052	33,542	28,324	31,550	36,421
Ethiopia	1,982	1,376	2,055	2,229	2,491	2,435	2,936	2,604	2,852	1,851	3,324	2,675	3,203	2,870	3,117
Kenya	1,328	1,096	736	920	754	673	597	817	608	525	531	609	803	815	799
Uganda	2,513	3,060	3,358	2,522	2,627	2,369	2,173	2,693	3,311	3,014	2,657	3,142	2,685	3,672	3,442
Domestics Consumption in '000' 60kg bags															
Brazil	12,700	13,200	13,590	13,750	14,200	14,946	15,540	16,331	17,125	17,660	18,390	19,132	19,720	20,330	20,085
Ethiopia	1,802	1,739	1,990	1,865	1,903	2,778	1,844	2,947	3,115	3,097	3,607	4,825	3,596	3,363	3,411
Kenya	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Uganda	119	142	141	140	131	140	150	175	180	185	189	204	210	216	221
Export to Production in %															
Brazil	37.87	74.01	89.21	53.03	91.87	66.71	83.08	66.30	81.81	66.03	83.74	69.74	65.14	62.07	74.10
Ethiopia	52.37	44.17	50.81	54.45	56.69	46.71	61.42	46.91	47.80	37.41	47.96	35.67	47.11	46.05	47.75
Kenya	88.44	109.38	74.27	97.27	111.91	91.51	90.46	98.96	93.30	96.98	84.34	95.05	106.02	93.04	95.32
Uganda	87.80	89.97	106.34	87.27	101.10	90.66	99.89	93.06	94.87	90.38	91.80	96.17	86.20	93.83	94.76
Domestic Consumption to Production in %															
Brazil	26.69	42.16	43.33	28.36	49.27	38.06	47.17	38.42	47.48	38.40	46.59	39.78	45.35	40.00	40.86
Ethiopia	47.63	55.83	49.19	45.55	43.31	53.29	38.58	53.09	52.20	62.59	52.04	64.33	52.89	53.95	52.25
Kenya	3.33	4.99	5.05	5.29	7.42	6.80	7.57	6.05	7.67	9.24	7.94	7.80	6.60	5.71	5.97
Uganda	4.16	4.18	4.47	4.84	5.04	5.36	6.90	6.05	5.17	5.55	6.52	6.24	6.74	5.52	6.08

Source: International Coffee Organization and Own Computation

4.4 Export Capacity of Firms

Export is dependent on production while production is determined by existing government policy priority for export, investment, private sector participation, innovation and supply side infrastructures including investment in science and technology. As can be seen from production data in Table 9, major commodities of export have increased production levels due to different institutional and structural improvements, but there are still capacity challenges to improve export; that is, challenges to reduce trade costs and economies of scale advantages. These challenges are visible in two areas:

i. **Agricultural sector challenge:** shortage of logistics facilities such as generators, shortage of other facilities, cooling stations (cold store) and transportation systems with refrigerators to export meat and horticulture products are persisting though there is high demand for horticulture and meat products in the Middle East countries (ESL, 2010). Besides, as most producers/growers in the agricultural sector are less skilled, it is a challenge to identify and use information about international standards, quality and existing opportunities.
ii. **Manufacturing sector challenge –** though there are improvements, lower supply of products due to firm size and supply side constraints are concurrent problems which exporters face to increase their exports. Firms are small size and could not supply the minimum cargo for export for a viable shipment. This ultimately increases the logistics cost and reduces competitiveness of export in the foreign market.

Generally, export capacity of firms in Ethiopia is not adequate from the view of shipping and logistics where there are more waiting times than average to get export cargo per ship call. This can be best explained by looking at the minimum tonnage available at Djibouti port per week where the average weekly cargo available is around 24,000 tons in 2013 assuming 85% export cargos are using the Djibouti port. This is, however, better than that of 2005 performance where the average weekly cargo was around 13,000 tons. Therefore, lower cargo availability increases shipping and logistics cost per ton which reduces the competitiveness of exports. However, looking at the number of firms participating in export and considering firms which were exporting products at least 12 times per year; it has increased from 411 in 2005 to 657 in 2013 though export volume is small. The frequency (weighted) of export of each firm has also increased; for instance, the firm with the highest frequency has exported 627 times in 2005 while the frequent exporter in 2013 has exported more than 2000 times (adding the frequency of different products).

4.5 Patterns of Export Diversification

Before going through the detail analysis, it is better to define terms that are used in this research; more particularly, new products and new destinations. Accordingly, new products are those commodities or products, at HS6 digit level, that were exported by Ethiopia after 2004 but not before which are still in the market[35] (till 2013) with a minimum value of $1,000 per annum. Old products are those export products which are being exported before 2004 till 2013 which might have zero values in between. Similarly, new destinations are those countries which were not export destinations of Ethiopia before 2004 with the level and value mentioned in the product definition but appeared as an export destination after 2004 while old destinations are those which where export destinations before 2004 too. While defining, 2004 is taken as a reference year because in 2004 and before, at HS6 digit level, there are more zeros in the export data set while after 2004, there are more new products joining the market with more values. Whereas, a value of $1,000 is used as a benchmark because values below this amount are either mostly not consistent (not exported with successive years) or did not show any progress year after year.

Thus, based on Amurgo-Pacheco and Pierola (2008) definition of export diversification, Ethiopia's export is diversified intensively and extensively. Extensively, it has exported 28 new products to 28 new destinations[36]. Among these destinations, 19 of them are African countries indicating its export to Africa is increasing. On the other hand, the number of new export products to existing destinations (NPOD) is 316 and the values of these exports to these destinations have increased from $2.2 million in 2005 to $927.7 million in 2013 (Table 10). The export of old product to new destinations (OPND) has also increased, but it is not as much as the value of NPOD.

Importantly, Table 10 illustrates that the concentration index (normalized and non-normalized) of OPOD has declined in 2013 from the value it had in 2004. This is reflected in the corresponding increase in the NPND concentration index in 2013 from zero in 2004. Therefore, this shows that export diversification is taking place in Ethiopia though a lot remains.

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[35] Products exported consecutively or with a brake in between years but minimum export $1000 for at least a year.

[36] Angola, Austria, Bahrain, Benin, Botswana, Burkina Faso, Cameroon, Colombia, Congo, Cote d'ivore, El Salvador, Gambia, Ghana, Kuwait, Madagascar, Malawi, Malaysia, Mozambique, Rwanda, Senegal, Swaziland, Tanzania, Thailand, Uganda, Vietnam, Zambia & Zimbabwe.

Table 10: Export Values and Concentration Index[37] in the Respective Destinations (Values in $'000')

S.N.	Description	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	NPND		103.37	39.97	356.37	1,199.09	575.42	2,428.58	5,641.15	7,790.48	191,010.67
	HI_1		*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0013*
	HI_2		-	*0.0001*	*0.0002*	*0.0005*	*0.0002*	*0.0006*	*0.0019*	*0.0015*	*0.0367*
2	NPOD		2,194.44	14,916.74	42,075.26	130,548.76	216,718.72	365,987.22	368,567.59	450,994.84	927,719.20
	HI_1		*0.0000*	*0.0004*	*0.0003*	*0.0024*	*0.0113*	*0.0125*	*0.0081*	*0.0065*	*0.0177*
	HI_2		-	*0.0196*	*0.0163*	*0.0503*	*0.1089*	*0.1149*	*0.0922*	*0.0828*	*0.1366*
3	OPND		322.00	213.52	2,471.00	3,569.89	6,398.88	8,445.79	9,560.43	59,811.10	51,581.06
	HI_1		*0.00000*	*0.00000*	*0.00001*	*0.00001*	*0.00003*	*0.00002*	*0.00002*	*0.00072*	*0.00023*
	HI_2		-	*0.00063*	*0.00335*	*0.00314*	*0.00556*	*0.00499*	*0.00476*	*0.02749*	*0.01541*
4	OPOD	05,349.33	299,486.48	376,006.69	739,905.31	1,013,924.09	987,540.19	1,372,327.92	1,709,737.17	1,961,487.21	2,364,781.97
	HI_1	*0.0694*	*0.0678*	*0.0586*	*0.0494*	*0.0426*	*0.0506*	*0.0445*	*0.0416*	*0.0346*	*0.0278*
	HI_2	*0.2442*	*0.2671*	*0.2485*	*0.2280*	*0.2118*	*0.2309*	*0.2165*	*0.2092*	*0.1908*	*0.1711*
5	Total	05,349.33	302,106.29	391,176.92	784,807.94	1,149,241.84	1,211,233.21	1,749,189.51	2,093,506.34	2,480,083.62	3,535,092.89
6	CI@HS2-digit	0.3957	0.4258	0.4300	0.3453	0.3473	0.3040	0.3094	0.3144	0.3126	0.2788

Source: Own Calculation based on WITS Data (Appendix 2-4)

37 $H_i = \frac{\sqrt{\sum_{j=1}^{n}\left(\frac{x_{ij}}{X_i}\right)^2} - \sqrt{\frac{1}{n}}}{1-\sqrt{\frac{1}{n}}}$, where H_i - Value of concentration index for product i; x_{ij} - Value of exports or imports for country j and product i; $X_i = \sum_{j=1}^{n} x_{ij}$, n= nō of products

Note that since the non-normalized Herfindhal Index (HI) has many zeros, it is normalized using the total number of exports so as to see the trend (in fact, it is a division by the same number 'four products' group; that is, it is dividing each by total number of exports of the four category).

Moreover, intensively, the export of old products to old destinations[38] (OPOD) has increased tremendously and this export is greater in value compared to the rest of the combinations due to the reason that the product is already in that market and the cost of marketing is very less compared to the rest of the markets. However, the numbers of products in this quadrant (141) are less than that of NPOD (316). There are many new products joining the export market both at vertical and horizontal diversification; especially, to existing destinations. Thus, in order to understand the major area of product diversification, it is better to look at HS 2002 2-digit (chapters) and section level. Accordingly, the major improvement in Ethiopia's export is made in textile and textile articles and among 316 new exports to old destinations (NPOD), 84 are from textile and textile articles (Table 11). Besides, export of vegetable products is also increasing both in number and values to old destinations. Though the values per each export are low, there are 74 new exports in the vehicles, aircraft, vessels and associated transport equipments.

Generally, in the NPOD quadrant at 2-digit levels, most of the new products emerge under 07 (edible vegetables and certain roots and tubers), 52 (cotton), 61 (articles of apparel and clothing accessories, knitted or crocheted), 62 (articles of apparel and clothing accessories, not knitted or crocheted), 63 (other made up textile articles; sets; worn clothing and worn textile articles; rags), 64 (footwear, gaiters and the like; parts of such articles), 73 (articles of iron or steel), 84 (nuclear reactors, boilers, machinery and mechanical appliances; parts thereof), 85 (electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers), 87 (vehicles other than railway or tramway rolling stock, and parts and accessories thereof), 90 (optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof) and 94 (furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere specified). Therefore, in terms of number of products, most of the diversification is in the non-agricultural (manufacturing) sector but the values are small.

[38] EU, Algeria, Australia, Canada, China, Djibouti, Egypt, Georgia, Guatemala, Hong Kong, India, Indonesia, Iran, Israel, Japan, Jordan, Kenya, Korea (both), Lebanon, Mexico, Morocco, New Zealand, Nigeria, Pakistan, Russia, Saudi Arabia, Singapore, Somalia, South Africa, Sudan, Tunisia, Turkey, UAE, USA & Yemen.

In the NPND quadrant, most of the products are not exported in the old destinations and the value of export is very minimal except in 2013. As most of these destinations are African countries, the new products, especially other vegetables; mixtures of veg., vaccines for veterinary medicine, raw hides and skins (of goats or kids), carcasses and half carcasses, vehicle parts and accessories have a growing trend to these markets. This is because the products are new with higher comparative advantages as Ethiopia has huge potential in these export products. But promotional outlay requires huge investment in advertizing to the new destinations.

Table 11: Illustration of the Selected Products to the Respective Destinations @HS-6 digit level

		Destination/Market for Export	
Products for the export market		**Old**	**New**
	Old	Coffee (non-decaffeinated), fresh (flower), sesamum seeds, kidney beans, other (live animals), meat of goats, leather further prepared, natural gum (other vegetables), chickpeas, sheep, oil seeds, broad beans, other vegetables (edible roots), ginger, tomatoes, coffee/tea (neither crushed nor ground), of cotton (apparel), beans, other textile materials, goats, other vegetables (mixtures of vegetables).	Other (live animal), Sheep, meat of goat, Butter, fresh (flower), tomatoes, cabbage, chickpea, other vegetables, kidney beans, broad beans, sesamum seeds, coffee (non-decaffeinated), leather further prepared, turmeric, agarbatti and other odoriferous, cotton (carded or combed), of other textile materials, worn clothing, with uppers of leather, tableware and kitchenware, wooden furniture, furniture of other materials.
	New	Other (vegetables), other (live animals), unrooted cuttings and slips, other (edible vegetables/roots), raw hides (of goats or kids), other machinery, unworked or simply sawn or roughly (precious or semiprecious stones), other (aircraft parts), measuring less than 714.29 decitex (cotton), measuring 714.29 decitex or more (cotton), soya beans, measuring per single yarn less than (cotton), other textile materials, footwear with outer soles of leather, banana, articles of apparel (of cotton), bamboos, other parts of aircraft, hard rubber, other apparatus, aircraft engines, grain splits, gum Arabic, carcasses and half-carcasses.	Other (mineral oil/fuel), soya beans, of low erucic acid rape or colza (residues, wastes, animal fodder), carcasses and half carcasses, guts, bladders and stomachs of animal, unrooted cuttings and slips, other vegetables; mixtures of veg., vaccines for veterinary medicine, raw hides (of goats or kids), unworked or simply sawn or roughly (precious or semiprecious stones), of a cylinder capacity exceeding 1 (vehicle parts, accessories), worked vegetable or mineral carving, color.

Lastly, in the OPND quadrant, the export value is lower than the export value of NPND. In fact, these destinations are new because no old products exported and again, old products were not exported to such destinations either because those old products did not have a demand or because there was no export market strategy to such destinations. However, the new products are exported possibly either due to the existence of a new demand for such new export products or due to the recently developed export promotion manual for diplomatic communities by foreign affairs which could have a good contribution to export growth for both new and old products in general.

4.6 Nature and Prospect of Export Diversification in Ethiopia

Ethiopia has made remarkable progress in export for the last 10-15 years. When one looks at the export performance at HS 6-digit level, export is diversified both in new products and expansion of clusters of products. As indicated in Appendix 2 and 3, two situations are visible; most of the new products exported to old destinations, Appendix 3, are classified under cluster of products (traditional exports) such as animal (HS 01-05) and vegetable (HS 06-15). Whereas, most of the new products exported to new destinations, Appendix 2, are completely new entering to new destinations; for example, metals (HS 72-83) and transport (HS 84-86). From such scenarios, it is possible to say that there is a correlation between product and destination. That is, diversification of cluster of products is more in the old markets which might be due to exporters' understanding for differentiated products demand in that market. These products have lesser cost of marketing than other completely new products. On the other hand, the new exports which found their way to new markets, especially African markets, could be due to lower standard requirements for such products in these markets compared to the traditional markets such as the EU which have stringent requirements (for example, vaccines for medicines). All in all, both categories of exports have a growing trend in the old markets due to the existence of trade preferences such as AGOA and EBA which could be due to specialization and market development. However, commodity export is vulnerable not only to volatile demand, price shocks and stringent requirements but also to a complete ban. For instance, chat, one of the top ten major exports of Ethiopia is banned in the UK recently[39].

[39] http://www.bbc.com/news/uk-27921832

Looking at export to USA for non-AGOA and AGOA eligible products, most of the non-AGOA products are traditional exports whereas, the AGOA eligible products are new and consistently exported especially after 2006 (detailed in Appendix 5). Besides, export of AGOA eligible products to the US market is increasing in number and value terms which are consistent compared to the same export to China, compare Appendix 5 and 6. This could indicate that AGOA benefited Ethiopia's diversification though Ethiopia did not benefit as supposed to be. This again indicates that destination and diversification influence each other.

4.7 Export Data Discrepancy

In the old destinations, the boom in export to USA and EU is supported by the existing trade preferences such as AGOA and EBA. These are huge markets for export and are given by preference schemes; thus, it is possible to say that the benefit scheme supported Ethiopia's export to these regions. That is, the exports to these destinations are true (no possible re-exports). However, in some destinations such as Somalia and Djibouti, the amount of trade has increased significantly and there is a doubt whether these countries are final destinations. Thus, due to such suspicion for re-export in these markets, export data are checked for whether export of Ethiopia is a re-export of the partner or not. That is, comparing the import as declared by the partners with the export amount reported by Ethiopia to the respective partner. However, due to data unavailability (Somalia did not report any trade data and Djibouti did only for 2009), the analysis is done for Djibouti (for one year), Kenya and Gulf States (such as UAE and Saudi Arabia).

Thus, according to Djibouti 2009 report, it had imported a total of $32.4 million value commodity from Ethiopia; on the other hand, Ethiopia's export report to Djibouti for the same year was $51.5 million, reflecting a difference of 37%. The number of export products as reported by Ethiopia is also greater than the number of import products as reported by Djibouti. This indicates the existence of re-export and this can be aggravated by the fact that the home port for Ethiopia is Djibouti port. Besides, the variation could be as a result of errors in data entry and registration. As indicated in Table 12, there is also great discrepancy between the reported values of Ethiopia's export to Kenya and the import of the same by Kenya. A 10% difference can be accommodated for the existing difference in the Incoterms as Ethiopia exports as FOB (free on board) but Kenya imports as CIF (cost, insurance and freight); however, the difference is very great (greater than around 37%) in this case. Thus, the implication is that either there exists re-export or under reporting or not reporting imports by Kenya. Accordingly, there are unreported imports by Kenya from Ethiopia. Among the unreported products, the important ones are kidney beans, ginger, fresh rose, other vegetables and vehicle spare parts and accessories; but there is no re-export for these commodities.

Furthermore, the discrepancy problem with the Gulf States, as shown in Table 12, is related to both under and over reporting as well as un-reporting by the respective partners. While Saudi Arabia and UAE have higher trade exchange with Ethiopia, the other Gulf States have lower volumes of trade and the analysis focused on the former partners. Thus, among the unreported products by Saudi Arabia importantly include sheep, other animals, other minerals, grain sorghum and seeds of cumin. Similarly, UAE did not report imports of products such as Sesame seeds, non-decaffeinated coffee, other vegetable saps, sheep, carcasses, kidney beans, other live animals and other parts of plants. The amount of export to UAE for 2007-2008 is very high which could be either over reported by UAE or wrongly reported imports from different origins as Ethiopia (as UAE is the main entrepot) or not reported by Ethiopia for some products. For instance, UAE did not report imports from Ethiopia consistently and it did not report any import from Ethiopia for 2004, 2006, 2009, 2010 and 2011 which could lead to a conclusion that some imports can be reported to other origins. Moreover, Ethiopia did not have any export to UAE for products HS code 711291, 710812 for which UAE has reported respectively 15.3 million and \$88.5 million in 2007 and 52.9 million and \$74.0 million in 2008. Therefore, such errors aggravated the discrepancy issue.

Table 12: Export Data Discrepancy with Kenya and Gulf States (values in '000' USD)

Partner	Particular	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Kenya	Export to Ken	1,020.9	2,431.2	2,591.1	5,236.2	4,443.5	4,300.9	4,680.6	16,574.2	13,030.6	18,484.3
	Import by Ken	254.0	291.9	1,561.3	847.9	1,681.4	2,164.7	2,908.2	3,081.0	963.7	3,235.1
	Difference	766.9	2,139.3	1,029.8	4,388.3	2,762.1	2,136.2	1,772.4	13,493.2	12,066.9	15,249.2
	Diff. in %	75.1	88.0	39.7	83.8	62.2	49.7	37.9	81.4	92.6	82.5
Bahrain	Export to Bah	4.6	7.8	43.4	65.8	272.5	372.1	897.0	589.6	595.5	8,559.3
	Import by Bah	3.2	13.4	N/A	N/A	181.9	18.7	1,395.0	2,793.9	4,229.0	5,340.1
	Difference	1.4	(5.6)			90.6	353.5	(498.0)	(2,204.3)	(3,633.5)	3,219.2
	Diff. in %	30.6	(71.6)	-	-	33.3	95.0	(55.5)	(373.9)	(610.1)	37.6
Kuwait	Export to Kuw	35.0	112.3	46.4	167.3	706.7	562.9	521.6	1,349.1	1,314.9	94,101.9
	Import by Kuw	N/A	N/A	544.1	1,467.4	N/A	N/A	1,236.6	N/A	N/A	4,052.0
	Difference	-	-	(497.7)	(1,300.1)			(715.0)			90,049.9
	Diff. in %	-	-	(1,072.3)	(777.0)	-	-	(137.1)	-	-	95.7
Oman	Export to Oma				47.4	102.1	358.1	1,364.6	935.7	2,488.4	4,016.2
	Import by Oma				10.5	91.5	194.4	150.5	309.8	182.9	168.2
	Difference				36.8	10.6	163.7	1,214.1	625.9	2,305.5	3,848.0
	Diff. in %				77.7	10.4	45.7	89.0	66.9	92.7	95.8
Qatar	Export to Qat	42.1	-	6.5	49.8	83.0	49.2	220.2	213.3	99.0	1,176.8
	Import by Qat	N/A	653.9	258.9	372.1	365.3	N/A	528.3	N/A	N/A	1,012.5
	Difference		(653.9)	(252.4)	(322.3)	(282.4)	-	(308.2)	-	-	164.3
	Diff. in %			(3,866.1)	(647.8)	(340.4)		(140.0)			14.0
Saudi Arabia	Export to Saudi	39,139.9	57,930.1	65,672.1	88,657.0	123,181.8	111,835.4	140,580.5	167,332.7	187,804.2	391,160.1
	Import by Saudi	49,584.9	65,142.8	70,405.4	89,263.3	128,337.2	109,755.2	145,890.9	158,916.2	198,862.4	156,999.9
	Difference	(10,444.9)	(7,212.7)	(4,733.3)	(606.3)	(5,155.4)	2,080.1	(5,310.3)	8,416.5	(11,058.1)	234,160.2
	Diff. in %	(26.7)	(12.5)	(7.2)	(0.7)	(4.2)	1.9	(3.8)	5.0	(5.9)	59.9
UAE	Export to UAE	10,402.6	32,283.1	27,269.9	42,304.3	68,196.6	71,958.5	110,351.1	82,286.6	79,792.9	95,480.4
	Import by UAE	N/A	35,923.2	N/A	123,540.0	172,715.2	N/A	N/A	N/A	81,526.3	106,865.3
	Difference		(3,640.1)	-	(81,235.7)	(104,518.6)	-	-	-	(1,733.3)	(11,384.9)
	Diff. in %		(11.3)		(192.0)	(153.3)				(2.2)	(11.9)

Source: WITS

Going further, the analysis is done for the existence of re-export of such products by Kenya and Saudi Arabia to the rest of the world and was found out that Kenya did not have any re-export of the unreported products. Moreover, Saudi Arabia has re-export of sheep to Middle East and other mineral fuel to Middle East and Senegal, Sudan and Somalia which are also direct destinations for Ethiopia's export. Therefore, it is understood that the discrepancy with Kenya is due to not reporting while with Saudi Arabia, it is due to existence of some re-exports and errors in reporting; but Saudi Arabia may have imports of the same products from other countries which can be included as re-export.

4.8 Factors Influencing Export Performance in Ethiopia

Export performance generally is determined by firms' production performance, but this analysis is more concerned with export performance after production. Traditionally, the determinants of export as identified by many authors include economic size, distance, trade relations, common language, common border, colonial history, etc. However, based on the analysis presented in the above sections, the relevant factors that positively determine Ethiopia's export performance include but not limited to:

a) Institutional and Structural Changes: due to the commitment the government has to boost competitiveness and volume of exports, there are around seven different manufacturing institutions[40] accountable to the ministry of industry. These institutes are given a shared objective to increase export base so as to uplift the country to an industry led economy. Thus, these institutional changes in Ethiopia have brought changes in export pattern. There are different export products which have shown increasing trends from each institute; for example, foot wear, textile products, manmade filaments, beverages, and so on. The other gain these institutions brought to the manufacturing sector is that they start from scratch, but with green development initiatives so that export products will have a low carbon footprint. In the future, this will make the exports of the manufacturing sector to be competitive enough within the global market.

b) Trade Facilitation and Export Priority: due to the export targets set high in the GTP and different initiatives such as the requirement to join WTO, COMESA

[40] These are leather industry development institute, metal industry development institute, textile industry development institute, food, beverage and pharmaceutical industry development institute, meat and dairy industry development institute, horticulture development agency and chemical and construction inputs industry development institute.

FTA, tripartite-FTA (COMESA-EAC-SADC), Ethiopia has done a lot of activities to facilitate trade especially export. The number of procedures and documents required to export has been reduced and trading made easier by addressing internal bureaucratic inefficiencies (World Bank, 2011). Besides, due to the priority given to export, there are incentive schemes since 2001 given to exporters such as a duty drawback scheme on imported raw materials for export; voucher scheme; bonded warehouse scheme as well as loans, tax holidays, exemption of export tax and other non-fiscal incentives. This is a great improvement and the benefits were visible. For instance, coffee[41] and cereals, oilseeds, pulses and many others have improved the export performances.

c) Infrastructure Improvements: though not surprising as Ethiopia is landlocked and started from scratch, it has made different efforts to alleviate the challenges of supply side challenges such as road networks, dry ports (seven with special window for exporting firms), banking, logistics operators such as Ethiopian Airlines and ESL. These relative improvements are prominent factors in boosting the export performance and diversification. For example, export of cut flower increased due to strong and continued support given to the sector such as: availing fertile land, storage facility at the farm gates and transport priority (for cut flowers and other horticulture products). Above all, existence of ESL in transport sector made shipment cost lesser especially, to Gulf States, China and Indian subcontinent routes. ESL, government owned enterprise, provide export transport services below market rates (up to 15%) for the reason that ships travel empty in the export leg and to support export.

d) Foreign Firm Participation: the importance of foreign direct investment in a country is promoted because most of the foreign firms are likely to bring not only capital equipments but also new technologies and human skills. For instance, in the textile sector, only three exporting foreign firms were operational before 2004/2005 but between 2004/2005 and 2013/2014, the number of participating foreign firms increased by 14 and in 2013/2014 (in one year) 16 new exporting foreign firms were registered. The figures explain that participation of foreign firms in the export sector is directly related to export diversification; for example, art of apparel and clothing access. Similar trends exist in the other manufacturing sectors such as in the footwear and leather industries; for example, foot wear.

[41] The establishment of ECX has made export of coffee more competitive and standardization with respect to quality has brought transparency for traders and coffee growing farmers. The same is true for oilseeds and pulses.

e) Promotion and Preferential Market Access: in the last decade, Ethiopia has made a lot of progress to promote its trade in the global market through embassies as well as by participating in trade fairs and trade promotion expos. In line with this, Ethiopia has prepared its foreign trade promotion manual for its diplomats in 2007. It has also made a remarkable victory over trade mark dispute with Starbucks, which improved its coffee export earnings. On top of that, Ethiopia has made different bilateral relations which could help to increase exports. Though not a member of any FTA and WTO, Ethiopia has preferential market access advantages to the EU and USA. Accordingly, its export to these markets has shown remarkable progress as indicated in Table 13 below. In such traditional markets, not only traditional exports but also exports of new products are increasing (Appendix 5). For instance, export of AGOA eligible products (most of them are new) to the USA market is increasing with an average annual growth rate of 16% and similar trends exist for EU market. Among the new products entering the US market due to AGOA are electrical machineries and equipments (products under HS section 85), travel sets, other articles of leather, other art of apparel and clothing access, and so on.

Table 13: Export of Ethiopia to EU and USA (in '000' USD)

Partner	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
EU27	21,798.56	86,718.54	33,013.11	41,600.20	57,878.86	61,784.97	74,436.85	81,346.78	18,935.54	,047,970.56	,196,116.08
Growth (%)		29.27	16.15	32.61	26.33	(17.22)	46.05	30.68	(7.08)	27.97	14.14
USA	5,623.07	3,181.67	0,534.14	07,201.77	14,339.42	72,675.86	02,114.62	7,953.61	15,335.57	47,425.42	58,320.27
Growth (%)		21.22	17.03	112.14	6.66	(36.44)	40.51	(4.07)	17.75	27.82	7.39

Source: WITS

f. Stretched Objectives: as per the GTP document (2011), \$5 billion and \$6.5 billion export earnings target were set for 201220/13 and 2014/2015 fiscal year, respectively. These targets were higher scenarios assumed with high commitment, excessive follow up and evaluation; however, as per the GTP progress report, only 62% of the 2012/13 plan is accomplished. Under normal scenario, such export performance has shown remarkable progress in an attempt to meet the stretched objectives; for instance, cut flower, meat and meat products and textile exports performed well.

g) Distance and Trade Costs: Ethiopia's geographical proximity to the EU and Middle East compared to some African countries has some location advantage for export. For instance, export of meat and meat products, live animals and vegetable products are increasing to Middle East. According to Anderson and Wincoop (2004), trade costs are strongly linked to trade policy of countries and a representative developed country's an ad-valorem tax equivalent trade cost is estimated to be 170% of producer price of exported goods of which 21% is transport cost, 44% is border related trade barrier, 55% is retail and distribution costs (1.7=1.21*1.44*1.55-1). Based on the inverse function of the gravity model[42], the World Bank estimated the bilateral trade between countries including Ethiopia. An estimate of bilateral trade cost is made using bilateral trade data and gross domestic production of each country. It is an average of both directions of trade (from country x to y and from y to x). Thus, the bilateral trade cost between Ethiopia and some selected partners indicates a substantially decline between 2001 and 2012 though they remain relatively high.

In general, as the trade costs have been declining since 2001, it had a favorable impact on the export performance of Ethiopia. Besides, export performance is a holistic phenomenon in the sense that though trade costs are low or distance is minimal or location is near, export may not be improved unless there is a good trade and political relation. This can be exemplified by the existing situation between Ethiopia and Eritrea where there is zero trade between them unless it is smuggling. However, in every respect, no country is as close as Eritrea to Ethiopia.

With no exception to Ethiopia, containerization has reduced trade and transport costs and non-containerized exports face more trade and logistics costs in all the supply chain including port service charges. In order to reduce the logistic costs, the government of Ethiopia has built domestic dry ports (in an attempt to stuff export cargos into containers though not that much effective) and airports in potential export zones with cold storage facilities. For instance, the export boom in cut flowers after 2000s created different infrastructure facilities such as airports in different regions that motivated vegetable exports. Moreover, since air transport is more expensive than shipping, the horticulture and flower exporters were negotiating with ESL, government owned, to export through water and some exports of horticulture products were exported to the Middle East. The other advantage exporters have while exporting to the Middle East, India and China, is the lower transport rate (15% below the market price) from ESL. Though shipment of exports is free to the buyer

[42] When a country sells more goods to its residents than to foreigners, it is because international trade costs have increased relative to domestic trade costs; similarly, if it sells more of its goods to foreigners than to residents, it is because international trade costs have fallen relative to domestic trade costs holding other factors constant (World Bank, 2013).

(importer), the availability of such alternatives (lower rates) triggers the market price down than up. Besides, the recent decline in oil prices reduced the transport costs and increased the competitiveness of export.

However, one may ask the question that why these all factors did not improve Ethiopia's export to the African countries as it did to Asia and Europe. The plausible answer is that increasing intra-Africa trade requires the export of diversified and differentiated/value added products than supplementary ones.

5. Concluding Remarks

With the current economic policy objective to attain a middle-income green economy, Ethiopia has provided more emphasis to diversification of exports central to its grand projects such as building industrial parks. Due to such promising objectives, exports are boosting in 2000s with some new exports joining the export market. Though the share of commodity export did not decline, there are new processed foods, vehicle spare parts and new commodities joining the export market which has helped to reduce the concentration of export on few agricultural commodities. In addition to product diversification, there are also few new destinations to where products of Ethiopia have been exported in the last decade especially to African markets.

However, only 20 commodities were contributing 88.3% of export earnings in 2005 while it is 84.8% in 2013. This implies, the rest of the export commodities were contributing less than 16% of the export earnings in the last decade. Thus, though the export performances are better, these performances are swinging on a few commodities and any price shock can pull down export earnings and devastate the national economy.

Meanwhile, after 2004, Ethiopia has exported 28 new products to 28 new destinations. Among these destinations, 19 of them are African countries indicating that Ethiopia is increasing its export in Africa. On the other hand, the numbers of NPOD are 316 and the values of these exports to these destinations increased from $2.2 million in 2005 to $927.7 million in 2013. The export of OPOD increased extremely and this export was greater in value compared to NPOD, NPND and OPND due to the reason that the products in the OPOD were already in that market. The major improvement in Ethiopia's export is observed in textile and textile articles and among 316 NPOD, 84 are from textile and textile articles. Thus, what change applied in Ethiopia that provoke such improvement in export is the question at hand. Based on the analysis made, the major factors that influence Ethiopia's progress in export are institutional and structural changes, trade facilitation and export priority, infrastructures improvements, foreign firm participation, promotion and preferential market access, stretched objectives and declining trade costs.

Therefore, the trade policy implication for Ethiopia is that the product diversification is moving slowly and still top 20 export commodities are taking more than 80% of the export share indicating the need to have aggressive product diversification which again requires the essentiality of right policy mix. In this regard, as the software is human capital that moves the policy mix, it is vital to have pool of quality experts in revising the trade policy and the export strategy as well as to negotiate favorable trade agreements. It is also wise to make no mistakes that no agricultural commodity priority objective alone can boost the terms of trade of a country without value addition. In line with this, agro-processing should be seen as an area of diversification since the current export of live animals, vegetables and horticulture related commodities are on the top of export basket. As well, availing cold storage facilities and refrigerated containers to export meat and meat products, milk products and horticulture products is essential.

While promoting export to foreign buyer, it is vital to promote and build the awareness and capacity of domestic producers or the private sector; this is because promoting for producers and building their capacities will create informed exporters. Finally, it will be the private sector that covers the cost of promoting export in the foreign markets. Moreover, it is vital to note that export promotion is costly; however, it will be more costly to promote while the domestic supply side constraints are still persisting. That is, trade facilitation should be the major area of concern in increasing trade volumes and competitiveness.

Finally, export of NPND is promising and many of African countries are the new destinations for Ethiopia’s export; thus, these new products could be better exported by improving the efficiency and the value adding steps of production. Besides, negotiating a favorable trade agreement and joining regional FTAs such as COMESA FTA, is unquestionable to diversify export products and destinations.

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Appendixes

Appendix 1: Export Performance of Major Export Commodities (Value in million USD)

Commodity	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Coffee	165.3	223.5	335.4	354.3	424.2	524.5	375.9	528.3	841.8	833.1	746.6	714.4
Oilseeds	46.1	82.7	102.3	211.4	187.4	218.8	356.1	358.5	326.6	472.3	443.5	651.9
Gold	42.1	48.7	52.5	64.7	97.0	78.8	97.8	281.4	461.7	602.4	578.8	456.2
Chat	58.0	88.0	100.0	9.1	92.8	108.3	138.7	209.5	238.3	240.3	271.3	297.3
Pulses	20.0	22.6	35.5	37.0	70.3	143.6	90.7	130.1	137.9	159.7	233.3	250.7
Flower	-	-	-	21.8	63.6	111.8	130.7	170.2	175.3	197.0	186.7	199.7
Live Animals	0.5	1.9	12.8	27.6	36.8	40.9	52.7	90.7	147.9	207.1	166.4	186.7
Leather & Leather Products	52.2	43.6	63.7	75.0	89.6	99.2	75.3	56.4	103.8	109.9	121.1	129.8
Meat & Meat Products	2.4	7.7	14.6	18.5	15.5	20.9	26.6	34.0	63.3	78.8	74.3	74.6
Fruits & Vegetables	9.6	12.7	16.1	13.2	16.2	12.8	12.1	31.5	31.5	44.9	43.9	45.9
Others	86.7	69.2	85.0	87.8	91.8	106.3	91.3	112.5	219.1	207.1	215.4	247.4

Source: NBE & CSA

Appendix 1a: Unit Value of Export Commodities (USD per kg)

Commodity	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Coffee	2.4	2.4	3.1	2.8	3.1	4.3	4.9	3.7	3.8
Oilseeds	0.8	0.8	1.4	1.24	1.20	1.3	1.28	1.56	2.08
Leather & Leather prod.	4.9	5.7	6.7	10.3	19.4	20.1	24.8	26.2	23.3
Pulses	0.3	0.4	0.6	0.7	0.6	0.61	0.71	0.65	0.71
Meat & Meat Prod	2.3	2.6	3.2	3.6	3.3	3.8	4.5	4.8	5.0
Fruits & Veg.	0.4	0.4	0.3	0.3	0.5	0.34	0.36	0.32	0.32
Live Animals	0.8	0.8	1.0	1.4	1.3	1.31	1.43	1.65	1.76
Chat	4.0	4.1	4.8	5.5	5.8	5.82	5.85	5.75	5.75
Gold ($/gm)	13.01	17.38	20.95	20.08	31.57	41.34	49.4	47.0	39.2
Flower	3.5	4.4	5.0	4.5	4.7	4.2	4.21	4.40	4.47

Source: NBE

Appendix 1b: Top 30 Export Products in Value Terms at HS2002 6-digit level

Product cod	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
090111	185,663	32,543	72,257	413,221	555,890	369,288	698,271	890,530	846,746	770,618
070990	1	-	1,515	55	83,438	168,463	245,049	247,789	238,035	558,771
060310	1,907	12,082	25,039	68,816	104,733	131,440	143,743	165,644	168,945	527,056
120740	61,914	173,065	160,151	133,029	209,929	334,484	303,307	432,818	350,039	494,808
010290	2,984	20,963	31,056	23,727	26,595	36,737	77,408	95,231	134,586	215,036
710813	71,212	44,405	64,420	34,917	79,898	92,540	182,336	174,828	124,618	157,355
071333	9,946	3,366	5,683	35,171	42,330	41,295	45,009	96,639	63,983	149,441
010619	-	-	122	3,385	12,857	17,194	44,660	40,583	35,337	66,632
411200	140	4,213	4,907	8,123	5,172	6,166	8,943	59,335	23,016	65,401
020450	4,849	12,809	12,277	8,514	20,196	17,744	32,133	59,396	56,701	63,640
060210	-	882	11,672	19,345	19,200	19,066	21,282	22,801	22,381	62,582
010410	187	451	635	5,948	3,710	6,051	5,249	24,030	12,869	47,266
071320	12,850	28,417	36,475	25,227	28,024	18,602	30,232	55,097	35,180	40,711
411310	-	158	113	1,149	684	952	2,612	21,918	1,530	32,287
120799	20,051	17,820	7,562	19,877	40,056	45,119	35,418	26,265	13,731	31,387
070190	1,376	-	-	13	7	416	2,951	12,690	9,794	30,916
071350	3,694	311	5,955	14,813	28,552	29,396	32,785	23,630	26,430	24,266
120100	2,914	4,428	2,789	668	956	231	181	2,670	491	23,463
071390	566	50	65	2,924	1,194	840	7,692	20,163	10,970	18,605
842890	-	-	-	7	457	-	-	490	-	15,821
880390	196	-	-	126	519	1,471	4	4,325	8	14,661
091010	3,527	8,198	5,438	6,313	6,237	6,599	20,581	16,205	23,647	13,554
130190	3,643	5,001	5,665	5,360	6,556	9,223	12,023	10,247	11,313	12,185
710310	-	5	2	41	26	223	1,446	9,569	7,602	11,293
070200	996	41	52	2,548	2,783	1,777	3,846	7,130	6,240	9,765
071290	-	-	-	0	3,044	5,681	5,711	5,721	6,825	8,608
520512	-	-	-	-	-	-	-	923	594	7,698
230649	-	-	-	109	412	486	1,043	1,588	2,083	7,609
520511	-	-	-	-	-	67	1,027	3,053	1,744	7,060
090411	82	2	127	158	120	121	238	5,670	2,764	6,636

Source: WITS

Appendix 1c: Top 30 growing products in Terms of Growth (%) of Values at HS2002 6-digit level

Product cod	2005	2006	2007	2008	2009	2010	2011	2012	2013	2013/x
070990			(96)	151,341	102	45	1	(4)	135	526,646
610990	2,249	710	(45)	(66)	474	83	15	98	306	3,388
710310		(52)	1,549	(36)	754	549	562	(21)	49	2,219
121190	2,724	5,281	872	0	(66)	65	253	(45)	206	1,738
640510	(100)			176	58	257	108	(40)	290	1,491
200899	(100)		(100)			629	42	(7)	174	604
630419	(100)		343	(71)	(43)	(7)	373	(62)	246	589
010619			2,684	280	34	160	(9)	(13)	89	548
411200	2,915	16	66	(36)	19	45	563	(61)	184	468
611780						63,692	1	13	(39)	447
640391				16,346	(98)	1,612	417	(99)	56,047	419
610510	1,608	182	(87)	1,345	(97)	72	618	74	438	316
060310	534	107	175	52	25	9	15	2	212	276
070110		(49)	33,744	(13)	15	35	(7)	(0)	20	257
010410	142	41	837	(38)	63	(13)	358	(46)	267	253
420329					(89)	34,406	418	(73)	379	243
411310		(28)	919	(40)	39	175	739	(93)	2,011	205
220870				(60)	3,485	83	584	(29)	35	171
870324			1,556	146	(19)	22	91	40	48	160
330590	(80)	13,494	13	42	112	49	33	15	(38)	133
440729	297	968	8	37	20	(61)	149	20	41	124
610910	(100)	84,975	(76)	326	(61)	355	1,027	(9)	62	119
010420	192	68	604	(89)	120	(20)	624	(20)	210	115
870323			7,100	15	(20)	33	(9)	23	15	112
520511						1,429	197	(43)	305	105
640299	543	(99)	8,534	3	(89)	1,357	1,088	(98)	4,934	85
090411	(98)	7,837	24	(24)	0	97	2,284	(51)	140	81
880390	(100)			312	183	(100)	114,933	(100)	190,851	75
010290	603	48	(24)	12	38	111	23	41	60	72
060210		1,224	66	(1)	(1)	12	7	(2)	180	71

*X is export year before 2013 where export value is not zero for the respective products.

Appendix 2: List of NPND (values in '000' USD)

Row Label	Sum of 2005	Sum of 2006	Sum of 2007	Sum of 2009	Sum of 2008	Sum of 2010	Sum of 2011	Sum of 2012	Sum of 2013
020230	-	-	-	-	-	966.45	3,774.43	217.94	-
020421	-	-	-	3.06	-	25.95	-	2,385.80	796.31
050400	-	-	-	-	-	-	412.31	1,161.60	683.26
060210	-	4.20	14.73	18.64	18.05	151.37	139.71	61.29	641.28
070490	-	-	-	-	-	2.10	6.10	1.70	2.61
071290	-	-	-	-	-	-	-	110.55	446.87
120100	-	-	-	-	-	-	121.66	2,316.46	7,139.23
121190	-	-	-	-	-	-	-	5.90	3.71
200899	-	-	-	-	-	-	-	0.06	119.73
230641	-	-	-	-	-	65.50	-	92.42	941.42
230649	-	-	-	-	-	-	-	341.99	684.19
271019	-	-	-	-	-	-	-	-	178,331.06
300230	94.01	14.17	251.38	274.99	954.25	603.63	680.67	417.37	380.09
411310	-	-	-	-	-	-	-	68.62	176.45
491191	-	-	0.41	-	-	8.22	-	0.31	5.86
570110	-	0.15	0.48	-	0.49	0.32	5.55	0.18	0.25
710310	-	-	-	45.63	-	238.01	233.99	115.52	261.88
821599	-	-	-	3.07	19.86	9.65	5.85	2.94	4.02
841821	-	-	-	7.52	0.29	0.49	0.25	-	0.50
850940	-	0.01	11.67	20.72	57.54	17.02	0.65	0.34	4.09
852739	-	-	-	1.10	4.08	3.19	0.82	5.15	0.18
852812	-	1.73	22.51	13.40	5.20	20.60	18.61	15.83	21.31
852830	-	-	-	-	-	-	-	5.55	0.89
870323	-	-	46.07	152.12	109.66	195.91	18.65	195.67	237.92
940161	-	-	1.33	-	-	0.42	1.32	1.99	7.59
940180	-	-	-	3.23	-	10.05	0.21	2.80	0.04
960200	9.36	19.71	7.80	23.75	29.67	33.56	220.38	240.20	116.93
960500	-	-	-	8.20	-	76.16	-	22.30	2.99
Grand Total	**103.37**	**39.97**	**356.37**	**575.42**	**1,199.09**	**2,428.58**	**5,641.15**	**7,790.48**	**191,010.67**

Source: WITS

Appendix 3: List of Selected NPOD (values in '000' USD)

Prod. Code	Sum of 2005	Sum of 2006	Sum of 2007	Sum of 2008	Sum of 2009	Sum of 2010	Sum of 2011	Sum of 2012	Sum of 2013
010619	-	121.59	3,384.57	12,856.77	17,193.82	44,660.41	35,337.34	48,568.34	69,247.68
020421	-	-	218.58	-	23.12	65.90	-	5,397.75	6,072.35
020629	-	-	-	-	-	-	-	26.35	111.34
020680	-	-	5.03	1.65	0.58	16.02	59.33	69.25	59.21
021099	-	-	-	-	-	19.44	28.57	37.93	4.27
030569	-	0.38	225.71	338.67	259.76	429.55	170.32	264.88	21.75
040291	-	-	16.05	79.51	107.50	223.38	170.12	195.53	378.53
050400	36.02	0.35	-	-	-	-	18.28	45.28	16.01
051199	-	91.92	203.63	59.03	167.82	332.05	122.42	209.42	280.38
060210	770.02	10,838.26	18,169.46	18,666.33	18,868.10	20,569.99	21,019.62	21,496.70	60,764.28
060220	-	-	-	-	-	1.31	5.50	76.32	160.66
070110	12.35	6.31	2,133.89	1,853.21	2,123.72	2,862.62	2,653.16	2,662.18	3,170.37
070190	-	-	10.42	-	405.92	2,948.53	9,711.44	12,686.43	30,914.89
070310	-	-	-	-	-	-	142.56	221.82	433.77
070490	-	-	-	7.16	-	7.06	49.45	32.51	41.20
070930	-	-	-	-	-	-	11.18	9.28	15.03
070940	-	-	5.72	5.69	9.17	12.72	13.81	13.47	14.50
070990	-	1,515.47	55.10	75,697.57	158,733.86	233,275.00	227,026.02	238,228.97	549,228.02
071090	-	-	-	-	7.54	56.84	10.02	-	0.01
071190	-	-	0.50	0.07	0.03	0.57	83.16	100.98	141.93
071310	-	-	530.63	76.16	-	0.00	-	-	93.52
080300	-	-	-	-	-	49.87	116.31	180.62	2,254.06
080420	-	-	1.70	0.88	0.84	2.72	1.47	1.59	2.48
080450	-	-	-	-	-	4.84	17.27	5.15	6.08
090121	-	-	21.75	13.21	14.34	35.46	50.76	66.91	37.05
090122	-	-	0.38	-	2.60	26.80	36.58	124.70	37.79
090210	-	0.07	-	1.01	5.19	0.10	0.68	1.23	1.06
090230	-	-	15.65	-	-	16.28	-	23.08	21.91
091020	-	-	-	-	-	-	-	11.42	8.66
110100	-	-	-	-	-	-	1.23	21.21	4.90
110620	-	-	-	0.46	0.81	2.18	20.94	47.57	89.91
110710	-	-	0.77	1.70	3.20	1.78	2.28	1.15	6.88
120100	-	-	-	421.18	-	110.39	306.62	353.50	6,951.87
120510	0.22	-	-	1.35	5.23	91.13	66.02	98.56	321.32
120810	-	-	-	-	-	-	-	795.55	85.95
120999	-	-	163.80	48.85	-	36.16	44.68	30.18	120.54
121299	-	-	0.04	-	-	-	1.19	20.35	25.84
130120	-	-	127.44	337.88	616.19	1,035.65	524.18	256.38	681.09
140110	-	-	-	-	-	-	-	1,076.98	1,221.98
160239	-	-	-	-	-	-	-	9.35	10.83
160250	-	-	-	-	-	1.27	1.61	16.51	30.74
190230	-	7.94	-	-	11.95	216.02	269.59	-	183.27
200899	-	33.10	-	-	228.35	1,029.89	1,388.39	2,139.29	5,181.02
200931	-	-	-	-	-	56.78	449.60	663.51	445.24
220210	-	-	-	-	-	-	-	47.27	180.48
220290	-	-	-	-	-	-	-	140.65	12.83
220421	22.94	30.13	-	20.75	21.16	35.13	72.30	16.89	23.56
220850	-	-	-	-	-	-	42.64	141.29	366.92
220870	-	-	1.10	4.74	9.24	4.36	40.03	2,528.47	558.98
230641	-	-	-	215.61	107.89	2,389.94	825.06	416.86	1,903.48
230649	-	-	109.38	356.93	486.31	1,032.81	2,083.16	1,134.75	6,924.45
230800	-	-	2.55	-	70.45	11.72	41.47	12.06	12.08
251511	-	-	-	-	-	26.13	10.29	121.53	61.61
252329	-	-	-	-	-	-	-	25.87	1,742.80
300230	15.19	-	220.18	895.30	143.69	644.82	201.06	86.67	175.00
320300	-	-	-	-	-	32.46	89.60	-	21.53
330499	-	-	-	0.01	1.63	0.58	5.88	13.23	22.81
330510	-	-	0.61	3.23	5.12	6.46	0.09	1.56	0.48
330590	-	-	0.14	-	2.58	3.19	9.56	2.54	10.19
340120	-	-	-	-	-	12.91	59.42	62.21	26.48
340490	-	81.24	-	-	-	98.45	83.93	-	128.44
360500	-	-	-	-	-	-	-	117.63	22.88
392610	-	-	-	-	-	0.18	0.03	30.96	0.10
392690	-	4.30	0.35	36.16	4.89	1.46	83.13	10.47	6.29

Source: WITS

Appendix 4: List of OPND (values in '000' USD)

Row Labels	Sum of 200	Sum of 200	Sum of 2007	Sum of 2008	Sum of 2009	Sum of 2010	Sum of 2011	Sum of 2012	Sum of 2013
010290	-	-	-	-	-	1,210.37	640.89	2,097.85	3,060.18
010410	-	13.23	-	-	217.49	246.71	800.75	1,208.41	8,273.43
010619	-	-	248.85	-	-	-	-	11,161.75	3,680.36
020450	-	-	-	-	53.64	237.29	-	21.61	113.01
040510	-	-	-	-	-	31.78	41.83	108.05	34.58
040900	-	-	-	-	-	35.32	83.05	-	2.16
060310	6.17	33.83	264.54	309.08	295.99	265.47	322.65	488.12	5,700.42
070200	-	-	30.02	0.29	-	34.28	62.09	18.24	6.14
070511	-	-	-	-	-	6.53	18.77	4.49	3.27
071290	-	-	-	0.33	9.67	12.63	76.48	66.23	40.93
071320	-	-	-	-	-	-	-	108.68	34.48
071333	104.06	-	529.64	822.87	338.65	329.02	478.05	4,639.01	5,560.24
071339		-	-	-	-	-	-	70.29	52.56
071350	-	-	-	-	-	-	-	40.35	105.50
071390	-	-	-	-	-	-	-	279.71	275.00
090111	-	-	138.38	-	140.15	2,534.23	2,004.26	948.84	2,066.45
091030	-	-	-	-	73.48	266.98	247.69	44.14	46.58
120210	-	-	-	-	-	-	-	26,028.29	3,200.03
120740	184.67	-	177.97	1,247.96	3,134.51	1,055.01	987.60	2,594.23	6,311.19
130190	-	-	-	-	922.04	747.75	1,994.01	734.75	1,283.30
190590	-	-	17.27	136.99	328.45	358.48	321.02	416.41	553.23
330741	-	-	-	0.28	-	0.60	0.78	1.50	4.62
410719	-	-	-	-	-	12.65	-	0.12	1.99
410799	-	-	-	-	8.48	-	-	86.29	6.93
411200	19.18	87.69	350.26	360.30	144.99	530.04	1,018.78	7,724.06	8,704.28
411390	-	-	-	-	-	30.42	109.75	56.80	48.30
490110	-	-	5.11	2.70	0.46	-	-	0.42	0.07
490199	-	-	7.64	31.76	41.39	44.78	28.02	39.39	65.81
520300	-	63.85	457.24	140.06	-	-	-	451.16	1,660.52
621490	-	-	-	0.60	-	-	1.04	4.02	1.17
630900	-	-	166.07	175.73	17.84	41.53	67.72	130.69	274.64
640510	-	-	-	-	-	-	-	48.48	16.09
691110	-	-	-	-	-	1.18	4.08	0.42	1.03
732399	-	-	0.04	2.36	1.00	4.35	12.43	2.89	13.49
750890	-	-	-	-	-	-	1.27	8.74	11.33
870899	-	-	-	-	-	-	0.71	7.13	1.50
940340	-	-	-	43.26	-	-	-	0.06	12.24
940350	-	-	-	1.11	-	-	3.19	6.96	0.30
940360	7.93	14.93	77.99	56.21	47.02	71.61	45.15	87.73	102.48
940380	-	-	-	18.54	79.31	87.16	69.33	30.64	105.87
Grand Tota	**322.00**	**213.52**	**2,471.00**	**3,569.89**	**6,398.88**	**8,445.79**	**9,560.43**	**59,811.10**	**51,581.06**

Source: WITS

Appendix 5: Trend of AGOA Eligible Export Products (value in '000' USD)

Code	Description	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Eligibility
090190	Other	1,618.9	22,191.9	33,281.4	65.7	154.5	0.2	0.0		1.2	1.1	AGOA
852812	Colour				6.7	2.7	1.9	5.8	5.1	11.9	5.7	AGOA
691110	Tableware and kitchenware	1.5			6.3	3.8	3.8	9.1	8.4	10.0	6.5	AGOA
460210	Of vegetable materials	0.3	0.1	0.1	3.3	2.9	10.4	3.8	10.6	10.9	10.0	AGOA
220110	Mineral waters and aerated waters	38.5	6.5	50.0	30.2	68.1	12.7	53.7	10.9	35.3	10.5	AGOA
960500	Travel sets for personal toilet, se					9.0	29.9	46.7	42.2	25.8	12.1	AGOA
620719	Of other textile materials	299.5		55.9	98.0	220.7	77.5	64.0	190.4	16.5	13.5	AGOA
220421	In containers holding 2 l or less		17.2	30.1		15.6	17.0	35.1	37.4	16.9	16.9	AGOA
852540	Still image video cameras and other				19.2	12.8	6.0	22.7	38.5	6.2	20.0	AGOA
691200	Ceramic tableware, kitchenware, other	0.8			1.7	1.7	2.6	2.9	12.0	25.9	27.2	AGOA
870323	Of a cylinder capacity exceeding 1,				18.8	10.7	21.7	69.4	47.3	25.4	30.4	AGOA
420221	With outer surface of leather, of c	4.0		0.0	1.2	16.4	51.7	81.8	70.2	35.4	74.3	AGOA
120890	Other	478.8	112.7		122.7	838.9	838.4	160.8	1.6		93.4	AGOA
071290	Other vegetables; mixtures of veget.					352.0	263.6	4.5	0.8	0.6	113.6	AGOA
640359	-- Other					0.2	40.0	0.2	82.3	112.2	126.0	AGOA
120210	In shell									128.5	134.0	AGOA
640510	- With uppers of leather or compos				1.0			99.0		88.9	1,271.6	AGOA
060310	Fresh			76.3	48.2	5.6	8.3	4.5	17.1	182.6	1,746.1	AGOA
640299	Other		1.5		0.4	0.4	0.0	49.1	3.9	1,600.6	1,935.4	AGOA
420329	Other									1,376.6	2,133.7	AGOA

640590	- Other			20.6	42.3	48.1	90.1	238.7	353.8	1,333.0	4,040.1	AGOA
640399	-- Other	0.3					36.1		153.4	4,143.1	4,903.8	AGOA
640391	-- Covering the ankle									999.7	5,445.7	AGOA
120600	Sunflower seeds, whether or not bro	2.8			0.5	0.1	1.8	2.7	3.3	5.3	3.2	non-AGOA
611490	Of other textile materials		0.6	1.2	3.2	5.1	173.9	103.2	5.5	4.3	3.5	non-AGOA
090930	Seeds of cumin	0.3		0.3	0.8	1.6	4.4	1.3	5.3	5.1	3.6	non-AGOA
050690	Other	136.5	41.2	28.6	49.3	31.1	87.4	4.1	1.2	135.0	3.7	non-AGOA
610510	Of cotton		114.0	321.2	11.0	618.4	18.2	31.3	106.5	12.0	4.0	non-AGOA
620590	Of other textile materials	142.0		44.1	25.4	45.7	48.0	78.1	211.0	121.8	4.9	non-AGOA
090240	Other black tea (fermented) and other	31.3			3.3	4.1	1.3	2.0	2.1	7.1	5.1	non-AGOA
071320	Chickpeas (garbanzos)	272.4	352.9	566.9	233.7	155.3	3.3	56.3	1.9	3.1	5.2	non-AGOA
701810	Glass beads, imitation pearls, imit.	0.3		1.8	0.3	3.1	0.5	0.5	5.5	4.8	6.8	non-AGOA
970190	Other	20.3	19.9	26.7	32.2	32.0	24.0	37.8	8.8	1.6	6.9	non-AGOA
121010	Hop cones, neither ground nor powder	25.0			7.4	6.0	3.9	5.5	2.9	8.9	9.4	non-AGOA
630251	Of cotton						2.9	6.9	19.8	27.6	9.8	non-AGOA
940180	Other seats				12.3	16.8	7.9	3.6	4.2	5.0	12.7	non-AGOA
490199	Other	28.4			8.7	56.3	27.0	25.6	9.2	26.8	18.7	non-AGOA
621410	Of silk or silk waste				31.5	20.8	31.8	40.2	13.0	13.9	20.8	non-AGOA
940340	Wooden furniture of a kind used in	0.2			64.3	92.8	13.5	24.1	28.4	1.0	26.3	non-AGOA
732399	Other				0.8	19.2	29.4	26.5	15.7	4.2	29.9	non-AGOA
630590	Of other textile materials			3.9				7.5	15.9	76.3	33.7	non-AGOA
110290	Other	117.1	270.7	71.2	44.2	7.6	28.5	28.9	22.9	29.4	33.7	non-AGOA

091099	Other	39.4	95.5	38.7	8.8	14.7	23.0	21.4	20.8	37.9	36.2	non-AGOA
940380	Furniture of other materials, inclu.	0.8				91.3	33.6	41.7	15.0	46.4	41.7	non-AGOA
750890	Other			8.7	4.7	15.1	11.2	18.4	50.8	30.8	43.6	non-AGOA
852520	Transmission apparatus incorporating				1.4	0.3	3.1	18.6	1.5	4.1	52.3	non-AGOA
330590	Other				8.6	1.6	0.9	9.9	42.2	0.6	55.1	non-AGOA
110620	Of sago or of roots or tubers of he						0.3	2.1	13.6	14.6	59.8	non-AGOA
610590	Of other textile materials			28.5	16.3		66.1	147.8	101.8	80.1	64.5	non-AGOA
090830	Cardamoms	8.6	0.2		21.4	15.8	8.5	37.6	48.8	52.7	64.9	non-AGOA
940360	Other wooden furniture	0.2	34.6	1.9	99.4	15.0	23.3	30.0	26.0	34.9	67.0	non-AGOA
851780	Other apparatus						784.1	19.2	0.2	0.9	68.0	non-AGOA
847130	Portable digital automatic data pro				167.5	7.5	85.9	3.4	50.0	11.8	69.4	non-AGOA
630260	Toilet linen and kitchen linen, of						0.0	8.1	35.8	36.0	74.0	non-AGOA
620349	Of other textile materials		0.0	80.2	137.5	127.7	36.7	33.2	372.9	229.6	86.8	non-AGOA
110610	Of the dried leguminous vegetables				7.5	19.0	11.2	58.8	48.6	60.4	99.7	non-AGOA
610910	Of cotton	54.7		121.8	49.3	222.3	44.0	231.8	260.2	4.8	101.2	non-AGOA
630900	Worn clothing and other worn articl.	20.2			135.9	150.2	90.8	18.6	115.6	131.2	104.7	non-AGOA
620442	Of cotton			2.5	10.5	39.1	10.5	2.4	37.3	94.8	135.8	non-AGOA
190410	Prepared foods obtained by the swel.	0.2		0.5				16.7	83.0	131.4	177.5	non-AGOA
610990	Of other textile materials	1.5	35.1	283.4	47.6	50.3	276.4	433.8	383.0	89.8	182.4	non-AGOA
610349	Of other textile materials			0.0		24.5	14.5	26.7	112.0	187.1	201.6	non-AGOA
130190	Other	44.0	32.5		309.5	90.5	70.3	342.6	7.7	71.9	204.8	non-AGOA
051199	Other			91.9	193.7	46.4	167.8	305.7	122.4	183.5	221.7	non-AGOA

610711	Of cotton	97.8				42.5	11.9		1.2	21.2	230.8	non-AGOA
220300	Beer made from malt.	98.8	93.8	240.8	169.3	344.3	224.2	307.6	171.8	380.9	251.0	non-AGOA
521214	Of yarns of different colours		3.4	2.2			24.3	164.7	215.0	116.8	257.0	non-AGOA
711790	Other				0.1	0.7	2.1	0.1	0.3	68.6	339.4	non-AGOA
620520	Of cotton		50.9	0.0	75.8	61.9	4.0	38.6	108.7	235.4	358.5	non-AGOA
090412	Crushed or ground	75.7	0.1	64.5	149.8	128.5	190.2	261.8	182.1	286.8	412.1	non-AGOA
071333	Kidney beans, including white pea b	194.9	28.1	226.5	829.5	932.5	276.4	664.0	2,069.1	900.3	415.6	non-AGOA
611090	Of other textile materials	3.0			67.1	401.2	193.2	384.2	445.7	385.9	529.0	non-AGOA
621490	Of other textile materials	7.1	0.5	5.9	5.1	85.2	91.3	158.0	265.7	418.2	621.0	non-AGOA
152190	Other	233.3	440.7	325.4	529.2	479.9	177.6	184.2	353.2	322.5	637.6	non-AGOA
610719	Of other textile materials	9.9	0.0	0.0		293.0	75.1	131.1	36.9	363.7	667.9	non-AGOA
710310	Unworked or simply sawn or roughly				9.8	8.6	65.9	381.7	1,060.8	879.7	772.1	non-AGOA
120740	Sesamum seeds	2,015.1	2,310.5	2,112.3	3,057.3	5,152.5	414.8	337.5	470.2	717.8	896.6	non-AGOA
880330	Other parts of aeroplanes or helicopters					14.1	385.9	794.3	857.0	844.7	1,225.7	non-AGOA
190590	Other		1.3	1.0		101.6	151.7	285.8	647.0	1,294.2	1,906.3	non-AGOA
640320	Footwear with outer soles of leather									0.8	2,255.2	non-AGOA
880390	Other					113.9	27.2			3,007.0	6,323.8	non-AGOA
060210	Unrooted cuttings and slips		115.5	1,284.0	2,765.7	3,423.3	2,196.7	1,262.2	1,080.1	1,647.5	7,662.4	non-AGOA
120799	Other	12,570.9	9,634.1	5,640.4	12,523.3	21,851.8	31,720.3	19,239.8	7,977.1	17,632.7	21,068.8	non-AGOA
090111	Not decaffeinated	11,714.9	2,724.9	2,730.5	40,641.6	72,378.1	29,840.7	71,746.0	76,289.6	66,478.3	73,611.3	non-AGOA

Source: WITS

Appendix 6: Export Trend of AGOA Eligible Products to China (Value in '000' USD)

Code	Description	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
060310	Fresh			0.78					0.08	3.82	
071290	Other vegetables; mixtures of veget.					35.05	850.90	2,801.12	2,822.25	924.84	30.61
090190	Other	643.43	5,323.06	4,593.82							
120210	In shell								1,365.39	801.09	85.16
220110	Mineral waters and aerated waters								24.16	13.10	
220421	In containers holding 2 l or less						17.39			16.87	
420329	Other					5.65		126.52		106.04	
640299	Other								0.35	0.27	0.06
640391	-- Covering the ankle										0.47
640399	-- Other										6.52
640510	- With uppers of leather or compos									0.01	70.83
640590	- Other								0.22	0.02	
691110	Tableware and kitchenware								2.68	1.75	
821599	Other						2.95		0.51		
852540	Still image video cameras and other				0.20	6.43	3.91	61.53	21.43	6.78	14.18
852812	Color					1.24		0.49	0.35	4.14	2.82
852910	Aerials and aerial reflectors of al						1.26	0.04			0.80
870323	Of a cylinder capacity exceeding 1,				6.42						27.54
960500	Travel sets for personal toilet, se						18.74				

Source: WITS

Impact of Capital Flow on Economic Growth: Empirical Evidence from Ethiopia (1980 - 2010) using ARDL Approach

Bewket Aschale Gashu[1*]

Abstract

Evidence abound that some transitioning and developing countries are attracting large inflows of foreign capital that could engender economic growth or have destabilizing effects on their economies if not well managed. This has undoubtedly aroused anxiety over its potential effects on economic growth, the competitiveness of the export and external sectors viability. The study examines the impact of capital flow on economic growth in Ethiopia as well as the causal short-run and long-run relationship among the variables, using time series data from 1980 – 2010. Using the Autoregressive Distributed Lag (ARDL) approach, the result reveals that all the variables are statistically significant; which implies that the capital flow has an impact on economic growth in both short- and long-run dynamic equilibrium models. Additionally, Vector Autoregressive (VAR) and Innovative Accounting Techniques approach to Granger causality analysis shows that there exists bidirectional causality between gross capital flow and economic growth. Consequently, these findings suggest that policy makers should critically understand, the nature, what drives the capital flows and the impact of its sudden surge or reversal on economy. Moreover, it is also recommended that government should continue to pursue trade, and foreign exchange policies that would ensure competitiveness of the export sector viability and economic growth.

Keywords: Economic growth; Capital flow; ARDL approach; Granger causality; Ethiopia.
Classification Code/JEL Code: C22, C32, D24, F32, F43, O11

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1. Introduction

The issue of foreign capital flow to Africa as a whole including Ethiopia has become an important topic today among academic scholars. Capital flow is a controversial issue regarding to its impact on the economic development of one country. Several literatures might support or discourage the flow mode by considering the background of the consumer/recipient country because it has both negative and positive consequences on development. For example, Montiel (2013) argues that while developing economies tend to be capital-scarce, access to foreign capital should therefore normally be expected to be beneficial to them, in fact large capital inflows as well as sudden outflows have presented significant policy challenges.

As many studies confirm that the topic impact factor of huge capital flow is the "financial crisis or debit crisis" either on a single country and continent or on the world as a whole. Evidently, Musibau et al., (2017) confirm that global economies are severely affected from the debt crisis in 1980s till present especially in Africa, Latin America and few countries in Eastern Europe and Asia. Consequently, the crises have been affecting foreigners and domestic agents asymmetrically (Broner et al., 2011).

Capital flows are transactions involving financial assets between international entities either inflow or outflow mode. Capital outflow generally results from economic uncertainty in a country, whereas large amounts of capital inflow indicate a growing.[2] The various form of inflow of foreign capital (loans, FDI, grant and portfolio) was welcome in developing countries to bridge the gap between domestic saving and domestic investment and therefore, to accelerate growth (Wondwesen, 2011). Unfortunately, an African economy is seriously affected by currency fluctuations, decay infrastructural development, high level of corruption, and political instability. Consequently, these are situations discourage foreign investors (Musibau et al., 2017). Musibau and his colleagues further argue that the bottleneck of Ethiopian economy is the deficiency of finance (resource gaps) that it emanates from imbalances between-exports and imports, debt payments and resource inflows, and domestic savings and domestic investments (ibid).

Consequently, the lack of adequate finance has reduced the ability of governments to embark on public expenditure in infrastructure and social services

[2] https://corporatefinanceinstitute.com : Capital Flows - Overview, Types, Objectives of Restrictions

required to boost domestic demand, encourage private sector activity and sustain high level of growth for economic transformation (Onyeiwu, 2015). Hence, Tasew (2011) suggests that poor countries like Ethiopia receive aid from foreign advanced countries to finance investment by directly fill this saving-investment gap and, aid can also indirectly fill the foreign exchange gap in the form of hard currency. Thus, this makes the importance of foreign capital inflow unquestionable to the high performance of the economy (Wondwesen, 2011).

Empirical findings about the impact of capital flow on economic growth are rare: it is almost negligible, especially in Ethiopia. Many studies at the country level focus on the effect/impact of foreign capital inflow, foreign aid and foreign direct investment on economic growth, and the causality of saving, investment and economic growth. However, the study investigates how capital flow which includes both foreign capital inflow and domestic capital outflow affect economic growth in Ethiopia. Furthermore, it encompasses, implicitly the effect of capital flow/foreign capital inflow and domestic capital outflow/ on gross domestic saving and gross domestic investment; and hence on economic growth.

Thus, the study is believed to fill the gaps on studies which are limited only on one side flow of capital, foreign capital inflow effect on the economic growth of Ethiopia, by considering the two sides of capital flows, inflow and outflow effects. The main objective of the study is, therefore, to explore the macroeconomic impact of capital flow on economic growth in Ethiopia using data from 1980 to 2010. Moreover, the study tries to analyze the magnitude and direction of an impact of capital flow on (domestic) saving and economic growth in both short run and long run, and also to examine the causal relationship between capital flow and economic growth in Ethiopia.

2. Literature Review

2.1 Capital Flow and Economic Growth: Controversy Issue

International capital flows not only offer a great deal of benefits to financially integrated countries they also pose numerous macroeconomic challenges (Alley, 2017). Alley further found that the impact of capital flows on the economy depends on the level of financial market development-capital inflows have positive (negative) effect on growth when the country is financially developed (underdeveloped) (ibid).

Most scholars support the positive impact of foreign capital on economic growth. For example, Musibau et al. (2017) found a strong, robust relationship between FDI (both inflows and outflows) and growth. Chen and Quang (2014) confirmed that the growth effect of international capital flows is contingent on the levels of economic, institutional and financial development and government spending (ibid). Moreover, moving capital flows from developed to developing countries would create employment opportunities and promote economic growth (Admasu, 2017). In contrary however, Musibau (2017) argue that FDI has negative impact on Domestic Investment in the short-run but positive effect in the long-run in the Sub-Sahara African economies and a net crowding out effect.

Generally, for making negotiation these two views of controversial issues; capital flows in the global market should be focused in the analyses of the effects of investment and savings on economic growth (Hideaki, 2015). Hence, Hideaki further pointed out the fact that capital inflows in developing and emerging economies has not always contributed to increase GDP growth, and that those countries which are not dependent on external capital are likely to have higher growth (ibid).

2.2 Capital Flow, Saving, Investment and Economic Growth: Nexus

Hideaki (2015) explained that domestic savings have not been effectively utilized for domestic investment in the real economy, but mobilized for other non-productive sectors of economies (e.g. financial sectors and real states) in both domestic and foreign markets. He also noted that capital inflows had positive effect on the domestic growth.

According to findings of Admasu (2017) examined on the nexus of foreign capital inflows and economic growth in Ethiopia over the period 1981–2014 by using ARDL approach:

"The long run and short run effect of explanatory variables on the dependent variable. Thus, the result reveals that the flow of foreign aid has a negative effect on economic growth both in long run and short run. This is mainly because the existence of poor institutional arrangement and the funds are not always connected to the productive sectors. Similarly, the long run relationship between the flow of foreign direct investment and the economic growth is negative. The possible explanation for this negative effect is due to inadequate basic infrastructures and poor institutional quality in the country. However, the long run and short run effect of other foreign capital inflows and the short run effect of foreign direct investment are found to be insignificant in affecting real GDP per capita".

3. Methodology

3.1 Sources and Types of Data

The study used annual time series (secondary)data ranging from 1980 to 2010 obtained from different publications of National Bank of Ethiopia (NBE), Ministry of Finance and Economic Development (MoFED), Statistical data base of Ethiopian Economic Association (EEA), African Development Indicator (ADI), IMF, and WB _CD-ROMs.

3.2 Description of Research Variables

This study treated two types of variables, dependent and explanatory variables. That is, one dependent variable, Real Gross Domestic Product (RGDP), and five different explanatory variables, Gross Domestic Saving (GDS), Gross Domestic Investment (GDI), Gross Capita Flow (GCF), Human Capital (HC) and Openness of Trade (OT).

4. Model Specification

4.1 Mathematical Model

In line with the theoretical propositions reviewed in the literature, the impacts of capital flows on saving and investment implicitly, and on economic growth explicitly is examined by specifying equation.

4.1.1 Growth Function

"The relationship between productivity growth and private capital flows appears to have strengthened over time. The productivity benefits of capital flows—through the transfer of technology and management techniques and the stimulation of financial sector development are significant in countries where a developed physical infrastructure, a strong business environment, and open trade regimes have facilitated the absorption of those flows, but not otherwise".[3]

Additionally, saving and investment have been considered as two macro-economic variables for achieving price stability and promoting employment opportunities thereby contributing to sustainable economic growth (Shimelis, 2014).

[3] International Capital Flows and Economic Growth.

Particularly, savings and economic growth have positive effect on each other in the long-run (Najarzadeh et al., 2014). For example, Carroll and Weil (1994) have established two interesting new empirical facts: (1) at the aggregate level, periods of high-income growth appear to be followed by periods of high saving; and (2) among young households, those households who should expect faster income growth appear to save more than households who should expect slower income growth. Moreover, economic growth should be strengthened in order to achieve high level of domestic investment both in the short and long runs (Alfa and Garba, 2012).

Hence, RGDP is an increasing function of capital flows, gross domestic savings and gross domestic investment, which can be given as below:

$$\ln RGDP = f(\ln GCF, \ln GDS, \ln GDI) \quad \textbf{(1)}$$

Furthermore, Equation (1) augmented by including two explanatory factors, human capital and openness of (international) trade over the function of RGDP. Human capital is important source of long -term growth because of its positive policy that enhances public and private investment in human capital, therefore, promote long-run economic growth (Lucas, 1988). Additionally, Barro (1991, as cited in Shimelis, 2014) confirms that human capital plays a special role in a number of models of endogenous economic growth. Moreover, exchange rate and trade-openness per capita exhibited positive and significant impacts on GDP per capita (Yeboah et.al, 2012). In contrast, Ulaşan (2012) does not support the proposition that openness has a direct robust relationship with economic growth in the long-run. Hence, economic reforms in these areas should take priority over the policies enhancing trade openness (ibid).

Accordingly, Equation (1) becomes as follows:

$$\ln RGDP = f(\ln GCF, \ln GDS, \ln GDI, \ln HC, \ln OT)$$

(2)

Where, RGDP _real gross domestic product, GCF _capital flow, GDI _Gross domestic investment, GDS _Gross domestic saving, HC _Human capital; and OT _Openness of trading.

4.1.2 Econometric Model

The developed econometric model of Equation (2) is given as follows:

$$\ln RGDP = \beta_0 + \beta_1 \ln GCF + \beta_2 \ln GDS + \beta_3 \ln GDI + \beta_4 \ln HC + \beta_5 \ln OT + \varepsilon_{it} .. \quad \textbf{(3)}$$

Where, β_0 is the intercept of dependent variable, RGDP; $\beta_i, (i = 1,2,3,4,5)$ is the ith parameter associated with explanatory variables, GCF, FDI, GDS, HC, and OT, respectively; and ε_{it} is the white noise error term.

5. Method of Data Analysis and Estimation Techniques

5.1 Unit Root Test

The first steps in building dynamic econometric models involve a detailed investigation of the characteristics of the individual time series variables. When discussing stationary and non-stationary time series, the need to test for the presence of unit roots in order to avoid the problem of spurious regression should be stressed. Unit root test should be conducted in order to determine whether individual variables are stationary or not.

5.2 Co-integration Test: ARDL Bounds Testing Approach

There are various techniques for conducting the Co-integration analysis among time-series variables. The study adopts the so-called autoregressive distributed lag (ARDL) bound which appears to be applied in recent empirical investigations since this method has certain econometric advantages relative to other co-integration procedures. For example, it is applicable irrespective of the degree of integration of the variables (i.e. purely I(0), I(1) or mixture of both) i.e. it avoids the pre-testing of the order of integration of the variables; the short-run and long-run parameters of the model are estimated simultaneously i.e. the error correction term be considered in its lagged period; and the ARDL approach is more robust/strong/ and performs better for small sample sizes.

The ARDL approach requires estimating the conditional error correction version for variables under estimation. Arising from the above, the augmented ARDL version of the model specified earlier is expressed as:

$$\Delta RGDP_t = \alpha_0 + \sum_{i=0}^{p} \beta_i \Delta \ln RGDP_{t-i} + \sum_{i=0}^{q_1} \gamma_i \Delta \ln GCF + \sum_{i=0}^{q_2} \theta_i \Delta \ln GDS + \sum_{i=0}^{q_3} \pi_i \Delta \ln GDI + \sum_{i=0}^{q_4} \phi_i \Delta \ln HC +$$
$$\sum_{i=0}^{q_5} \varphi \Delta \ln OT + \delta_1 \ln GDP_{t-1} + \delta_2 \ln GCF_{t-1} + \delta_3 \ln GDS_{t-1} + \delta_4 \ln GDI_{t-1} + \delta_5 \ln HC_{t-1} + \delta_6 \ln OT_{t-1} + \varepsilon_{it}$$

(4)

where, δ_i, ($i = 1,2,3,4,5$) - the parameters that the corresponding long-run multipliers, and $\beta_i, \gamma_i, \theta_i, \pi_i, \phi_i, \varphi_i$ are the short-run dynamic coefficients of the underlying ARDL model.

From Equation (4), firstly test the null hypothesis of no Co-integration, $H_0 : \delta_i = 0$, $i = 1,2,3,4,5$ against the alternative using F-test with upper and lower critical values that are calculated automatically and reported after the ARDL regression estimates. Then finally, the order of the lag distribution function had been selected using one of the standard information criteria such as Akaike Information Criterion (AIC) and Schwartz-Bayesian Criterion (SBC). Pesaran and Shin (1995, as cited in Shimelis, 2014) recommend the Schwartz-Bayesian Criteria (SBC) which is preferable to other model specification criteria because it often has more parsimonious/economical/specifications. Therefore, a more parsimonious model is selected using the SBC criteria with the maximum lag order of two.

5.3 The Error Correction Models (ECM)

Estimating a dynamic equation in the levels of the variables is problematic and differencing the variables is not a solution; and consequently, any information about the long run is removed. The more suitable approach the easier to convert the dynamic model into an error correction model (ECM). It is shown that this contains information on both the short-run and long-run properties of the model, with disequilibrium as a process of adjustment to the long-run model (Harris and Sollis, 2003, as cited in Haile, 2015). The error correction (EC) representation of the ARDL model can be expressed as:

$$\Delta \ln RGDP_t = \alpha_0 + \sum_{i=0}^{p} \beta_i \Delta \ln RGDP_{t-i} + \sum_{i=0}^{q_1} \gamma_i \Delta \ln GDS + \sum_{i=0}^{q_2} \theta_i \Delta \ln GDI + \sum_{i=0}^{q_3} \pi_i \Delta \ln HC$$
$$+ \sum_{i=0}^{q_4} \phi_i \Delta \ln OIT + \psi ECM_{t-1}`$$

(5)

where: ψ is the speed of adjustment and ECM_{t-1} is error correction term lagged by one period.

The existence of an error-correction term among a number of co-integrated variables implies that changes in the dependent variables are a function of both the level of disequilibrium in the co-integration relation (expressed by the ECM) and the changes in other explanatory variables.

5.4 Granger Causality Test

There are three approaches to implement the Granger causality test depending on time-series properties of variables—namely a VAR model in the level data (VARL), a VAR model in the first-differenced data (VARD), and a vector error correction model (VECM). The VECM approach which involves pre-testing through unit root and co-integration tests suffers from size distortions and can often lead to mistaken conclusions about causality. Hence, the study adopted the VAR approach. The lag augmented VAR representation of Equation (2) is given as below:

$$\begin{aligned}\ln RGDP_t = {} & \beta_{10} + \sum_{i=1}^{p}\theta_{1i}\ln RGDP_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\delta_{1i}\ln RGDP_{t-i} + \sum_{i=1}^{p}\pi_{1i}\ln GCF_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\Omega_{1i}\ln GCF_{t-1} + \\ & \sum_{i=1}^{p}\lambda_{1i}\ln GDS_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\gamma_{1i}\ln GDS_{t-i} + \sum_{i=!}^{p}\eta_{1i}\ln GDI_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\mu_{1i}\ln GDI_{t-i} + \sum_{i=1}^{p}\phi_{1i}\ln HC_{t-1} + \\ & \sum_{i=p+1}^{p+d_{\max}}\varphi_{1i}\ln HC_{t-1} + \sum_{i=1}^{p}\omega_{1i}\ln OIT_{t-1} + \sum_{i=p+1}^{P+d_{\max}}\Psi_{1i}\ln OIT_{t-1} + \varepsilon_{1t}\ldots\ldots\ldots\ldots(6)\end{aligned}$$

$$\begin{aligned}\ln GCF_t = {} & \beta_{20} + \sum_{i=1}^{p}\theta_{2i}\ln RGDP_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\delta_{2i}\ln RGDP_{t-i} + \sum_{i=1}^{p}\pi_{2i}\ln GCF_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\Omega_{2i}\ln GCF_{t-1} + \sum_{i=1}^{p}\lambda_{2i}\ln GDS_{t-i} \\ & + \sum_{i=p+1}^{p+d_{\max}}\gamma_{2i}\ln GDS_{t-i} + \sum_{i=!}^{p}\eta_{2i}\ln GDI_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\mu_{2i}\ln GDI_{t-i} + \sum_{i=1}^{p}\phi_{2i}\ln HC_{t-1} + \sum_{i=p+1}^{p+d_{\max}}\varphi_{2i}\ln HC_{t-1} \\ & + \sum_{i=1}^{p}\omega_{2i}\ln OIT_{t-1} + \sum_{i=p+1}^{P+d_{\max}}\Psi_{2i}\ln OIT_{t-1} + \varepsilon_{2t}\ldots\ldots\ldots\ldots(7)\end{aligned}$$

$$\begin{aligned}\ln GDS_t = {} & \beta_{30} + \sum_{i=1}^{p}\theta_{3i}\ln RGDP_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\delta_{3i}\ln RGDP_{t-i} + \sum_{i=1}^{p}\pi_{3i}\ln GCF_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\Omega_{3i}\ln GCF_{t-1} + \sum_{i=1}^{p}\lambda_{3i}\ln GDS_{t-i} \\ & + \sum_{i=p+1}^{p+d_{\max}}\gamma_{3i}\ln GDS_{t-i} + \sum_{i=!}^{p}\eta_{3i}\ln GDI_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\mu_{3i}\ln GDI_{t-i} + \sum_{i=1}^{p}\phi_{3i}\ln HC_{t-1} + \sum_{i=p+1}^{p+d_{\max}}\varphi_{3i}\ln HC_{t-1} \\ & + \sum_{i=1}^{p}\omega_{3i}\ln OIT_{t-1} + \sum_{i=p+1}^{P+d_{\max}}\Psi_{3i}\ln OIT_{t-1} + \varepsilon_{3t}\ldots\ldots\ldots\ldots(8)\end{aligned}$$

$$\ln GDS_t = \beta_{40} + \sum_{i=1}^{p}\theta_{4i}\ln RGDP_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\delta_{4i}\ln RGDP_{t-i} + \sum_{i=1}^{p}\pi_{4i}\ln GCF_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\Omega_{4i}\ln GCF_{t-1} + \sum_{i=1}^{p}\lambda_{4i}\ln GDS_{t-i}$$
$$+ \sum_{i=p+1}^{p+d_{\max}}\gamma_{4i}\ln GDS_{t-i} + \sum_{i=!}^{p}\eta_{4i}\ln GDI_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\mu_{4i}\ln GDI_{t-i} + \sum_{i=1}^{p}\phi_{4i}\ln HC_{t-1} + \sum_{i=p+1}^{p+d_{\max}}\varphi_{4i}\ln HC_{t-1}$$
$$+ \sum_{i=1}^{p}\omega_{4i}\ln OIT_{t-1} + \sum_{i=p+1}^{P+d_{\max}}\Psi_{4i}\ln OIT_{t-1} + \varepsilon_{4t} \quad \text{.....(9)}$$

$$\ln GDI_t = \beta_{50} + \sum_{i=1}^{p}\theta_{5i}\ln RGDP_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\delta_{5i}\ln RGDP_{t-i} + \sum_{i=1}^{p}\pi_{5i}\ln GCF_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\Omega_{5i}\ln GCF_{t-1} + \sum_{i=1}^{p}\lambda_{5i}\ln GDS_{t-i}$$
$$+ \sum_{i=p+1}^{p+d_{\max}}\gamma_{5i}\ln GDS_{t-i} + \sum_{i=!}^{p}\eta_{5i}\ln GDI_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\mu_{5i}\ln GDI_{t-i} + \sum_{i=1}^{p}\phi_{5i}\ln HC_{t-1} + \sum_{i=p+1}^{p+d_{\max}}\varphi_{5i}\ln HC_{t-1}$$
$$+ \sum_{i=1}^{p}\omega_{5i}\ln OT_{t-1} + \sum_{i=p+1}^{P+d_{\max}}\Psi_{5i}\ln OIT_{t-1} + \varepsilon_{5t} \quad \text{.....(10)}$$

$$\ln GDI_t = \beta_{50} + \sum_{i=1}^{p}\theta_{5i}\ln RGDP_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\delta_{5i}\ln RGDP_{t-i} + \sum_{i=1}^{p}\pi_{5i}\ln GCF_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\Omega_{5i}\ln GCF_{t-1} + \sum_{i=1}^{p}\lambda_{5i}\ln GDS_{t-i}$$
$$+ \sum_{i=p+1}^{p+d_{\max}}\gamma_{5i}\ln GDS_{t-i} + \sum_{i=!}^{p}\eta_{5i}\ln GDI_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\mu_{5i}\ln GDI_{t-i} + \sum_{i=1}^{p}\phi_{5i}\ln HC_{t-1} + \sum_{i=p+1}^{p+d_{\max}}\varphi_{5i}\ln HC_{t-1}$$
$$+ \sum_{i=1}^{p}\omega_{5i}\ln OIT_{t-1} + \sum_{i=p+1}^{P+d_{\max}}\Psi_{5i}\ln OIT_{t-1} + \varepsilon_{5t} \quad \text{.....(11)}$$

$$\ln HC_t = \beta_{60} + \sum_{i=1}^{p}\theta_{6i}\ln RGDP_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\delta_{6i}\ln RGDP_{t-i} + \sum_{i=1}^{p}\pi_{6i}\ln GCF_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\Omega_{6i}\ln GCF_{t-1} + \sum_{i=1}^{p}\lambda_{6i}\ln GDS_{t-i}$$
$$+ \sum_{i=p+1}^{p+d_{\max}}\gamma_{6i}\ln GDS_{t-i} + \sum_{i=!}^{p}\eta_{6i}\ln GDI_{t-i} + \sum_{i=p+1}^{p+d_{\max}}\mu_{6i}\ln GDI_{t-i} + \sum_{i=1}^{p}\phi_{6i}\ln HC_{t-1} + \sum_{i=p+1}^{p+d_{\max}}\varphi_{6i}\ln HC_{t-1}$$
$$+ \sum_{i=1}^{p}\omega_{6i}\ln OIT_{t-1} + \sum_{i=p+1}^{P+d_{\max}}\Psi_{6i}\ln OIT_{t-1} + \varepsilon_{6t} \quad \text{.....(12)}$$

where $\theta_i s, \delta_i s, \pi_i s, \Omega_i s, \lambda_i s, \gamma_i s, \eta_i s, \mu_i s, \phi_i s, \varphi_i s, \omega_i s, \Psi_i s$ are parameters of the model; p is the true lag length; ε_{it} are the residuals of the model which represents in natural logarithm.

Equations (6) - (12) were estimated to determine the direction of causality between the variables under consideration. From (6), Granger causality from $\ln GCF_t$ to $\ln RGDP_t$ implies $\pi_{11} = \pi_{12} = \ldots = \pi_{1p} \neq 0$; Granger causality from $\ln GDS_t$ to $\ln RGDP_t$ implies $\lambda_{11} = \lambda_{12} = \ldots = \lambda_{1p} \neq 0$; Granger causality from $\ln GDI_t$ to $\ln RGDP_t$ implies $\eta_{11} = \eta_{12} = \ldots = \eta_{1p} \neq 0$. From (7), Granger causality from $\ln RGDP_t$ to $\ln GCF_t$ implies $\theta_{21} = \theta_{22} = \ldots = \theta_{2p} \neq 0$; Granger causality from $\ln GDS_t$ to $\ln CF_t$ implies $\lambda_{21} = \lambda_{22} = \ldots = \lambda_{2p} \neq 0$; Granger causality from $\ln GDI_t$ to $\ln GCF_t$ implies $\eta_{21} = \eta_{22} = \ldots = \eta_{2p} \neq 0$. From (8), Granger causality from $\ln RGDP_t$ to $\ln GDS_t$ implies $\theta_{31} = \theta_{32} = \ldots = \theta_{3p} \neq 0$; Granger causality from $\ln GCF_t$ to $\ln GDS_t$ implies $\pi_{31} = \pi_{32} = \ldots = \pi_{3p} \neq 0$; Granger causality from $\ln GDI_t$ to $\ln GDS_t$ implies $\eta_{31} = \eta_{32} = \ldots = \eta_{3p} \neq 0$.. From (9), Granger causality from $\ln RGDP_t$ to $\ln GDI_t$ implies $\theta_{41} = \theta_{42} = \ldots = \theta_{4p} \neq 0$; Granger causality from $\ln CF_t$ to $\ln GDI_t$ implies $\pi_{41} = \pi_{42} = \ldots = \pi_{4p} \neq 0$; Granger causality from $\ln GDS_t$ to $\ln GDI_t$ implies $\eta_{41} = \eta_{42} = \ldots = \eta_{4p} \neq 0$. Then, Granger causality is tested using the modified Wald (MWald) test which is theoretically very simple, as it involves estimation of a VAR model augmented in a straight forward way.

5.5 Impulse Response Function (IRF)

In empirical research, it is often necessary to know the response of one variable to an impulse in another variable in a system that involves a number of further variables as well. Thus, one would like to investigate the impulse response relationship between two variables in a higher dimensional system (Lutkepohl, 2005). To this end, generalized impulse response which is invariant to the ordering of the variables in the VAR has been used.

6. Results and Discussions

6.1 Descriptive Statistics

Before directly going to the econometric estimation, it is better to have a look at the descriptive statistics of the variables under consideration. This is vital because the statistics summarize the statistical properties of the series in the model such that some explanations about the behavior of the series can be offered at a glance (Table 1).

Table 1: Descriptive statistics of variables in the model (STATA/SE 12 output)

Statistics	lnRGDP	lnGCF	lnGDS	lnGDI	lnHC	lnOT
Mean	11.0652	8.9304	8.2093	2.1780	2.0972	1.8216
Median	10.9885	8.7647	8.2121	2.1707	2.1056	1.8399
Maximum	12.0414	11.7789	10.714	2.4663	2.3716	2.0687
Minimum	10.5044	7.22023	6.2982	1.9767	1.8403	1.5781
Std. Dev.	0.42322	1.39209	1.0682	0.1530	0.1290	0.1253
Skewness	0.85051	0.45506	0.3776	0.2831	0.1205	0.0816
Kurtosis	2.66122	2.01514	2.5295	1.8138	2.3518	2.1051
Sum	343.0211	276.8414	254.4884	67.5179	65.0126	6.4695
Observations	30	30	30	30	30	30

6.2 Unit Root Testing

The null hypothesis for the test in ADF depicts that the data series under consideration has unit root while the alternative hypothesis claims that the series is stationary. As can be seen from Table 2, ADF test witnessed that RGDP in natural log at level is non-stationary since the null hypothesis couldn't reject the unit root at 1%, 5 %, and 10% level of significance. Additionally, the ADF test shows that none of the variable is stationary at level. On the other hand, when the first difference of natural log of RGDP is considered, it becomes stationary at 1%, 5% and 10% level of significances. Coming to the ADF test, the result reveals that the first difference of lnRGDP and other variables are stationary at 1%, 5% and 10% level of significance. Consequently, the null hypothesis of unit root is rejected at 1%, 5% and 10% level of significance.

In general, the ADF test from Table 2 shows that all variables are integrated at first order order, I (1); that is, all variables are stationary at their first difference. Thus, the determination of co-integration relationships using the ARDL technique does not face a problem from the existence of I(2) or beyond variables in the model specified.

Table 2: Result for the ADF-Unit Root Test (STATA/SE 12 Output)

Variables	Test Statistics	1%CV	5%CV	10%CV	P-Value	Recommendation
Variables at the level						
lnOT	-0.983	-3.723	-2.989	-2.625	0.7595	I(1)
lnHC	-0.827	-3.723	-2.989	-2.625	0.8112	I(1)
lnGDI	0.648	-3.723	-2.989	-2.625	0.9887	I(1)
lnGDS	-0.494	-3.723	-2.989	-2.625	0.8931	I(1)
lnGCF	1.441	-3.723	-2.989	-2.625	0.9973	I(1)
lnRGDP	2.285	-3.723	-2.989	-2.625	0.9989	I(1)
Variables at the first difference						
dflnOT	-5.058	-3.723	-2.989	-2.625	0.0000***	
dflnHC	-7.966	-3.723	-2.989	-2.625	0.0000***	
dflnGDI	-6.250	-3.723	-2.989	-2.625	0.0000***	
dflnGDS	-7.765	-3.723	-2.989	-2.625	0.0000***	
dflnGCF	-6.250	-3.723	-2.989	-2.625	0.0000***	
dflnRGDP	-4.378	-3.723	-2.989	-2.625	0.0003***	

Note: CV represents critical value, *** is significant at 1% and it shows that the variable is stationary. I(1) implies that the variable is stationary at first difference.

6.3 Co-integration Test and Estimation of Long-run Relationship

A two-step procedure is used in estimating the long-run relationship: an initial examination of the existence of a long-run relationship among the variables in Equation (2) is followed by an estimation of the short-run and long-run parameters.

Bound Test

The results in the bound test (see on Appendix-I) shows that lnRGDP, lnGCF, lnGDS, lnGDI, lnHC and lnOT are co-integrated when lnRGDP is taken as dependent variable without intercept (i.e. constant = 0) because F-statistic, written as FlnRGDP (lnRGDP| lnGCF, lnGDS, lnGDI, lnHC, lnOT) = 4.7154 [with lag order of (1,0,0,0,0) selected by the SBC] is greater than both lower and upper bounds at 95% critical values of Narayan (2004) and Pesaran et.al (2001) which are 2.5080 and 3.9478, respectively. However, while the intercept (i.e. constant $\neq$ 0) included (considered) in the model, the result shows that variables are not co-integration because F-statistics value, 2.5821 less than both upper and lower bounds which are 3.1815 and 4.5996, respectively. Hence, taking the model without intercept is preferable to test the co-integration. (Note: the existence of a clear co-integrating equation indicates that there is a long-run relationship among the variables (Pesaran et al., 2001).

Table 3: Estimated Long-run Coefficients using the ARDL Approach: (Output obtained from Microfit 5.5 version)

Estimated Long Run Coefficients using the ARDL Approach ARDL (0,0,1,0,1,1) selected based on Schwarz Bayesian Criterion			
Dependent Variable in lnRGDP			
Regressor	**Coefficient**	**Standard Error**	**T-Ratio[Prob]**
lnGCF	3.2651	1.6328	1.9997[0.057]*
lnGDS	-3.4458	1.7935	-1.9212[0.067]*
lnGDI	-26.5916	14.7476	-1.8031[0.084]*
lnHC	31.0953	15.2222	2.0428[0.052]*
lnOT	1.7171	0.91013	1.8866[0.071]*
R-Squared	0.98981	R-Bar-Squared	0.98768
S.E of Reg.	0.04690	F-Stat. F(5,24)	466.1148[0.000]

Diagnostic Test		
Test Statistics	LM Version	F Version
A: Serial Correlation	CHSQ(1) = 0.38599[0.534]	F(1,22) = 0.28675[0.598]
B: Functional Form	CHSQ(1) = 0.38084[0.537]	F(1,22) = 0.28287[0.600]
C: Normality	CHSQ(2) = 1.0562[0.590]	Not applicable
D: Heteroscedasticity	CHSQ(1) = 3.8315[0.050]	F(1,28) = 4.0996[0.053]

Note: * indicate that significance at 10% level of significance. Figures in parenthesis are p-values. (A)Lagrange multiplier test of residual serial correlation; (B)Ramsey's RESET test using the square of the fitted values; (C)Based on a test of skewness and kurtosis of residuals; (D)Based on the regression of squared residuals on squared fitted values.

Before estimating the long-run relationship and the short-run dynamics of the model, it is important to analyze performance of the ARDL estimates through the diagnostic tests. Further the result revels that R- squared is 99 percent and it is statistically significant (P = 0.000) at 1% level of significance implying that the model fits well. Moreover, the model (ARDL estimates) is free from the problem of serial correlation, functional form, heteroskedasticity and normality as revealed in LM and F version of tests because the null hypothesis couldn't reject on each test statistic (see on Appendix-I).

Table 3 presents the estimated coefficients of the long-run relationship along with the diagnostic tests of the model. Based on the results, the long-run growth equation is given as:

$$\ln RGDP = 3.2651 \ln GCF - 3.4458 \ln GDS - 26.5916 \ln GDI + 31.0953 \ln HC + 1.7171 \ln OT$$

…(12) P-value (0.057) (0.067) (0.084) (0.052) (0.071)

The estimated coefficients show that gross capital flow, human capital and openness of trading have a statistically significant positive impact on economic growth, which is in line with theoretical argument that capital flow, human capital and trade openness shall contribute to economic growth. More specifically, the elasticity of capital flow indicates that a 1% increase in capital flow leads to 3.265 percent increase in economic growth on average, keeping other variables constant. Similarly, the long-run elasticity of human capital is 31.095 and openness of trading is 1.717 which imply that a 1% rise in human capital and openness of trading result in about 31.095 and 1.717 percent increase in economic growth, respectively.

However, as seen Table 3, the long-run model suggests that gross domestic saving and gross domestic investment have significantly ($p < 0.1$) negative effect on economic growth. Particularly tabulation reveals that, the long-run elasticity of gross domestic saving is -1.9212 and gross domestic investment is -1.803 which imply that a 1% increase in gross domestic saving and gross domestic investment result in about 1.921 and 1.803 percent decrease in economic growth, respectively. However, a quick review of literature on the relationship between savings and economic growth indicates a positive relationship between domestic savings and economic growth (Misztal, 2011).

6.4 The Short Run Dynamic Modeling: (Error Correction Model)

After estimating the long-run coefficients, the error correction representation is obtained (see on Appendix-I). The result of the short-run dynamic growth model is presented in Table 4. About 64.7 percent of the variation growth is explained by explanatory variables included in the model. R-squared which is 64.66 is statistically significant at 5% level of significance implying that the model fits well since the explanatory variables are jointly significant at 5% level of significance.

Table 4: Short Run Dynamics Result for the Selected ARDL Model

Error Correction Representation for the Selected ARDL Model (ARDL (1,0,0,0,0,0) selected based on Schwarz Bayesian Criterion)			
Dependent Variable is $\Delta \ln RGDP$			
Regressor	**Coefficient**	**Standard Error**	**T-Ratio[Prob]**
$\Delta \ln GCF$	0.55738	0.19936	2.7958[0.010]**
$\Delta \ln GDS$	-0.58823	0.24737	-2.3779[0.026]**
$\Delta \ln GDI$	-4.5395	1.8002	-2.5217[0.019]**
$\Delta \ln HC$	5.3083	1.9962	2.6592[0.014]**
$\Delta \ln OT$	0.29312	0.13992	2.0949[0.047]**
ECMt-1	-0.17071	0.057872	-2.9498[0.007]***
R-Squared	0.64662	R-Bar-Squared	0.57300
S.E. of Reg.	0.046905	F-Stat. F(5,24)	8.7832[0.000]

Notes: Figures in parenthesis are p-values. Δ represents the first difference. *** &** means the coefficients are significant at 1% & 5% level of significance respectively.

The coefficient on the lagged error-correction term is highly significant at one percent level of significance with the expected sign (negative), which confirms the result of the bounds test for co-integration. The estimated coefficient of the ECMt-1 is equal to 0.17 which states that departure (disequilibria) from the long-term growth path due to a certain shock is adjusted (converge back to long-run equilibrium) by 17 percent over the next year, significant at the 1% level of significance.

Based on Table 4, the short-run dynamics of growth equation is given as:

$$\begin{array}{lllllll} \Delta \ln RGDP = 0.55738\Delta\text{lnGCF} & -\,0.58823\Delta\text{lnGDS} & -\,4.5395\Delta\text{lnGDI} & +\,5.3083\Delta\text{lnHC} & +\,0.2931\Delta\text{lnOT} & -\,0.1707\text{ECM}_{t-1} \\ \text{P-value} \quad (0.010) & (0.026) & (0.019) & (0.014) & (0.047) & (0.007) \end{array} \tag{13}$$

From this equation, the result reveals that the estimated coefficients of lnGCF, lnHC and lnOT are statistically significant with the positive sign. In line with the postulates of growth theories; gross capital flow, returns to schooling (human capital) and trade openness have a positive effect on real gross domestic product of Ethiopia in the short-run. Even though gross domestic savings (lnGDS) and gross domestic investment (lnGDI) are statistically significant, they have a negative effect on the real economic growth of Ethiopia in the short-run. Particularly, since (gross) capital flow and real gross domestic product have positive relationship, the one percentage change in percentage of GDF to RGDP ratio causes RGDP to be changed approximately by 0.56 percent, other variables remaining constant.

Stability Test

The stability of the long-run coefficient is tested by the short-run dynamics. Once the error correction model has been estimated the cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) are applied to assess the parameter stability (Pesaran, 1997). Figure 1 show plots of CUSUM and CUSUMSQ of the growth equation in its SR version are drown (Appendix-III).

6.5 Granger Causality Test

As seen from Table 5, the optimal lag length is one. Since all variables become stationary after the first differencing, it implies that dmax is also one. Then a system of VAR has estimated in levels with a total of (dmax +k=1+1) which is 2 lags; where k is the lag length selected by information criteria. Using this information, the system of equations (i.e. Equations 6 - 12) is jointly estimated as a "Seemingly Unrelated Regression Equations" (SURE) model.

Table 5: Estimates of long-run Granger Causality Wald Tests

Equation	Excluded	χ^2	Prob. > χ^2
lnRGDP	lnGCF	3.9538	0.138
lnGCF	lnRGDP	0.02683	0.987

Table 5 shows that the null hypothesis that 'Granger no-causality from (gross) cash flow to economic growth' could be rejected since the causality is insignificant even at 10% level of significance. Hence, the alternative hypothesis that 'Granger causality from gross capital flow to economic growth' is accepted. That is, gross capital flow causes positively the economic growth with scalar of 3.9538. Similarly, when the reverse effect checked on economic growth on gross capital flow, it causes by amount of scalar 0.02683 positively. Therefore, the result reveals that the Granger causality between gross capital flow and economic growth is bi-directional effect. That is, gross capital flow Granger causes economic growth and there is a feedback from economic growth. But, the effect of the reverse cause (i.e. from economic growth to gross capital flow) is weaker than the effect from gross capital flow to economic growth.

6.6 Impulse Response Functions (IRF)

The impulse response functions of variable lnRGDP and lnGCF for eight years is estimated generalized Table 6 and illustrates graphically in Fig. 2 (see on Appendix-IV). While considered Impulse (lnGCF) and Response (lnRGDP) that a one standard deviation disturbance originating from economic growth results in an approximately 4.76 percent increase in gross capital flow in the first period. Similarly, it continuously increases to about 24.7 percent in the third period and starts increasing after the fifth period and reaches about 33.5 percent in the 8th period implying that the impact of gross capital flow on economic growth is positively increased in both short-run and long-run. Thus, the impulse of domestic cash flow on the economic growth is increasing response.

Table 6: Generalized Impulse Responses to one SE shock in the equation for lnRGDP

IRF(varbasic), Impulse (lnGCF), Response (lnRGDP)	
Horizon	**IRF**
0	0.000000
1	0.047602
2	0.116382
3	0.166032
4	0.210189
5	0.247131
6	0.279681
7	0.308682
8	0.335229
IRF(varbasic), Impulse (lnGCF), Response (lnRGDP)	
Horizon	**IRF**
0	0.000000
1	0.094813
2	0.038955
3	0.031539
4	0.013343
5	0.002886
6	-0.006844
7	-0.014321
8	-0.02063

However, when seen in reverse direction by considering Impulse (lnRGDP) and Response (lnGCF) that a one standard deviation disturbance originating from economic growth results in an approximately 9.48 percent increase in gross capital flow in the first period. But it continuously declines to about 0.29 percent in the fifth period and starts negatively decreasing after the fifth period and reaches about 2.06 percent in the 8th period implying that the impact of economic growth on gross cash flow causes positively decreased for short-run and negatively decreased for long-run. Thus, the impulse of economic growth on the domestic cash flow is a decreasing response.

7. Conclusion and Policy Implications

7.1 Conclusion

The evidence offered on the relationship among the real gross domestic product (lnRGDP), gross capital flow (lnGCF), gross domestic saving (lnGDS), gross domestic investment (lnGDI), and openness of trade (lnOT) in Ethiopia. The series used in the analysis was tested for stationarity, using Augmented Dickey-Fuller (ADF) . The result indicates that the variables are not stationary at level though stationary at first difference. On the Johansen Cointegration test, it shows the presence of long-run relationship among the cointegrating variables. Furthermore, an Engle-Granger 2-Step procedure is applied and an error correction model (ECM) is developed from long-run static model. The error correction term in the short-run dynamic model has a statistically significant coefficient with the appropriate negative sign and this is a requirement for dynamic stability of the model.

As determinants of growth, the long-run coefficients of the natural logarithm of gross capital flow, human capital and openness of trading are positive and statistically significant at 10% percent level of significance, implying that these three variables have a significant and positive impact on growth in the long-run. However, the long-run coefficients of gross domestic saving and gross domestic investment are significantly negative effect on economic growth.

Similarly, ARDL based short-run dynamic modeling (Error Correction Model) for growth shows that gross capital flow, human capital, and trade openness have statistically significant positive effect on growth in the short-run. Furthermore, the stability of the estimated parameters of both short-run and long-run relationships is supported by CUSUM and CUSUMSQ stability tests. The direction of causal relationship among the gross capital flow and economic growth using the Granger causality tests suggests that the direction of Granger causality from gross capital flow to economic growth which is in line with the conventional wisdom. That is, gross capital flow causes positively the economic growth. In turn, even though the Granger reverse causality from economic growth to gross capital flow is weaker, it a positive cause. Therefore, the result reveals that the Granger causality between gross capital flow and economic growth is bi-directional effect. That is, gross capital flow Granger causes economic growth and there is a feedback from economic growth.

However, Granger causality running from gross capital flow to economic growth is strong and positively increases as suggested by impulse response and variance decompositions in both short-and long-run. But Granger causality running from economic growth to gross capital flow is weak and negatively decreases in long-run, even though positively decreases in short-run.

7.2 Policy Implication

Empirical evidences show that the capital flows of a country can be either positive or negative based on their import and export levels, economic and political stability, and financial markets. Strong capital flows into a country can result in many benefits. As firms and people invest new capital from outside countries, this can lead to new factories, research and development advances, and technology improvements. Ultimately, the results in more jobs, increases income, lower prices, and higher standards of living for citizens. One risk of too much capital inflow is that inflation could result if a country is already operating at full capacity and continues to receive strong foreign investment.

Furthermore, capital flows are very important because of their potential effects on the macroeconomic stability, monetary and exchange rate management as well as competitiveness of the export and external sectors viability of a country. This is because no matter how the nature of capital flows (flows over a medium-to long-term), they are expected to influence the monetary aggregates, especially, the economy's net foreign assets (NFA), inflation as well as real effective exchange rate, aggregate output (GDP) and possibly the domestic interest rates.

Consequently, any policy recommendation on this should understand, the nature, what drives the capital flows and the impact of its sudden surge or reversal on economy. It is recommended that government should continue to pursue trade and foreign exchange policies that would ensure competitiveness of the export sector viability and economic growth, while foreign direct investment should be encouraged amidst thriving business environment that would engender economic growth.

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Appendices

Appendix-I: Results of Bounds Test for Co-integration

Dependent Variables (Excluding Intercepts)	Order of ARDL	F-Statistics	Decision
FlnRGDP (lnRGDP| lnGCF, lnGDS, lnGDI, lnHC, lnOT)	(1,0,0,0,0,0)	4.7154*	Cointegrated
F lnGCF (lnGCF | lnRGDP, lnGDS, lnGDI, lnHC, lnOT)	(1,0,1,0,0,1)	16.8935*	Cointegrated
lnGDS (lnGDS | lnGCF, lnRGDP, lnGDI, lnHC, lnOT)	(0,0,0,1,0,0)	14.2454*	Cointegrated
F lnGDI (lnGDI | lnGCF, lnGDS, lnRGDP, lnHC, lnOT)	(1,1,0,0,0,0)	2.6000	
F lnHC (lnHC |, lnGCF, lnGDS, lnGDI, lnRGDP, lnOT)	(0,0,0,1,0,0)	----	
F lnOT (lnOT |, lnGCF, lnGDS, lnGDI, lnHC, lnRGDP)	(1,0,0,0,0,0)	---	Non-integrated

Note: * means F-statistics is greater than the 95% Upper Bound critical value.

Appendix- II: Results of ARDL Estimated and Diagnostic Tests; and Results of Authogresive Distributed Lag Estimates

Autoregressive Distributed Lag Estimates ARDL(1,0,0,0,0,0) selected based on Schwarz Bayesian Criterion

R-Squared	.98981	R-Bar-Squared	.98768
S.E. of Regression	046905	F-Stat. F(5,24)	466.1148[.000]
Mean of Dependent Variable	11.0796	S.D. of Dependent Variable	.42264
Residual Sum of Squares	052801	Equation Log-likelihood	52.5682
Akaike Info. Criterion	46.5682	Schwarz Bayesian Criterion	42.3646
DW-statistic	2.2317	Durbin's h-statistic	-.66895[.504]

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
4.7154*	2.5080	3.9478	2.0493	3.2987
W-statistic				
28.2923*	15.0477	23.6871	12.2955	19.7921

Note: * means F-statistics is greater than the 95% Upper Bound critical value. Dependent variable is LNRGDP 30 observations used for estimation from 1981 to 2010

Appendix –III: Stability Test

Figure 1 (a): Plot of Cumulative Sum of Recursive Residuals

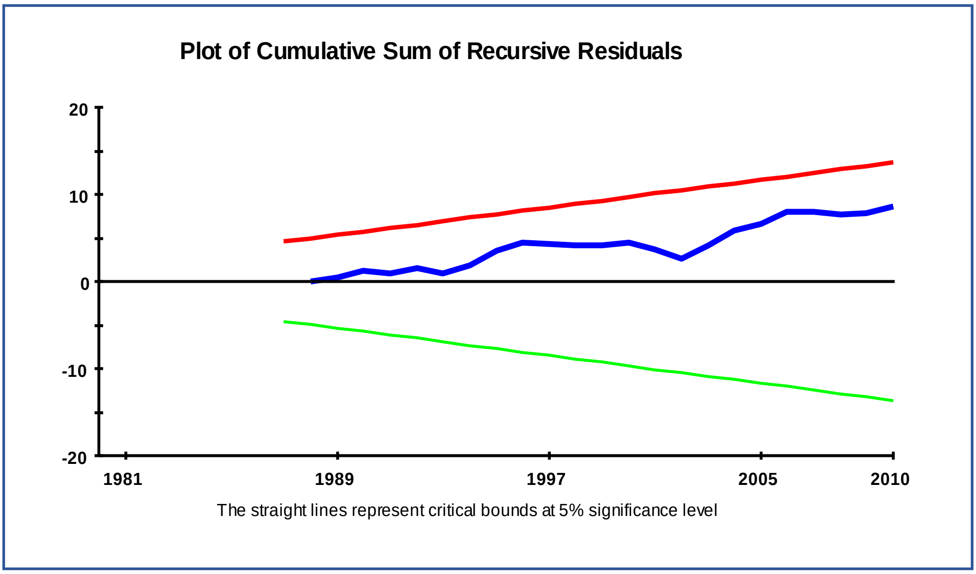
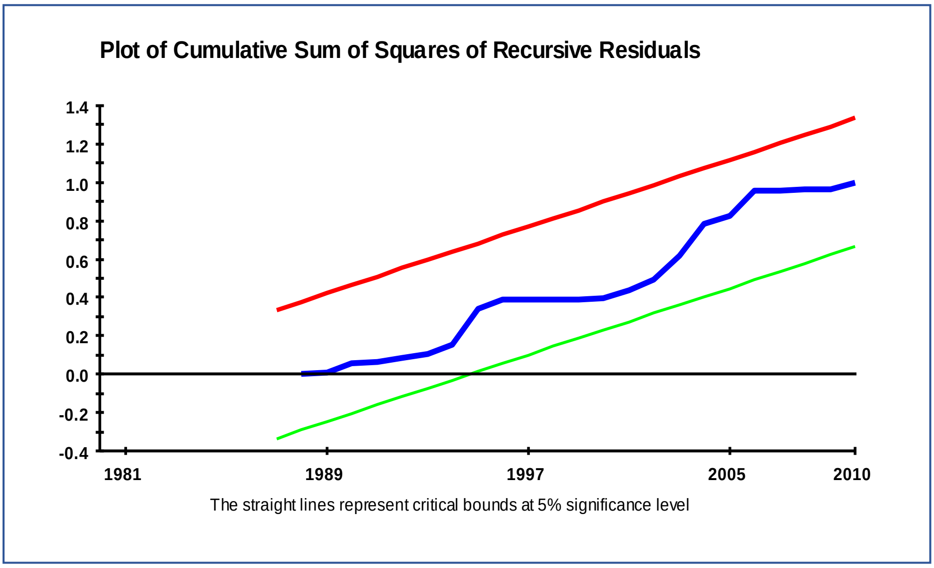
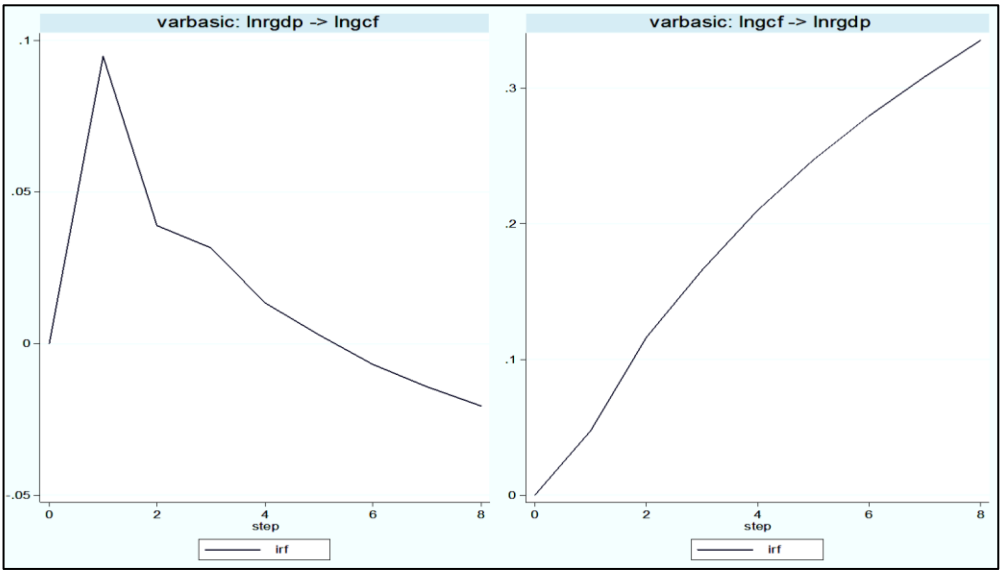


Figure 1 (b): Plot of Cumulative Sum of Squares of Recursive Residuals



Appendix-IV: Impulse-Response Function (IRF): lnRGDP vs lnGCF

Figure 3: Impulse-Response Function (IRF): lnRGDP vs lnGCF



Post-Harvest Losses of Crops and Its Determinants in Ethiopia: Tobit Model Analysis

Sisay Debebe Kaba[1]

Abstract

Reduction of wastage and post-harvest losses of crops is a crucial task to ensure food and nutrition security. However, a lack of understanding of its extent and its associated impeding factors are posing major challenges to the effectiveness of grain post-harvest loss management strategy and to scale up for all other crop types in Ethiopia. This study estimates the magnitude of post-harvest losses of crops and identifies its determinants. A national-level representative cross-sectional data were obtained using agriculture survey data from the Central Statistical Agency of Ethiopia. Data were analyzed using appropriate descriptive statistics and Tobit model analysis techniques. The analysis shows 25.81% annual average perceived post-harvest losses of crops was obtained with considerable variation across the crop types. The main factors impeding post-harvest losses of crops were households with larger adult family size, higher levels of education attendance, and being wealthier, large landholding size and damage of stored crops by insect pests infestation and/or rodent feeding, provision of extension support services, being member of cooperative marketing, and being far away from both all weathered roads and near local market centers. Minimization of post-harvest losses of crops could be achieved through a holistic approach by providing short and long-term training on post-harvest management practices, promoting the use of post-harvest technologies, paying special attention to the institutional support systems (agriculture extension and rural credit services), strengthening the support for post-harvest handling technologies, reinforcing the existing farmer cooperative marketing, and improvements of the local market and road networking infrastructures of rural areas should be undertaken by the government in collaboration with non-government organizations.

Key words: Post-harvest losses of crops, Determinants, Tobit model, Ethiopia.

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Abbreviations

CSA:	Central Statistical Authority;
FDRE:	Federal Democratic Republic of Ethiopia;
FOA:	Food and Agriculture;
MANR:	Ministry of Agriculture and Natural Resources;
MoFED:	Ministry of Finance and Economic Development;
PMS:	Post-harvest Management Strategy;
SDGs:	Sustainable Development Goals;
UN:	United Nations

1. Background

Ethiopia with 110 million people is the second-most populous country in sub-Saharan Africa (UN, 2018). The majority of its population depends on agriculture both for livelihood and sources of food. The sector, as is the case in most African countries, still remains the backbone of the economy. It accounts for about 32.7 percent of the total GDP, contributes more than 70 percent of total export, serves as 70 percent of sources of raw material for the industry, and it also employs more than 70 percent of the employment opportunities and source of livelihoods for 90 percent of the population residing in rural areas (Sisay *et al*. 2015; EEA, 2018; WB, 2020). Moreover, the sector has been contributing to the attainments of the country's objectives trajectory to become a middle-income economy by the year 2025. However, realizing the self-sufficiency in food still calls active involvement of both government and development partners.

Over the last years, both the government and non-governmental organizations (NGOs) have implemented various development interventions aiming for transforming the agriculture sector and thereby achieving food self-sufficiency in the country. The government gives special attention to agriculture development in its all-development strategy plans. In 2001/2 Sustainable Development and Poverty Reduction Plan (SDPRP) (MoFED, 2002), the Rural Development Policy and Strategies in 2003 (MoFED, 2003), subsequently in 2005/05 Plan for Accelerated and Sustainable Development to End Poverty (MoFED, 2005), in 2009/10 Growth Transformation Plan-I (GTP-I) (MoFED, 2010) and an extension to the latter in 2015/16 GTP-II was implemented and considered the agriculture sector as one of the major growth drivers of the economy (MoFED, 2015). Despite the fact that all development plans gave emphasis on the improvements of agriculture production and productivity and fostering commercialization. But, only the recent GTP-II plan gave specific attention for minimization of post-harvest losses of crops and thereby ensuring food security in the country. In view of this, the government specifically designed and implemented the Post-harvest Management Strategy (PMS) in 2016 for grain crops and aspires to reduce post-harvest loss from 25% to 5% by 2020. In addition, the government has been working hard towards the achievements of international stated goals such as the 2014 agreements of the Malabo Declaration of Africa Union (halve post-harvest loss by 2025) and 2030 global targets of SDGs (end poverty and hunger) (MANR, 2018).

Despite such policy focus, the country remains far below stated post-harvest loss targets. According to recent studies, the estimated average magnitudes of post-harvest loss in Ethiopia ranges from 15.5 to 27.2% for major grain crops (Mohammed and Tadesse, 2018) and 23% average loss for all crops (MANR, 2018). A post-harvest loss contributes to the reduction of food supply and hence leads to high food prices in the market and thereby aggravating the food insecurity situation in the country. The main reasons for post-harvest loss among others is inherent weaknesses in post-harvest handling techniques due to the poor management practices, lack of infrastructure and appropriate equipment and limited access to market (FOA, 2017; Mohammed and Tadesse, 2018). In response to this, a number of cost-effective post-harvest handling management techniques and technologies (such as hermetic plastic bags (such as PIOS, AgroZ, and Yabi bags), metal silos and others) were introduced by government in collaboration with development partners. However, the limited focus in scope of the PMS to grain crops only also pave difficulties (MANR, 2018). Therefore, the reduction of post-harvest losses of all crops could be considered as a viable strategy for improving livelihoods of farmers and releasing the pressure on the environment. This needs a depth understanding on where and why the post-harvest losses of crops occur and thereby helps for providing a sustainable solution to the problems.

Previous empirical studies on post-harvest losses examined the causes, challenges, opportunities for reduction of post-harvest losses of crops and its implication on food insecurity in Ethiopia (Kasso et al. 2016; Emana et al., 2017; Tadesse et al., 2018; Tesfaye and Tirivayi, 2018; Kumera et al., 2020). While these studies were conducted in different parts of the country for different types of crops, they did not utilize national-level representative data and hence it creates difficulties for understanding the severity of problems and its associated effects at the national level. In contrast, there are some other few studies attempted to quantify the magnitude of post-harvest losses of major grain crops at various stages of post-harvest management practices in Ethiopia (FOA, 2017; Hengsdijk and de Boer, 2017; Bachewe et al., 2018; Gebre et al., 2018; Mohammed and Tadesse, 2018). They all reported a higher significant proportion of post-harvest losses of major grain crops in their respective studies. In addition, they are few other empirical review studies done at the national level such as Abrehet (2018) and Dubale (2018). These studies are not only essential for creating awareness on the implications of post-harvest losses of crops on food security but also provides input for the effectiveness of PMS, direct future needful strategies, policies, and programs in the country. However, there are few national representative studies that measure the extent of post-harvest losses of all crops and their impeding factors in Ethiopia. In view of the above facts, this study was undertaken with the objectives of measuring the magnitude and identifies the factors impeding post-harvest losses of all crops using national-level representative agriculture survey data in Ethiopia. The remaining part of the article describes the methodology, the main findings and discussions, and conclusion of the study.

2. Methodology

2.1 Data Type, Sources and Sampling Design

Secondary agriculture survey data was used from Central Statistical Agency (CSA) of Ethiopia. The sampling frame covered population from all rural areas of Ethiopia. The survey was carried out in 2019/20 considering the outputs of crops for 2018/19 production season, was designed in such a way that represent all regions including Amhara, Oromia, SNNPR (Southern Nation and Nationalities Region), and Tigray regional states of Ethiopia. The survey included 3,830 national-level representative farmers that are selected from all regions of the country (CSA, 2020).

2.2 Method of Data Analysis

In this study, the magnitude of perceived post-harvest losses of crops was estimated for all crops (such as cereals, pulse, oilseed, fruit, and vegetables). In the first phase, the status of post-harvest losses of crops was determined. In the second stage, the extent of post-harvest losses of crops is estimated by asking the estimated perceived post-harvest losses of all crops during field drying, transportation, winnowing, packaging, and storage of harvest crops. The concept of calculating perceived post-harvest loss is also applied by other researches in similar studies such as Hengsdijk and de Boer (2017) and Bachewe et al. (2018).

Tobit model is used when the status and extent of post-harvest loss are assumed to be influenced jointly or factors affecting them are assumed to be the same. Moreover, Tobit model is more applicable in truncated distribution of observations in the data set. In this study, perceived post-harvest loss of crops status has censored distributions due to the fact that a large number of farmers did not encounter post-harvest losses of crops. The censored distribution is a combination of continuous and discrete distributions because of the mass of observations at zero. Since the latent variable has a normal distribution, strictly positive values of perceived post-harvest loss status have a continuous distribution. The probability associated with latent variable values below or equal to the censoring point is summed to a single discrete value. Thus, the Tobit model uses all of the information, including information on censoring and provides consistent estimates (Cameron and Trivedi, 2009; Greene, 2012).

The model was developed by Tobin (1958) and perceived post-harvest loss observed for values greater than 0, i.e. for perceived post-harvest crop loss, but is not observed, i.e. censored or no perceived post-harvest crop loss for values of 0 or less. Accordingly, the model is specified as:

$$Y_* = \begin{cases} Y_i^* \ if \ Y_i^* > 0 \\ 0 \ if \ Y_i^* \leq 0 \end{cases} \quad \textbf{(1)}$$

Where, Y_* is observed variable and Y_i^* is latent variable which is the perceived post-harvest crop loss is explained by the following equation:

$$Y_i^* = \beta X_i + \mu_i \quad \textbf{(2)}$$

Where, X_i is observed demographic, socio-economic, farm specific attributes, marketing and institutional variable and β a vector of parameters and μ_i is a normally distributed error term which is a normally distributed with zero and constant variance of σ^2 which is explained by $\mu_i \sim \mathrm{N}(0, \delta^2)$

Based on McDonald and Moffit (1980), three marginal effects of the model are specified as:

i). The marginal effect on the latent variable (unconditional expected value):

$$\frac{\partial E(Y/X)}{\partial X_K} = \beta_K \Phi\left(\frac{X\beta}{\sigma}\right) \quad \textbf{(3)}$$

ii). The marginal effect on the expected value of observations conditional on being uncensored:

$$\frac{\partial E(Y/X, Y>0}{\partial X_K} = \beta_K + \beta_K \frac{\partial \lambda(c)}{\partial c} = \beta_K \left[1-\lambda(c)(c+\lambda(c))\right] < \beta_K \quad \textbf{(4)}$$

Where, $\lambda(c)$ is inverse mill's ratio.

iii). The marginal effect on the probability that observations are uncensored:

$$\frac{\partial \Pr(Y>0/X)}{\partial X_K} = \phi\left(\frac{X\beta}{\delta}\right)\frac{\beta_K}{\delta} \quad \textbf{(5)}$$

3. Results and Discussion

3.1 Descriptive Statistics Results

Cultivation of cereals, pulses, oilseeds, fruit, and vegetable crops are important food crops widely cultivated in different parts of the country. The survey result estimated 25.81% annual average perceived post-harvest losses of all crops. The quantity of self-reported post-harvest loss varies with the types of crops. Fruit and vegetables take the lead to the first by taking 33.38% of post-harvest loss. Cereal crops, the second and it take 23.36% of post-harvest loss. Pulses and oilseed the third and account 23.25% post-harvest loss during the cropping seasons. Moreover, as shown in Table 1, from the total interviewed farmers, 64.83% (2,483) encountered post-harvest losses of crops while the remaining 35.17% (1,347) did not perceive post-harvest losses of crops during the year.

Table 1 reports the mean or proportion values of the demographic, socio-economic, farm-specific, institutional, and marketing variables which are hypothesized to influence perceived post-harvest losses of crops. The result of the comparison for demographic and socio-economic characteristics shows that the average size of a household member was 3.84 in adult equivalence, 4.7 years of education attendance and 0.29 wealth indexes. Besides, farmers who did not encountered perceived post-harvest losses of crops have significantly higher mean household size (4.04), levels of education attendance (4.97) and wealth index (0.57) as compared to those who did not with mean household size (3.73), level of education attendance (4.65), and wealth index (1.37) and all are statistically significant with a mean the difference at 1 percent level of significance.

Table 1: Independent variables by perceived post-harvest losses of crops status

Variables	Total (n = 3,830)	Post-harvest loss (n = 2,483)	No loss (n = 1,347)	χ^2 or t-test
	% (frequency) or Mean (St.dev.)	% (frequency) or Mean (St.dev.)	% (frequency) or Mean (St.dev.)	
Demographic characteristics				
Sex of the Household head (*% male)*	50.52 (1,935)	51.62 (999)	48.37 (936)	7.55
Household size - *adult equivalent scale*	3.84 (1.94)	3.73 (1.920)	4.04 (1.993)	-4.716***
Socio-economic characteristics				
Education level- *years*	4.70 (2.35)	4.56 (2.33)	4.97 (2.37)	-5.226***
Total wealth index	0.29 (0.39)	1.37 (1.67)	0.57 (5.09)	-1.297***
Farm specific attributes				
Total landholding size in *hectare*	1.54 (0.64)	1.39 (1.92)	1.82 (5.34)	-2.191***
Insect pests infestation &/or rodent – Dummy	87.78 (3,362)	7.17 (241)	92.83 (3,121)	-3.14***
Availability of storage – Dummy	34 (1,302)	51.07 (665)	48.92 (637)	5.85
Institutional & Marketing characteristics				
Extension support services - *Dummy*	55.69 (2,133)	34.89 (744)	65.11 (1,389)	-3.11 ***
Cooperative membership – Dummy	39.11 (1,498)	40.65 (609)	59.34 (889)	-3.03***
Use of credit – Dummy	14 (535)	49.53 (265)	39.53 (262)	6.32
Distance to all weathered road *Km*	14.34 (21.55)	15.85 (27.96)	13.52 (17.04)	3.201***
Distance to nearest main market *Km*	59.74 (47.30)	66.20 (52.48)	56.24 (43.85)	6.253***

Source: Own computation based on CSA 2020 survey data

Comparison of farm-specific attributes explained in Table 1, the result shows the average landholding size was 1.54 hectare. Farmers who did not perceive post-harvest losses of crops have significantly higher mean landholding size 1.82 hectare as compared to others with a mean landholding size (1.39). Moreover, from the total 87.78 % of farmers encountered insect pests infestations and/ or rodent feeding on their storage of crops, the proportion is significantly higher among farmers who perceived post-harvest losses of crops (92.83%) than others with (7.17%) and a statistically significant proportion difference at a 5 percent level of significance.

In Table 1, the result of comparison for the institutional and marketing characteristics shows that the proportion of farmers who have taken extension support services related to post-harvest loss minimization techniques (65.11%) and farmers who are a member of cooperative marketing (34.89 %) was significantly higher among farmers who perceived post-harvest losses of crops than others and statistically significant proportion differences at a 1% level of significance. Moreover, the average distance from home to all weathered road was 14.34 km and to the nearest local the market center was 59.74 km. Farmers who did not perceive post-harvest crop losses of crops on averaged travelled a longer distance to all weathered road (15.85 km) and local market center (66.20 km) and both are statistically significant with a mean difference at a 1 percent level of significance.

3.2 Econometric Model Result

Tobit model result in Table 2 shows that the estimation of F statistics with a value of 13 is statistically significant at a l% level of significance, implying the adequacy of the model to estimate the relationship between the dependent and the selected independent variables. Further, the variables included in the model were tested for the problems of multicollinearity, heteroskedasticity, and model misspecification. As suggested by Arabmazer and Schmidt (1984), the problem of multicollinearity was checked using Variance Inflating Factor (VIF) and the mean value of VIF was found to be 1.19 indicating less degree of collinearity among explanatory variables. Following Breusch and Pagan (1979), the problem of heteroskedasticity was conducted using Breusch- Pagen test (λ^2 = 0.58, P = 04475) the result implying homoscedasticity in the of the error term. Moreover, the model misspecification was carried out using Ramsey's regression specification error test (RESET), and the results revealed with value of Ramsey test (F = 0.78, P= 0.4563) indicating that no omitted relevant variables in the model. Finally, the results of the model show that all coefficients of the variables hypothesized to influence post-harvest losses of crops have the expected sign and of the twelve variables included in the model, nine are found to have statistically significant effect on the status and extent of post-harvest losses of crops.

Table 2: Tobit model result and their marginal effects

Variables	Coefficient	Std. Error	Marginal effects: Unconditional Expected value	Marginal effects: Conditional uncensored	Marginal effects: Probability Uncensored
Demographic characteristics					
Sex of the household head	0.26	1.705	0.1843	0.1298	0.0022
Household size (adult equivalent)	-0.91**	0.437	-0.6401	-0.4511	-0.0077
Socio-economic characteristics					
Education level in years	-0.26*	0.144	-0.1807	-0.1273	-0.0022
Total wealth index	-0.075***	0.023	-0.0531	-0.0374	-0.0006
Farm specific attributes					
Total land holding size in hectare	-0.129***	0.047	-0.0913	-0.0643	-0.0011
Insect infestation and/or rodent attack	0.01**	0.002	0.0026	0.0018	0.0001
Availability of storage (Dummy)	0.79	2.037	0.5590	0.3939	0.0067
Institutional & marketing characteristics					
Extension support services	-5.55**	2.199	3.9137	-2.7579	-0.0472
Cooperative membership	-0.38**	0.166	-0.2642	-0.1862	-0.0032
Use of credit	0.85	2.377	0.6024	0.4245	0.0073
Distance to nearest main market	0.07***	0.009	0.0489	0.0344	0.0006
Distance to all weathered road	0.25**	0.107	0.1760	0.1240	0.0021
Constant	35.12***	6.719			
Log likelihood	-9309.29				
F (12, 2474)	13***				
Left-censored observations	808				
Uncensored observations	1678				
Right-censored observations	0				

Note: *, **, ***statistically significant at 1%, 5% and 10% respectively

Source: Model Result

3.3 Discussions

Demographic characteristics:

Family size (in terms of adult equivalent) in the household is negative and significantly influenced the status and extent of post-harvest losses of crops at one percent level of significance, indicating farmers with more adult family size were less likely encountered post-harvest losses of crops. This is due to the fact that most post-harvest activities area labor-intensive requiring more number of adult people. The various activities include; prompt harvesting, timely drying of crops, winnowing, packaging, and transportation to storage of harvested crops. A one percent increase in adult equivalent family size in the household would lead to 64.0%, 45.11% and 0.77% decrease unconditional (considering all observation), conditional (considering uncensored observation), and the probability of the proportion of post-harvest losses of crops, respectively (Table 2). The relationship between family size and post-harvest loss of grain crops was also obtained a similar result by Bachewe et al. (2018).

Socio-economic characteristics:

The average level of education of the household head has negatively and significantly affected the status and extents of post-harvest losses of crops at ten percent levels of significance. This implies that household head who attended more education level in years better understand and implement agriculture instruction, grasp written material, and able to integrate the technical skills with the tacit local knowledge of post-harvest management practices. Thus, a higher educational level attendance of the household head in years suggests as an important factor in decreasing the status and extents of post-harvest losses of crops. A one percent increase in the level of education of the household head in years would lead to 18.07%, 12.73% and 0.22% decreases the unconditional, conditional, and probability of the proportion of post-harvest losses of crops, respectively (Table 2). This is consistent with the research result of Hodges *et al*. (2011) and attendance of secondary education by Shee *et al*. (2019), Bachewe *et al*. (2018), and Tadesse *et al*. (2018).

The size of household wealth index has negatively and significantly affected the status and extents of post-harvest losses of crops at one percent level of significance, indicating being wealthier was less likely encountered post-harvest losses of crops. This is due to the fact that wealthier farmer get the required finance for purchasing various post-harvest handling technologies such as hermetic metal silo and Purdue improved crop storage bag. This is might also indicate the provision of rural credit services for post-harvest handling purposes might also rectify the shortage of finance for poor farmers. A one percent increases in the wealth index would lead to 5.31%, 3.74%, and, 0.06% decreases in the proportion of unconditional, conditional, and probability of post-harvest losses of crops, respectively (Table 2). A study by Bachewe et al. (2018) obtained a similar result in their studies.

Farm specific attributes:

The size of a farm in hectare has negatively and significantly affected the status and extent of post-harvest losses of crops at a five percent level of significance, implying farmer households who own relatively large farm sizes were encountered less post-harvest losses of crops than others. This is due to large farm size owners' produce more production and hence earn adequate income for purchasing the various post-harvest handling technologies. A one percent increase in the size of a farm in hectare would lead to 9.13%, 6.43%, and 0.11% decrease in the unconditional, conditional, and probability of proportion of post-harvest losses of crops, respectively (Table 2). However, some other studies such as Magingxa *et al*. (2009) and Taddesse et al. (2018) found a positive relationship between landholding size and post-harvest losses on various crops. They explained their reason large producer farmers might face various constraints related to post-harvest handling practices such as shortage of storage and its facilities.

Damage by insect pests infestations and/ or rodent feeding while storage has negatively and significantly affected the status and extent of post-harvest losses of crops at five percent levels of significance, implying farmers who face damage to insect pests infestations and/or rodent feeding during storage was encountered post-harvest losses of crops as compared to those farmers who did not. This is probably due to poor storage management and facilities, inadequate knowledge of diseases control methods. The farmers who face damage of insect and pest infestations and/or rodent feeding during storage as compared with those who did not would lead to 0.26%, 0.18%, and 0.01 % increases the unconditional, conditional, and probability of the proportion of post-harvest losses of crops, respectively (Table 2). A significant amount of post-harvest losses of crops occurred due to rodents/ pests/ insect attacks on storage (Dubale, 2018; Hogges et al., 2011; Hengsdijk and de Boer, 2017).

Institutional & market characteristics:

Extension support service is given to smallholder farmers in response to reducing post-harvest losses of crops was negative and significantly affected the status and extent of post-harvest losses of crops at 5 percent levels of significance. The result implies farm households who receive extension support service were less likely encountered post-harvest losses of crops than those who did not receive extension support services. This is because the extension support service gives to farmers via development workers and/ or non-governmental organizations (such as SG2000 and FOA) have an important role in creating awareness and dictating post-harvest loss of minimization techniques. Some of such techniques include cultivation of diseases resistant crops, prompt harvesting, proper drying of crops before storage, and techniques of treatments of crops with pesticides during the storage. Farmers who receive extension services as compared with those who did not would lead to 91.37%, 75.79%, and 4.72% decrease the unconditional, conditional, and probability of the proportion of post-harvest losses of crops, respectively (Table 2). A similar study also confirmed by FOA (2017). Farmers' membership in cooperative marketing has negatively and significantly affected the status and extents of post-harvest losses of crops at five percent levels of significance, implying farmers who are members of cooperative marketing was less likely encountered post-harvest losses of crops. This is probably because the farmer who is a member of cooperative marketing gets an advantage of additional resource related to storage and transportation of their production to the market. A farmer who is a member of farmer cooperative marketing as compared with who did not would lead to 26.42%, 18.62%, and 0.32% deceases the unconditional, conditional, and probability of the proportion of harvested crop losses, respectively (Table 2). Distance from the nearest local the market in km has positively and significantly affected the status and extents of post-harvest losses of crops at one percent level of significance, indicating farmers who live far away from the nearest local market were more likely encountered post-harvest losses of crops. This is due to a higher transaction cost associated with a lack of market information, contamination, and mechanical injuries associated with the longer distance travel to supply to the market and hence the magnitude of losses increases especially for fruits and veritable. A one percent increases in the distance to the nearest local market in km would lead to 4.89%, 3.44%, and 0.06 % decreases in the unconditional, conditional, and probability of the proportion of post-harvest losses of crops, respectively (Table 2). Similar results also obtained by Hengsdijk and de Boer (2017), Gilbert et al. (2017), Kasso et al. (2016), and Tadesse et al. (2018). Distance from the nearest all weathered road in km has positively and significantly affected the status and extents of post-harvest losses of crops at a five percent level of significance, indicating farmers who live far away from the nearest all weathered road were more likely encountered post-harvest losses of crops. The higher losses of crops might be occurred during transportation of their produce to the market using pack animals (donkey or horse cart), mini-track, and/or own labor (carrying sacks). A one percent increase in the distance to the nearest local market in km would lead to 17.6%, 12.4%, and 0.21% increases in the proportion of the unconditional, conditional, and probability of post-harvest losses of crops, respectively (Table 2). A similar result also obtained by Arah et al. (2017), Emana et al. (2017), Hengsdijk and de Boer (2017) in their respective studies.

4. Conclusions

Reduction of wastage and post-harvest losses of crops between farm and market is crucial tasks to minimize the food gaps and thereby to ensure food and nutrition security in Ethiopia. However, a lack of understanding of the extent and associated contributing factors are posing major challenges for the effective implementation of grain post-harvest loss management strategies and to scale up for all other crop types in Ethiopia. Therefore, this study aims for assessing the extent and determinants of post-harvest losses of all crops in Ethiopia. Both descriptive and Tobit econometrics model were applied using large scale national-level representative agriculture survey data from CSA of Ethiopia. The result shows 25.81% annual average perceived post-harvest losses of crops were obtained with considerable variation across the crop types. The magnitude of post-harvest losses of crops is first for fruit and vegetables (33.38%), second for cereals (23.36%) and third for pulse and oilseed crops (23.25%). Post-harvest losses of crops were affected by the socio-economic, farm-specific, institutional and marketing factors. Among socio-economic variables– households with larger family sizes, higher education attendance, and being wealthier. Farm specific variables- households with large landholding size and damage of insect pests infestation and/or rodent attack during storage of harvested crops. Institutional and marketing variables– households who receive extension support services related to post-harvest management practices, cooperative marketing membership, and being far away from both all weathered roads and near the local market center. Therefore, minimization of post-harvest losses of crops, contribute to the achievements of national (GTP-II) and international (Malabo Declaration and SDGs) targets and thereby achieving food security could be mentioned via a holistic approach. The approach calls active involvements of the national and/or regional government in collaboration with privet and NGOs - development partners. These activities include providing short and long term training on post-harvest management practices in general and particularly on the application of post-harvest handling technologies which helps for reducing the damage of stored crops by insect pests infestation, rodents feeding and mould contamination, strengthening the existing institutional support system (agricultural extension and credit services) by paying special attention to the public and privet investment on the use of post-harvest loss management practices, strengthening the government efforts of supplying post-harvest technologies in various means such as leaving a duty-free tax, providing subsidies & financial support for local industries as stated on PMS, reinforcing the existing farmer cooperative marketing, improving both the local market and road networking infrastructure of rural areas of the country. In addition, the focus of grain post-harvest management strategy of the country should be scale upped to all types of crops.

Finally, this research suggested some possible areas for future researchers: The study applied CSA data and measured post-harvest loss by asking the estimated perceived quantitative post-harvest losses of crops considering 2019/20 cropping season production. It could be better to measure the magnitude of post-harvest losses as suggested by FOA (2017) methodologies and also be good to estimate separately the magnitude and identify associated impeding factors for each post-harvest activity to provide specific policy recommendations.

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Adoption of Improved Soybean Varieties and their Impact on Households' Food Security: The Case of Pawe Woreda, Western Ethiopia

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Abstract

The study has analyzed the impact of adoption improved soybean variety on food security of smallholder farmers in Pawe District. The data have been collected from Pawe district of Benishangul Gumuz Region, Ethiopia, in the 2019 main season. The survey has consisted of 384 households out of whom 227 have been adopters of improved soybean varieties. In the study logit and Tobit models have been used to analyze factors affecting adoption probability and adoption intensity of improved soybean varieties respectively. An endogenous switching regression (ESR) model has been used to analyze the impact of improved soybean varieties on households' food security; i.e., *using food security scale, food consumption score, and household dietary diversity score as proxy variables. The results have showed that education level, total land owed, the existence of neighbor adopters, credit, perception, training, and total household income were found to be the driving factors of adoption probability and use intensity of improved soybean varieties. The ESR model results have prevailed that adoption of improved soybean varieties increases the average dietary diversity score and food consumption scale by 0.53 and 5.91 points respectively. Consistently, the food security scale estimation result also has shown that adoption of improved soybean varieties reduces food insecurity by 2.56 units. The results suggest that promotion and adoption of improved soybean varieties will improve the nutritional status of the farming households.*

Keywords: Adoption, Endogenous switching regression model, Food security, Improved Soybean Variety, Impact, Ethiopia

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1. Introduction

Food insecurity is one of the major challenges the world has been facing for a long period (Jaleta M. *et al*., 2015); (FAO, 2017). The prevalence of food insecurity is even more complex in regions with increasing population growth leading to more people under malnutrition (Brown GW.*et al.*, 2008; Pachapur PK. *et al*.,2020). Recent data showed that 0.8 billion people in the world are undernourished, out of which 28% of them are living in sub-Saharan Africa and more than half are living in East Africa (McGuire S. FAO, IFAD;WFP, 2015 and (Abdulselam Abdulahi, 2017)).

Likewise, in Ethiopia, poverty and food insecurity remain to be the major development challenges. Food insecurity is a prolonged problem in Ethiopia. Specifically, 23.5 percent of the population is living under poverty (Ayele *et al*. BMC Public Health, 2020). The country is ranked 104th out of 119 countries labeled as "serious hunger" based on the Global Hunger (MoFED, 2014). To this end, the government has set a clear agricultural development policy to reduce the challenge and help millions of smallholders' farmers to escape out of the food insecurity trap. Among others, the support by agricultural research and extension endeavors particularly on improving the production and productivity smallholder farmers is one. In this regard, effort that has been made on soybean research and extension is a good example period (Jaleta M.*et al*., 2015).

Soybean (*Glycine max*) is a multipurpose and drought tolerant crop that can be utilized as food and animal feed. Specifically, soybean can be used for making soymilk (Bekabil UT., 2015). The crop is an important source of cash for smallholders and generates export earnings for the country (Iticha MD. and Taresa B., 2020). There is also a prospect of integrating soybean to the common food crops such as maize through intercropping thereby reducing fertilizer costs and increasing profitability of smallholder farming (Kebebew S. *et al*., 2016). Soybean is also an alternative food crop to address malnutrition among agriculture dependent communities, as it comprises more than 36% protein, 20% oil, 30% carbohydrates, dietary fiber, minerals and vitamins (Kebebew S. *et al*., 2016; Sales P, V. G.*et al*.,2016). Since its introduction in Ethiopia in the early 1950s, soybean has become one of the most important lowland grain legumes in the country. Furthermore, soybean covers a total cultivated area of 40000 ha and total production of 98000 tons and productivity of 2450 kg/ha in Ethiopia (FAOSTAT, 2018).

Globally, soybean is the primary source of edible oil with the highest gross output of vegetable oil. Therefore, the demand for soybean has been increasing worldwide (Mubichi F., 2017). Despite the increasing demand globally and convenient environmental conditions locally, soybean production and productivity remained low in Ethiopia particularly in Pawe *woreda* (Abate T. *et al*., 2012). The second growth and transformation plan (GTP, II) for the period 2014/15-2019/20 therefore has aimed to increase soybean production from 0.72 million quintals in 2015 to 1.2 million quintals by the year 2020 to meet the demand of households' food security. In line with this, during the period of 2008 through 2016, the area, production and yield of soybean in the country have increased by 30.8%, 45.4% and 11.2% per annum respectively (Bekele A. *et al*.,2018). These figures show that there is an upward shift in area allocated for soybean and hence total production. However, the gain from increased yield is only limited due to low adoption rates of improved soybean varieties (Iticha MD. and Taresa B., 2020). Among others, adopting improved soybean varieties is a major cause for improved yield.

Most, if not all, improved soybean varieties have large number of pods and seeds per pod, and ability to adapt to local conditions. They are also early maturing and perceived to be easy for cooking compared to local varieties (Tesfaye A. *et al*., 2013). In Pawe, soybean is the major crop produced by many farmers, but the adoption rate of improved soybean varieties is still low. Hence, this study was motivated to study the determinants of adoption and its effect on households' food security.

It is acknowledged that there are empirical studies on adoption of soybean varieties in Ethiopia (Nelson K. M.,2013; Ketema M. *et al*.,2016; Iticha M. D. and Taresa B., 2020). However, these studies have not addressed the impact of adoption on households' food security. Hence, the study has investigated the demographic and socio-economic characteristics of farmers that influence the probability and level of adoption of improved soybean varieties and its impact on farm household food security. More importantly, the current study has used three different but related measures of food security; i.e. household dietary diversity score (HDDS), food consumption score (FCS) and food security scale (FSS) – to account for different dimensions of food security.

2. Data and Variable Definition

2.1 The Study Area

The study has been conducted in Pawe district of Benishangul Gumuz Regional State, Ethiopia. Pawe is one of the seven districts of Metekel Zone. The district is located about 575 km away from Addis Ababa and 378 km from the regional capital city, Assosa. The district has an estimated total population of 49,758 of whom 24,438 are women. The area has hot and humid temperature and it is characterized by a unimodal rainfall pattern with high and torrential rainfall that extends from May to October. The area receives a mean annual rainfall of 1586.32 mm (Miruts F., 2016).

The total area of the district is 63,400 hectares of land out of which 50.4% of the land is suitable for the cultivation of different crops. The farming system in the area is dominated by mixed crop-livestock production, which accounts for 96% of the population and 3.8% involved only in livestock production. The types of crops grown in the area include cereals (maize, sorghum and finger millet), oil crops (sesame and groundnuts), vegetables, fruits (mainly mango and papaya), pulses (mainly haricot bean and soybeans). The area also grows nine released soybean varieties which have been obtained from Pawe Agricultural Research Center which is the national coordinating center for soybean research in Ethiopia (Getahun A. *et al*., 2016).

2.2 Data Type and Source

The study has used both primary and secondary data. A structured questionnaire has been employed to obtain the primary data. The questionnaire has been coded and programmed on Kobo toolbox, and the data have been collected by trained enumerators. The household level data have been collected through house-to-house survey. Interviews with key informants including development agents (DAs) based in each *kebele* and *woreda* agricultural experts have been also conducted face to face. A check list has been prepared to collect qualitative data from experienced adopters of improved soybean varieties (ISV) through focus group discussion (FGD). The study has also consulted secondary data from the zonal and district agricultural offices' annual report and Pawe agricultural research center.

2.3 Sampling Techniques

The study has used a multistage sampling technique to select the sample respondents. In the first stage, Pawe *woreda* has been selected purposely for its long years of experience in the adoption of improved soybean varieties. In the second stage, four *Kebeles* have been selected randomly. Finally, the entire list of households including improved soybean adopters and non-adopters in each Kebele is prepared separately. These lists have been used as a sampling frame to draw the final list of households, using a random sampling technique proportional to size. Accordingly, 227 adopters and 157 non-adopters households of improved soybean variety have been selected for a face-to-face interview.

Table 1: Sample size by Kebeles and adoption of ISVs

Name of Kebeles	Adopters	Sample	Non-adopters	Sample	Total Sample
Kebele 9/10	175	68	150	58	126
Kebele 28/29	105	41	55	21	62
Kebele 30	227	89	128	49	138
Kebele 23/45	75	29	75	29	58
Total	**555**	**227**	**435**	**157**	**384**

Own source, 2019

2.4 Variable definition and hypothesis

The full range of food insecurity and hunger cannot be captured by any single indicator (Bickel G. *et al.*, 2000). Hence, in the study we adopt three measures of food security (i.e. HDDS, FCS, and FSS) to account for different dimensions of food security.

Outcome variables

According to FAO (2010), the HDDS measures a household's economic access to food and can be calculated by summing a number of food groups consumed by the household over the last 24-hour recall period. For this, respondents were asked whether they consumed the 12 food groups and their "yes" responses are coded as 1 and the negative response are labeled as "no" and coded as 0. The next step is summing the dietary diversity variable values of all food groups to get a potential score that ranges from 0 to 12. The higher score has indicated that households consumed more diversified food groups. The households with HDDS values of ≤3, 4-5 and ≥ 6 are categorized as low, medium and high dietary diversity respectively (FAO, 2011).

The second food security indicator used in this study is FCS. According to WFP, 2008 the FCS is a composite score based on dietary diversity, food frequency, and relative nutritional importance of different food groups. The FCS can be calculated using the frequency of consumption of different food groups consumed by a household during the 7 days before the survey. The following four procedure have been followed to calculate the FCS: (i) group all the 16 food items into the nine food groups (ii) sum all the consumption frequencies of food items of the same group, and recode the value of each group above 7 as 7 (iii) multiply the value obtained for each food group by its weight (the standard weights for main staples 2, pulses 3, vegetables 1, fruit 1, meat and fish 4, milk 4, sugar 0.5, oil 0.5, condiments 0) and create new weighted food group scores and, (iv) sum the weighed food group scores, thus creating the food consumption score (FCS). As done for HDDS, the households with FCS of 0-21, 21.5-35, and >35 are characterized as poor, borderline, and acceptable household consumption respectively (WFP, 2008).

The third measure of food insecurity adopted in this study is FSS. Following Bickel G.*et al*., 2000 FSS can be measured using 18 food security questions that provide with the statistically strongest set of indicator items for constructing a 12 months measurement scale. The sum of affirmative ("Almost every month", "Often true", "Sometimes true", and "Yes" are coded as 1) and negative responses ("Never true", "only one or two months", "No", and questions that a household does not answer because it has been screened out, coded as 0) provide the FSS. According to Price V. *et al*.(1997), this measure expresses the household's level of food security or insecurity in terms of a numeric value that ranges between 0 and 10. The scale values of 0, indicating that households have not experienced any of the conditions of food insecurity and the scale value 10 refers to the most severe level of food insecurity. More specifically, households with children having a scale value of 0-1.6 (0-2 affirmative response), 2.3-4.3 (3-7 affirmative responses), 4.7-6.4 (8-12 affirmative response), and 6.8-10 (13-18 affirmative responses) out of the 18 food insecurity questions, are classified as food secure, food insecure without hunger, food insecure with hunger, and food insecure with severe hunger, respectively. Household without children having a scale value of 0-2 (0-2 affirmative responses), 2.8 - 4.3 (3-5 affirmative responses), 5-6.5 (6-8 affirmative responses) and 7.5-8.2 (9-10 number of affirmative responses) also were classified as food secure, food insecure without hunger, food insecure with hunger, and food insecure with severe hunger, respectively.

Participation in improved soybean variety adoption (ISV): a dummy variable that takes the value of 1 if the household participated in adoption of soybean variety (if adopting) and 0 otherwise. Intensity of improved soybean variety adoption is a continuous variable measured as a proportion of cultivated land allocated for improved soybean varieties to the total land covered by soybean crop (measured in percent).

Independent variables

Selection of the variables used in this study is mainly based on a literature review. Table 2, below presents the variable definition, measurement and hypothesis on adoption and ISV use intensity.

Table 2: Measurement and definition of explanatory variables

Variable name	Variable definition and measurement	Hypothesis
SexHH	= 1 if sex of the household head is male and 0 otherwise	+
AgeHH	Age of the household head (years)	+
Education	Education level of the household head measured in completed years	+
FamSize	Total number of people living in the house for more than 6 months	+
FarmSize	Total area of cultivated land the household owned (hectares)	+
Livestock	Livestock holding of the household in tropical livestock unit (TLU)	+
FarmExp	Farming experience of the household head (years)	+
MktDistance	Distance from the residence to nearest market (minutes of walk)	
NeighborAdopt	= 1 if the household has a neighbor who adopted ISV and 0 otherwise	+
Perception	= 1 if the household perceives that ISV are early maturing and 0 otherwise	+
Credit	= 1 if the household has access to credit and 0 otherwise	+
Extension	Household's frequency of contact with the extension agent in the last one year	+
Training	= 1 if the household has attended formal training on agricultural technology and 0 otherwise	+
MktInfo	= 1 if the household has market information and 0 otherwise	+
HHIncome	Total income of the household measured in Ethiopian birr	+

Source: From Literature, 2019

3. Estimation Strategy

3.1 Participation Model

Binary logistic regression is typically used when the dependent variable is dichotomous and the independent variables are either continuous or categorical. The treatment decision is defined as a binary outcome of the use of improved soybean varieties by households in the sample, with "1" assigned to households that were adopters and "0" otherwise. Hence, the response probability by household can be expressed as follows.

$$P_i = F(Z_i) = F(\beta x_i) = \left\{\frac{1}{1+\exp(-Z_i)}\right\} = [\exp(Z_i)]/[1+\exp(Z_i)] \quad \textbf{(1)}$$

Where $F(Z_i)$ is the value of the logistic cumulative density function associated with each possible value of the underlying index, Z_i and x_i and are the independent variables that will influence this decision is a linear combination of the independent variables such that:

$$Z_i = \beta_o + \beta_1 x_{i1} + \varepsilon_i \quad \textbf{(2)}$$

Where Z_i is the unobserved index level or the logarithm of the odds ratio of the i^{th} observation; β is the parameter to be estimated; and ε_i is a random error or disturbance term. The coefficients in the Logit analysis are estimated using maximum likelihood and serve the purpose of indicating a direction of influence on probability. The marginal effect of each of the independent variables is calculated and indicated by the calculated changes in probabilities (Maddala G. S., 1992).

Following (McDonald J. F. and Moffitt R. A. (1980), the level of adoption of improved soybean varieties can be analyzed using the Tobit model, and it can be expressed mathematically as:

$$Y^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_n X_n \ldots\ldots\ldots + \mu_i$$
$$Y = Y^* \text{ if } Y^* > 0 \; and \; Y = 0, \; if \; Y^* < 0 \quad \textbf{(3)}$$

where Y is the observed dependent variable, in this case the proportion of area under improved soybean varieties in the total cultivated areas; Y^* = is the latent dependent variable, which is not observable, X refers to explanatory variables, β is a vector of

Tobit maximum likelihood estimates, and μ_i is an independently and normally distributed error term with mean zero and constant variance.

3.2 Impact model

Following Becerril and Abdulai (2010) and Khonje *et al.* (2015), the households' decision to adopt improved soybean varieties using a random utility framework can be modeled as follows. Let A_i represent the difference between the utility from the adoption of improved soybean varieties (U_{i1}) and the utility from using the local variety (U_{i0}). The farmer chooses to adopt improved soybean varieties if the utility from adoption is greater than the utility from local variety (i.e. $U_{i1} - U_{i0} > 0$). However, the two utilities are non-observable and the net benefit, A_i which the farmer gains from adoption is a latent variable determined by observed and unobserved characteristics given in Equation (1)

$$A_i^* = X_i\beta + \varepsilon_i \text{ where } A_i = \begin{cases} 1 & \text{if } A_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad \textbf{(4)}$$

Where A_i is a binary variable representing the adoption of improved soybean varieties; β is a vector of parameters to be estimated; X stands for a vector of socioeconomic and institutional characteristics that influence adoption of improved soybean varieties, and εi represents the random error term.

The relationship between the adoption of improved soybean varieties and its impact on households' food security (i.e. measured by HDDS, FCS, and FSS) can be modeled as follows:

$$Y_i^* = Z_i\,\partial + \theta Ad_i + u_i \quad \textbf{(5)}$$

where Y_i^* represents the households' food security, Z_i stands for a vector of explanatory variables, Ad_i refers to the adoption of improved soybean varieties, ∂ and θ are vectors of parameters to be estimated, and u_i is an error term.

The impact of the adoption of improved soybean varieties on the households' food security is therefore measured by the estimations of the parameter θ if farmers are randomly assigned to adopter or non-adopter groups (Faltermeier and Abdulai 2009; Khonje *et al.* 2015). However, since farmers themselves decide to adopt the technology based on the information they have, adopters and non-adopters may not be randomly distributed to the two groups leading to selection bias ***(Amare M.**et al.**, 2012)***. Selection bias is a common challenge in estimating impact.

Recent empirical studies (Asfaw *et al.* 2012; Khonje *et. al.* 2015 and Mohammed E., 2019), that measured the impact of agricultural technologies have indicated the existence of unobservable factors. Therefore, with this premise, it is possible to implement ESR to correct the selection bias due to observable and unobserved household characteristics. For the ESR model to be identified, it is important to include selection instruments that affect the adoption decision but have no direct effect on food security outcome variables (Shiferaw B. *et al.*, 2014). Accordingly, following Khonje M. *et al.*, 2015; Di Falco SADIF. *et al.*, 2011), it is possible to included distance from cooperatives as selection instruments and conducted a simple falsification test. The test results show that the identified instruments are jointly significant in explaining adoption [chi^2 = 36.22 (p = 0.000)] but are not jointly significant in the outcome equation [F = 0.73(0.3956)].

The ESR model is estimated in two stages. In the first stage (adoption equation), the farmer's decision to adopt soybean improved variety or not is estimated using a logit model. In the second stage the two outcome regression equations faced by the farmers: to adopt (regimes 1) and not to adopt (regimes 2) conditional on adoption can be expressed as:

$$Regime\ 1\ (Adopters): Y1i = \beta 1x_i + \delta_{\varepsilon 1}\lambda_{i1} + \eta 1_i \quad if\ Ai = 1 \qquad (\boldsymbol{6a})$$

$$Regime\ 2\ (non-adopters): Y_{2i} = \beta_2 x_i + \delta_{\varepsilon 2}\lambda_{i2} + \eta_{2i} \quad if\ Ai = 0 \qquad (\mathbf{6b})$$

Where Y_i -is the FSS, FCS and HDD in each regime, represents a vector of exogenous variables expected to affect food security, $\lambda_{1i} = \frac{\phi(\mathrm{Z}\iota\alpha)}{\phi(\mathrm{Z}\iota\alpha)}$ and $\lambda_{2i} = \frac{\phi(\mathrm{Z}\iota\alpha)}{1-\phi(\mathrm{Z}\iota\alpha)}$ are the inverse mill's ratio (IMRs) computed from the adoption equation (first stage) to correct the selection bias in the second stage estimation, β and σ are the parameter to estimated and η is an independently and identically distributed error term with mean zero and constant variance.

Following Di Falco *et al.*, (2011) and Asfaw *et al.*, (2012*)***,** the expected values of the outcomes (FSS, FCS and HDD) of adopters and non-adopters in actual and counterfactual scenarios are computed as follows:

Actual adopters (observed in the sample): $\mathrm{E}\ [\mathrm{Y}_{i1} A_i = 1;\ \mathrm{x}] = X_{i1}\beta + \delta_{\varepsilon 1}\lambda_{i1}$ **(7a)**

Actual non-adopters (observed in the sample): E $[\mathrm{Y}_{\mathrm{i}2} A_i = 0;\ \mathrm{x}] = X_{i2}\,\beta + \delta_{\varepsilon 2}\lambda_{i2}$ **(7b)**

Adopters had they decided not to adopt (counterfactual): E $[\mathrm{Y}_{\mathrm{i}2} A_i = 1;\ \mathrm{x}] = X_{i1}\,\beta + \delta_{\varepsilon 2}\lambda_{i1}$ **(7c)**

Non-adopters had they decided to adopt (counterfactual): E $[\mathrm{Y}_{\mathrm{i}1} A_i = 0;\ \mathrm{x}] = X_{i2}\,\beta + \delta_{\varepsilon 1}\lambda_{i2}$ **(7d)**

Finally, the average treatment effect of the treated (ATT) and of the untreated (ATU) can be obtained from the above ESR framework by using comparison of the expected values of the outcomes of adopters and non-adopters in actual and counterfactual scenarios. Specifically, the ATT, which represents the effect of improved soybean varieties on the HDDS, FCS and FSS of the farm households that actually adopted the technology, is calculated as the difference between (7a) and (7c) as follows:

$$\mathrm{ATT} = \mathrm{E}\,[Y_{i1}|A_i = 1;\ \mathrm{X}] - \mathrm{E}\,[Y_{i2}|A_i = 1;\ \mathrm{X}] = \mathrm{X}_{i1}\,\beta + \delta_{\varepsilon 1}\lambda_{i1} - \mathrm{X}_{\,i2}\beta + \delta_{\varepsilon 2}\lambda_{i2} \quad \textbf{(8)}$$

Similarly, we can calculate the ATU for the farm households that actually did not adopt improved soybean varieties as the difference between (7d) and (7b) as:

$$\mathrm{ATU} = \mathrm{E}\,[\mathrm{Y}_{\mathrm{i}1} A_i = 0;\ \mathrm{x}] - \mathrm{E}\,[\mathrm{Y}_{\mathrm{i}2} A_i = 0;\ \mathrm{x}] = X_{i2}\,\beta + \delta_{\varepsilon 1}\lambda_{i2} - X_{i2}\,\beta + \delta_{\varepsilon 2}\lambda_{i2} \quad \textbf{(9)}$$

Finally, transitional heterogeneity (TH) can be estimated as a difference between ATT and ATU.

4. Results and Discussions

4.1 Descriptive Statistics

Table 3 below presents summary statistics of the outcome variables by adoption category. Based on the three food security measures adopted in this study (HDDS, FCS, and FSS), the results consistently show that households who adopt ISVs are more food secure than non- adopters, at 1% significance level. Specifically, share of adopters and non–adopters with “high” HDD score were found to be 57% and 45%, respectively. The FSS indicator also shows that 96 percent of adopters are food secure, while only 33% of non–adopters are food secure. Other results of Table 3 can be discussed in a similar fashion. However, it is important to note that it is not possible to make a conclusion based on these results as there may be a confounding effect.

Table 3: Summary of outcome variables, by adoption status

Variables	Adopters (n=227)		Non-adopters (n=157)		Total (n=384)		X^2–Value
	Freq.	Perce.	Freq.	Perce.	Freq.	Perce.	
HDDS Categories							
Low	11	4.85	26	16.56	37	9.64	16.107***
Medium	86	37.89	61	38.85	147	38.28	
High	130	57.27	70	44.59	200	52.08	
FCS Categories							
Poor	19	8.37	26	16.56	45	11.72	19.0539***
Borderline	58	25.55	62	39.49	120	31.25	
Acceptable	150	66.08	69	43.95	219	57.03	
FSS Categories							
Food secured	220	96.92	52	33.12	272	70.83	182.947***
Food insecure w/out hunger	5	2.20	69	43.95	74	19.27	
Food insecure with moderate hunger	1	0.44	10	6.37	11	2.86	
Food insecure with sever hunger	1	0.44	26	16.56	27	7.03	

Source: Authors calculation, 2019

Table 4 below discusses descriptive statistics of explanatory variables used in this study. The results presented in the last column of Table 4 shows statistical tests of mean difference for continuous and dummy variables. Overall, the results show that, with some exceptions (i.e. education and household income), there is significant difference in household and farm characteristics between adopters and non–adopters.

The results show that adopters have significantly larger family size and are older than their counterparts. Adopters of ISV were also found to have more assets (measured by livestock and farm size) than non-adopters.

Table 4: Summary statistics of explanatory variables, by adoption status

Variables	Non- adopter (N=157)	Adopter (N=227)	Total (N=384)	t-value/ Chi-square value
Age of household head	47.3(0.76)	49.05 (0.60)	47.41	-1.81*
Sex of household head	0.78 ( )	0.88 ( )	0.84 ( )	-2.71***
Education	1.42(0.34)	1.67 (0.30)	1.57	-0.25
Family Size	4.16(0.14)	4.88 (0.11)	4.59	-3.96***
Farm Experience	23.21(.77)	24.80 (0.60)	23.21	-1.65*
Farm Size	2.24(0.09)	2.59(0.06)	2.45	-3.33***
Extension	0 .993(0.13)	2.32(0.09)	1.78	-8.17***
Neighbor Adopt	0.14 ( )	0.79 ( )	0.53 ( )	-16.39***
Market Distance	107.8 (8.59)	183.1 (7.74)	152.33	-6.44***
Training	0.20 ( )	0.81 ( )	0.56 ( )	-14.52***
Market information	0.59 ( )	0.94 ( )	0.79 ( )	-4.74***
Credit	0.11 ( )	0.32 ( )	0.23 ( )	-4.82***
Livestock	3.56 (0 .16)	4.75 (0.12)	4.26	-6.16***
Annual Income	11652 (7908.5)	11241.9(8148.2)	11409.6	0.49

Notes: Values in parenthesis are standard errors; ***, **, and * denote 1, 5 and 10 percent significance level.

4.2 Econometric Analysis

The study used econometric analysis to examine the determinants of improved soybean varieties and their impact on household food security. Accordingly, Table 5 below discusses the factors that drive households to adopt improved soybean varieties. Education level of the household head has been found to have a positive and significant relation with adoption of the improved soybean varieties. Educated respondents are 1.7% more likely to adopt at ISV, *ceteris paribus*, possibly because education empowers individuals with technological skill and ability to analyze information and knowledge (Faturoti B. O. *et al*.,2006).

The total land owned by farmers has been also found to have a positive effect on adoption of improved soybean varieties at 1% significant probability level. The marginal effect of the output shows that, as the total area of the land increases by 1 hectare the probability of adoption increases by 18.6%, *ceteris paribus*. The result of this study has been consistent with prior expectation and Bukul B. B. *et al.*, (2018). Likewise, the existence of neighbor adopters is also associated with the adoption of improved soybean varieties at 1% of significant level. Farmers whose neighbors adopt ISV are 45.7% more likely to be adopting improved soybean varieties than their counterparts. This result is intuitive as farmers could learn about the new agricultural technologies and build trust from their neighbor. The other possible explanation is that the neighbor producer farmers could be the source of seed. This result is in line with Foster A. D. and Rosenzweig (2010) who found a positive association between adoption of technologies and prior extent of adoption by neighbors.

Credit is another factor that drives farmers' decision to adopt improved variety. Farmers who have got credit were 17.8% more likely to adopt the new varieties of soybean, *ceteris paribus.* Credit improves farmer's cash constraint and hence the purchasing capacity to pay for improved soybean varieties. This result is in line with previous empirical studies Zelalem (2007 and Abadi *et al.* (2015)**.** Results of the study also prevailed that participation in training has a positive and significant effect on adoption of ISV. On average, farmers who participated in training are 31% more likely to adopt ISV than those who don't participate in the training, *ceteris paribus*. This is similar to a previous finding by Musba Kedir (2017)**.** Income of the household is another factor that affects the probability of adopting ISV. Keeping other factors constant, a hundred birr increase in household's income increases the probability of adoption of improved soybean varieties by 0.2%. This result is in line with our prior expectation as adoption of modern agricultural technologies requires financial resources. This result is consistent with findings of Ahmed M. H. *et al*. (2017).

Table 5: Factors affecting probabilities of adoption (Logistic regression model)

Variables	Marginal effect(dy/dx)	Standard error	P>|z|
AgeHH	0.005	0.006	0.369
Education	0.016**	0.008	0.044
SexHH	0.031	0.101	0.756
FamSize	0.021	0.024	0.372
FarmExep	-0.006	0.006	0.297
FarmSize	0.186***	0.037	0.000
MktInfo	0.049	0.056	0.375
Perception	0.029	0.041	0.478
NeighborAdopt	0.456***	0.067	0.000
MktDistance	0.0003	0.000	0.313
Credit	0.178***	0.067	0.008
Extension	-0.023	0.025	0.362
Training	0.311***	0.086	0.000
Livestock	-0.004	0.019	0.840
Annual Income	0.002***	0.000	0.002
Constant term	-5.710***	1.293	0.000
Number of obs = 384 LR chi2(15) = 258.32 Prob > chi2 = 0.000 Log likelihood = -130.592 Pseudo R^2 = 0.497			

Note: ***, ** and * are significance at 1%, 5% and 10% respectively.

Table 6 presents the factors affecting intensity of adoption. The Tobit model result shows that family size, having neighbor adopters, perception about earliness of ISVs, participation in agricultural training, credit, and the size of cultivated land significantly affect adoption of improved soybean varieties. The result showed that an increase in family members by one person increases the extent of adoption of ISV by 0.47%. The result in lined with Samuel Diro and Wondaferahu Mulugeta (2015), on their study determinants of adoption of soybean and its impact on the livelihood of smallholder farmers in Jimma zone, found similar results. Likewise, the existence of neighbor adopters and the proportion of area allocated for improved soybean varieties have been positively related with intensity of adoption at 1% significance level. This result is in line with Ebrahim M. (2019).

Table 6: Intensity of adoption and the marginal effect of explanatory variables

Variables		Change in intensity of adoption	P>|z|	Standard error
AgeHH		-0.001	0.418	0.00069
Education		0.001	0.159	0.00092
SexHH		-0.001	0.956	0.01201
FamSize		0.005	0.054**	0.00244
FarmExep		0.0004	0.584	0.0007
FarmSize		0.013	0.002***	0.00411
MktInfo		0.006	0.323	0.00572
Perception		0.008	0.081*	0 .0047
NeighborAdopt		0.039	0.000***	0.00988
MktDistance		-0.000	0.372	0.00004
Credit		0.017	0.059*	0.00919
Extension		0.001	0.642	0.00291
Training		0.018	0.086*	0.01053
Livestock		-0.0004	0.830	0.00212
HHIncome		0.000	0.126	0.00000
Number of obs	=	384		
Left censored	=	157		
LR chi2(15)	=	227.73		
Pr>chi2	=	0.000		
Psedu R^2	=	0.2777		

Note: ***, ** and * are significance at 1%, 5% and 10% respectively.

Farmers' perception on earliness of the improved soybean varieties is another factor that drives adoption intensity. The result is in line with findings by Nelson (2013); Di Falco SADIF *et al*. (2011). The result also shows that households who have access to credit have 1.7 percent higher adoption intensity than otherwise. A possible explanation for this could be because credit resolves the cash constraint to buy improved varieties. Participation in training has been also found to have a positive and significant influence on intensity of improved soybean variety adoption. It is intuitive that training enhances agricultural production skills, knowledge and experiences of farmers, and hence intensity of adoption. Previous study also found similar results Wabwile (2016); Gecho *et al*., (2014); Bruns. (2016). The size of land owned has significantly and positively affected the adoption intensity (i.e. proportion of land allocated for improved soybean varieties) at 1% level of significance. The results show that, on average, each additional hectare of land increases adoption intensity of ISVs by 1.3 percent, possibly due to economies of scale (Ahmed *et al*., 2017)

4.3 Endogenous Switching Regression Model Result

The study has employed an ESR model to determine the impact of ISVs on food security. Specifically, this subsection addresses the most important question of whether households that adopt ISVs are better in terms of food security using proxy indicators (i.e. FSS, FCS and HDDS).

Table 7 below present results of treatment effect on treated (TT), which measures the effect of adopting ISV on food security of farmers that actually adopt ISV. Computing the average of TT of adopter household's results in the average treatment effect on the treated (ATT). Likewise, the effect of treatment on untreated (TU) refers to the impact of adopting ISV on food security of farmers who actually do not adopt ISV. Once TU is estimated, the average treatment effect on untreated (ATU) can be estimated by computing the average TU of households that have not adopt ISVs. Finally, the transitional heterogeneity (TH) that measures whether the effect of adopting ISV is higher or lower for actual adopters compared to actual non-adopters is calculated as a difference between ATT and ATU (Lokshin M.,2011).

The value across the diagonals (cells (a) and (b) represents the mean values of adopters and non-adopters in the sample. The values in cells (d) and (c) are expected values of the counterfactual adopters and non–adopters, respectively. The last column of Table 7 presents the treatment effects of adopting ISV. Accordingly, in line with our priori expectation, the ATT for FSS outcome variable is negative and significant (-2.56) suggesting that adopters of ISV are less food insecure than their counterparts. Likewise, results of FCS and HDDS also demonstrate that adopter households are more food secure than non-adopters. Specifically, the ATT value for adopter households has been higher by 5.91 and 0.53 points of FCS and HDDS, respectively, compared to their counterfactuals. These results suggest that adoption of ISV improves food security status of the household, for example by nearly 6 units of FCS. Results of this study therefore may have important implications towards meeting the national goal of reducing poverty through promotion of improved variety adoption. These findings are consistent with previous studies Ebrahim M., (2019); Teferi A., *et al*.,(2015); Wabwile V. K., (2016).

Table 7 also presents ATU and TH results. The ATU value of -4.77 (second row of last column) can be interpreted as non–adopters would have been less food insecure (measured by FSS) if they adopt ISV. Likewise, ATU values of 5.78 and 1.78 for FCS and HDDS show that non–adopters would have been better in nutrient adequacy and consumption of diversified foods if they adopted ISV. Finally, the TH value for FSS and HDDS have been statistically significant suggesting that non–adopters would have actually benefited more from adopting ISV compared to actual adopters. This result is consistent with Stubbs B. *et al*.,(2016).

Table 7: Expected conditional and average treatment effect of ISV on dietary diversity, food consumption and food security of the household

Outcome variables	Categories	Decision stage		Adoption effect
		ISV adopter	ISV non-adopter	
FSS	ATT	(a1) 0.26	(c1) 2.81	-2.56***
	ATU	(d1) 0.98	(b1)5.76	-4.77***
	HE			2.21***
FCS	ATT	(a2) 39.31	(c2) 33.39	5.91***
	ATU	(d2) 36.30	(b2) 30.53	5.78***
	HE			0.14
HDDS	ATT	(a3) 6.19	(c3) 5.65	0.53***
	ATU	(d3) 5.88	(b3) 4.10	1.78***
	HE			-1.24***

Note: ***, ** and * are significance at 1%, 5% and 10% respectively.

5. Conclusion

The study has aimed to analyze the determinants of ISV adoption and its implication on household food security. A Logit and Tobit models have been employed to analyze factors affecting the adoption and use intensity of ISVs adoption respectively. The level of education, training and availability of neighbor adopters have a positive effect on probability and use intensity of ISV possibly because access to knowledge about benefits of ISV. Similarly, households with access to credit and higher total income are more likely to adopt than their counterparts. A possible explanation for this can be because these households will have better purchasing power to buy the relatively expensive agricultural input, improved seed. Moreover, land size and perception on maturity period have also positive and significant effect on probability and use intensity of ISV adoption.

The impact of adopting ISV on household food security has been examined using the ESR model. The ESR model helps to correct selection bias and systematic differences between adopters and non–adopters, due to observable and unobservable factors. Results of the ESR model consistently revealed that adopting ISV significantly contributes to households' food security positively. Specifically, participation in improved soybean production has statistically significant and positive impact on household's food security, food consumption, and dietary diversity. This result suggests that, beyond the direct benefit of expected yield increment, adoption of improved variety will be transformed to enhancing food security status of the households.

It is acknowledged that the results of the study are based on cross sectional data from one district. However, despite this limitation, results of the study will have important contribution for the current literature. Accordingly, based on results of this study, it is possible to draw the following conclusions. First, the results have prevailed that there is a systematic difference between adopters and non–adopters that cannot be accounted by including covariates used in the study. The highlights are the appropriateness of using ESR for the current data. Second, the transitional heterogeneity results show that impact of adopting ISV would have been higher for actual non–adopters. Hence, adoption strategies that help non-adopter farmers to adopt improved varieties (e.g. through training and improving access to credit) will help to enhance the overall benefit from ISV adoption.

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Measuring Status and Intensity of Smallholder Agricultural Commercialization in Northwest Ethiopia

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Abstract

In Ethiopia, shifting the subsistence to a commercialized farming system is one of the key development policy instruments to enhance income and reduce the level of poverty status of households. However, the intensity, status, and interaction of crop and livestock commercialization have not been well understood in the study area. Therefore, this study attempts to examine the status and intensity of agricultural commercialization in northwest Ethiopia. Primary data have been collected on 370 households using semistructured interviews. The study has employed a combination of descriptive statistics and econometric estimation techniques, including a seemingly unrelated regression and bivariate probit model, to analyze the raw data. The result has endorsed that both crop and livestock commercialization is left-skewed, implying that most households are produced agricultural enterprises for noncommercial purposes. The econometric model results also has indicated that there is a strong interdependence between crop and livestock commercialization. Moreover, the intensity and status of crop and livestock commercialization have been influenced by common underlying factors. ***Therefore, there should be a virtuous and sustainable integration among stakeholders in developing, designing, and implementing effective policies and strategies*** *to transform subsistence to commercial farming systems* ***in Ethiopia.***

Keywords: Commercialization, Seemingly unrelated regression, Bivariate probit, Household, Ethiopia

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1. Background

Agriculture is an engine for the Ethiopian economy. It generates employment opportunities for 72.7% of the total population, earns 70% from total exports, serves as a source of GDP (36.7%), and provides 70% of the county's raw material requirements for industrial sectors (ADEA, 2014, ATA, 2017, FAO, 2015). Having such a pivotal and huge contribution to the economy, the sector has faced several challenges (UNDP, 2014). The performance of the agricultural sector remains weak, highly dependent on rain-fed and subsistent farming systems, in short of optimum rate of fertilizer application, and lack of extensive use of improved seed varieties. The sector suffers from land degradation and deforestation which results in poor agricultural production, productivities, and marketing.

Ethiopia is known to have mixed farming systems. Mixed farming is a systematic process in which farmers produce crops and livestock simultaneously to ensure a sustainable income growth (Iiyama et al., 2007). However, agriculture is still dominated by traditional and subsistence systems. Therefore, agricultural commercialization through pertinent market integration is a prime strategy for the sustainable growth and development of the Ethiopian economy (Gebremedhin and Jaleta, 2010, Goshu et al., 2012b, Hagos and Geta, 2016, Melese et al., 2018). In contrast to subsistent producers in commercial farming are able to produce a huge amount of quality products for the market to maximize their income and stabilize household economic status. However, the commercialization of agricultural enterprises until now has been low in Ethiopia (Leta, 2018).

Although the Ethiopian government has a policy decision to transform traditional agriculture to commercialize agriculture, there is a huge information gap on the process and integration among stakeholders (Bekele and Alemu, 2015). Similarly, (Hagos and Geta, 2016) have endorsed that transforming traditional to a commercialized system has been influenced by various socioeconomic, institutional, demographic, technological, and policy parameters. Likewise, commercializing the farming system has been influenced by various internal and external driving factors(Goshu et al., 2012b, Pender et al., 2006, Pingali and Rosegrant, 1995).

In Ethiopia, most smallholder farmers depend on producing crops and livestock for both consumption and commercial purposes. Even though the Ethiopian government has been encouraging commercialization among households, various constraints are still facing the households to transform subsistence farming systems into the commercialized farming system in Northwest Ethiopia.

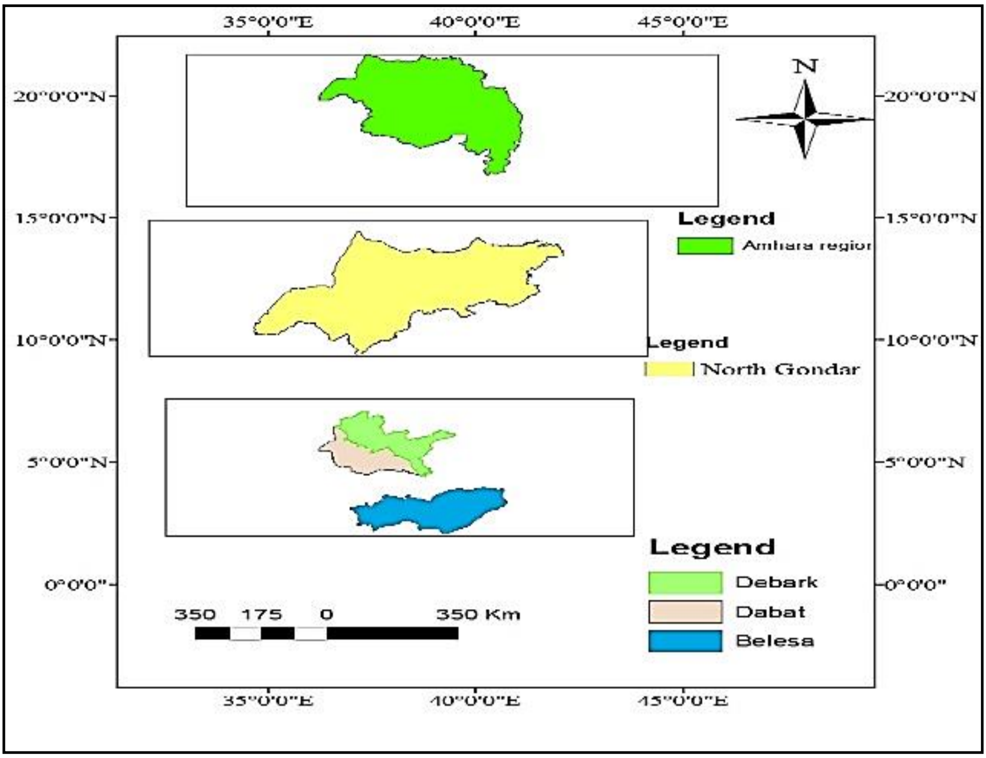
Although agricultural commercialization is an important policy option for most Ethiopian smallholder farmers, little research has been done thus far on what factors determine households' decisions and the extent to which agricultural enterprises are commercialized in northwestern Ethiopia. Hence, based on the above statement, the study is intended to empirically answer the following key questions; namely what factors affect the intensity, status, and interdependency of crop and livestock commercialization by households. Hence, the findings of this study can reduce the information gap on agricultural commercialization and backing to work better on the production and marketing of various agricultural enterprises to improve the economy of households in the country.

2. Research Methods

2.1 Description of the study area

The study is conducted in the North Gondar zone, Amhara region of Ethiopia. The zone is located in northwestern Ethiopia and 738 km from the capital city of the country. The capital city of the zone is Gondar city, which is located at 12° 35' 60.00" N latitude and 37° 28' 0.01" E longitudes with a mean altitude of 2133 meters above sea level. In the zone, a mixed farming system is the principal source of livelihood for households. The lowland of the zone is dominated by semiarid natural forests. In the zone, 51% and 49% of the population are men and women, respectively (Abate et al., 2019, Dessie et al., 2019a). The survey is done in three large districts of the zone, Debark, Wogera, and Belessa (Figure 1).

Figure 1: Map of the study area



2.2 Methods of data collection and sampling techniques

The study has used primary data and secondary data collected from various sources. Moreover, a multistage sampling technique has been used to select the sampled households.

In the first stage, districts were stratified according to their agroecology, such as highland and mid attitude. In the second stage, two districts have been purposively selected from each agroecology. From midland agroecology, East Belesa and West Belesa districts have been selected. Similarly, from highland Debark and Dabat have been selected. In the third stage, sixteen kebeles/villages were selected randomly. Finally, 385 sampled households have selected through a systematic random sampling technique following (Cochran, 1977)

$$n = \frac{Z^2pq}{e^2} = \frac{1.96^2(0.5*0.5)}{0.05^2} = 385 \qquad \textbf{(1)}$$

where n = sample size; Z= confidence level ($\alpha = 0.05$, hence, $Z = 1.96$); p = proportion of the population containing the major interest, $q = 1-p$ and e = allowable error.

However, in this study, only 370 households were considered for analysis. The remaining 15 sampled households were rejected and not included in data analysis due to missed and inappropriate data filled by enumerators.

2.3 Methods of data analysis and empirical model specification

The study has employed a combination of descriptive statistics and econometric estimation techniques, including a seemingly unrelated regression model and bivariate probit model, to analyze the data.

Commercialization is the process of transforming production from subsistence to commercial (Sokoni, 2008). Agricultural commercialization is also defined as the degree of participation in the output markets to earn better incomes (Hazell et al., 2007). The intensity of commercialization is measured by the commercialization index (CI). The commercialization index is obtained as the ratio of the gross value of all enterprise sales over the gross value of all enterprise production multiplied by a hundred (Strasberg et al., 1999). Moreover, the zero value of the commercialization index indicates subsistence and moving toward one shows that an increase in the intensity of commercialization. Following (Von Braun and Kennedy, 1994), the household crop-output market participation (COMP) index is computed as follows:

$$COMP_i = \frac{\sum_{k=1}^{k} P_k S_{ik}}{\sum_{k=1}^{k} P_k \bar{Q}_{ik}} \tag{2}$$

where S_{ik} is the quantity of output k sold by household i evaluated at an average community-level price (Pk) *and* Q_{ik} is the total quantity of output k produced by household i.

Livestock commercialization (LSC) is proxied by the sales rate, and the sales rate is further measured as follows. The sales rate will be measured as the net commercial off-take rate to represent the level of commercialization of livestock (Dagne, 2016, Merkel, 2019, Negassa and Jabbar, 2008).

$$\boldsymbol{LSC = \frac{sales - purchases}{0.5(openingstock + endingstock)}} \tag{3}$$

Based on the distribution of the commercialization scale, the commercial status of smallholder farmers is mainly classified into either binary value or three ordinal scales: non-commercial (an index less than or equal to 30%), semicommercial (an index found between 30 and 60%) and commercial (an index greater than or equal to 60%), following (Bedaso et al., 2012, Goshu et al., 2012b, Pingali, 1997). In the study, the commercialization index of the smallholder farmer is left-skewed, implying that the majority (59.19%, and 68.92%) of households had a commercialization index less than or equal to 30%. Therefore, the commercialization status of households is assumed to be a binary value (non-commercial and semicommercial).

The extent of household commercialization in crop and livestock enterprises is estimated simultaneously using a two-equation seemingly unrelated regression model.

Therefore, the general form of a seemingly unrelated regression model can be specified as follows (Greene, 2012b, Zellner, 1962):

$$\begin{aligned} \boldsymbol{Crop}_i &= x_1\beta_1 + \varepsilon_{i1} \\ \boldsymbol{Livsi} &= x_2\beta_2 + \varepsilon_{i2} \end{aligned} \qquad \textbf{(4)}$$

where Cropi and Livsi are the value of crop and livestock commercialization index of ith households, respectively; $\beta_1\ and\ \beta_2\ are\ respective\ vecore\ of\ cofficent$; x are vectors of covariates determining the intensity of crop and livestock commercialization scale; and $\varepsilon_{i1} and\ \varepsilon_{i2}$ are their random term.

Moreover, the interdependency of crop and livestock commercialization status is estimated by a bivariate probit model. Therefore, the general form of a bivariate probit model can be specified as follows (Cameron and Trivedi, 2009, De Luca, 2008, Goshu et al., 2012a, Greene, 2012a):

$$\begin{aligned} comstatuc_i{}^* &= x'{}_1\beta_1 + v_{1i} \\ comstatul_i{}^* &= x'{}_2\beta_2 + v_{2i} \end{aligned} \qquad \textbf{(5)}$$

where $comstatuc_i{}^*$ and $comstatul_i{}^*$ are the value of crop and livestock commercialization status of i^{th} households, respectively; $\mathrm{\beta_1\ and\ \beta_2\ are\ respective\ vecore\ of\ cofficent}$; x are vectors of covariates determining the status of crop and livestock commercialization; and $\mathrm{v_{1i}\ and\ \varepsilon_{2i}}$ are their respective error terms in the model.

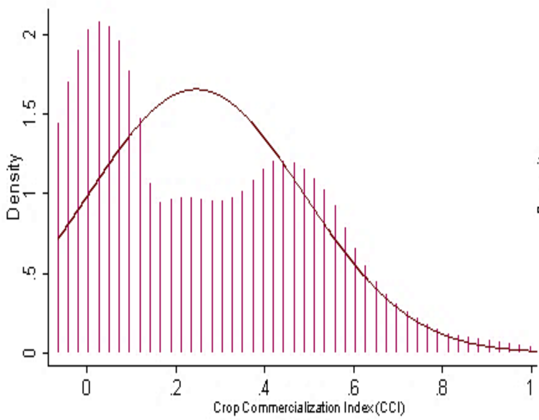


Fig 2: Mean of Crop Commercialization Index

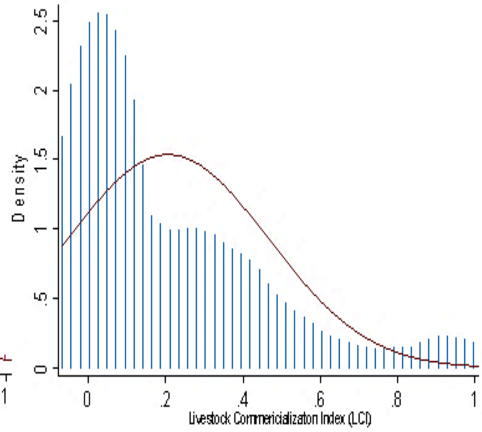


Fig 3. Mean of Livestock Commercialization Index

Therefore, in this study, the observed and unobserved variables are specified as follows:

$$comstatuc_i = \begin{cases} comstatuc_i{}^* = \ x'_1\beta_1 + v_{1i} & if\ comstatuc_i{}^* > 0 \\ 0 & if\ \ comstatuc_i{}^* \ \leq 0 \end{cases}$$

$$comstatul_i = \begin{cases} comstatul_i{}^* = \ x'_2\beta_2 + v_{2i} & if\ comstatul_i{}^* > 0 \\ 0 & if\ \ comstatul_i{}^* \leq 0 \end{cases} \qquad (\mathbf{6})$$

3. Results and Discussion

3.1 Socioeconomic and commercialization status of households

The commercialization scale of crop and livestock enterprises is left-skewed (Figures 1 & 2). The mean commercialization index of the sample household is 24% for crops and 20% for livestock outputs, signifying that there was no significant difference between enterprises in the scale of commercialization. The results also have endorsed less than one-third of households to produce crops and livestock only for marketed purposes. Similarly, most households, 59.19%, and 68.92%, are produced livestock and crop enterprises for non-commercial purposes, respectively (Table **1**). This study is in line with Goshu et al. (2012b), who endorsed that the commercialization scale of agricultural enterprises is left-skewed.

Table 1: Mean and proportion of household characteristics (N=370)

Continuous variables		Mean	Standard Deviation
Crop Commercialization Index		0.24	0.01
Livestock Commercialization Index		0.20	0.01
Age in years		47.47	0.52
Tropical livestock unit (TLU)		4.56	0.17
Farming experience in years		26.85	0.57
Quantity of chemical fertilizer in Qt		0.93	0.03
Distance to nearest market in Minutes		39.43	1.12
Dummy variable	**Response**	**Frequency**	**Percentage**
Credit access	Yes	156	42.16
	No	214	57.84
Sex	Male	317	85.68
	Female	53	14.32
Education status	Illiterate	160	43.24
	Literate	210	56.76
High yielding crop variety	Adopter	91	24.59
	Nonadopter	279	75.41
Improve livestock breeds	Adopter	95	25.68
	Nonadopter	275	74.32
Livestock commercialization status	Semi commercial	115	31.08
	Non-commercial	255	68.92
Crop commercialization status	Semi commercial	151	40.81
	Non-commercial	219	59.19

Out of 370 sample households, 85.68% and 14.32% are male- and female-headed households, respectively. The average age, quantity of chemical fertilizer used, livestock number, market distance, and farming experience of the households are 47.47, 0.93, 4.56, 39.43, and 26.85, respectively (Table **1**). Likewise, 43.24% and 56.76% of households are illiterate and literate, respectively. Moreover, the majority of sampled households (57.84%), 75.41%, and 74.32% do not receive credit services, are nonadopters of high-yielding crop varieties, and improves livestock breeds, respectively (Table **1**).

3.2 Determinants of the Intensity of Crop and Livestock Commercialization

The seemingly unrelated regression (SUR) model estimation result of agricultural commercialization is reported in Table 2. The Breusch–Pagan test result has endorsed that the null hypothesis of independence between crop and livestock commercialization is rejected at the 1% level of significance. Therefore, the SUR model is used to estimate the simultaneous equations of crop and livestock commercialization. The results of the SUR model show that the extent of crop commercialization is enhanced by male-headed households, experienced/aged households/households, plot size to cash crops (ha), adoption of a high-yielding crop variety, optimum amount of fertilizer (Qt), extension contact, credit access and distance to the nearest market. On the other hand, crop and livestock commercialization has declined by adopting improved livestock breeds and male-headed households, respectively.

Household sex has positively and negatively influenced crop and livestock commercialization at the 1% and 5% levels of significance, respectively. The model results in Table 2 show that a male-headed household has increased crop commercialization by 15.1% and declined livestock commercialization by 8.9%. This implies that in Ethiopia, there is a task division between male- and female-headed households in agricultural production. Males mainly control the main factors of production, such as land, labor, and capital, more than females do. Therefore, male-headed households mainly have accomplished the task of crop commercialization, and female-headed households have accomplished the task of livestock production and commercialization. The study is in line with the finding of Justus et al. (2015), who depicts that agricultural commercialization is mainly dominated by males due to a high degree of ownership of production resources compared to female-headed households.

The age of the household has positively influenced crop commercialization at the 10% level of significance. A unit change in a year of household age has increased crop commercialization by 0.21%. This implies that aged households have good knowledge and skills in cash *crop* production and marketing at the right time with affordable prices for the right customers. The study is in line with the findings of Dessie et al. (2019b) and Abay (2010), who depicts that experienced households have produced a huge amount of cash crops for marketed purposes.

The Land that is allocated to cash crops has positively influenced crop commercialization at the 1% level of significance. A unit change in a hectare of land allocated to cash crops has increased the extent of crop commercialization by 3.1%.

This implies that a producer that allocates a plot of land for the marketed crop can enhance crop commercialization and profit as well. The study has confirmed the finding of Goshu et al. (2012b), who has stated that crop commercialization and cash crop-producing households have a direct relationship.

The quantity of fertilizer has positively influenced crop commercialization at the 1% level of significance. This implies a unit change in quintals of fertilizer used increases crop commercialization by 6.8%. A possible explanation is that an efficient application of fertilizer on a given plot size can increase crop production and commercialization. This study is in line with the finding of Goshu et al. (2012b), who depicts that the quantity of fertilizer used has enhanced crop commercialization.

High-yielding crop variety has positively influenced crop commercialization at the 5% level of significance. A household that adopts a high-yielding crop variety has increased crop commercialization by 5.7%. This implies that adopting a high-yield crop variety is a key input to enhance the crop production, productivity and income of households in most parts of Ethiopia.

Soil and water conservation practices are one of the key factors that positively influence livestock commercialization at the 5% level of significance. A household that adopts soil and water conservation practices increases livestock commercialization by 7.6%. This implies that agricultural conservation practices are an important instrument to enhance and keep the productivity of the soil for efficient crop and hay production, in turn improving livestock production and commercialization.

Access to extension services negatively influences crop commercialization at the 10% level of significance. A household that receives extension services decreases crop commercialization by 0.04%, implying that households may not apply all extension agents' advice and techniques at the right time and in appropriate ways. In most parts of the country, the skills of development agents are poor and may not provide appropriate advice and techniques for households. The study is confirmed by the findings of Melese et al. (2018) and Abraham (2013), who depicts that access to extension services significantly and negatively influence onion and potato commercialization.

Distance to the nearest market positively influences crop commercialization at the 5% level of significance. A unit change in market distance in minutes increases crop commercialization by 0.12%. This implies that households who are close to markets mainly participated in nonfarm employment opportunities, which in turn decrease crop production and commercialization. The study, in line with the findings of Melese et al. (2018) and Goshu et al. (2012b), confirmed that distance to the nearest market positively affected crop commercialization.

Table 2: SUR model estimation results of the intensity of agricultural commercialization

Variables	Coefficients (Std. Err)	
	Crop	Livestock
Sex of households (1=male,0 otherwise)	15.078 (3.856)***	-8.942 (4.320)**
Age of household (year)	0.207 (0.117)*	0.091 (0.131)
Literacy status (1=literate, 0 otherwise)	2.997 (2.452)	-0.294 (2.747)
Land allocated to cash crops(ha)	3.141 (1.173)***	1.085 (1.314)
Quantity of fertilizer used (Qt)	6.758 (1.688)***	0.690 (1.891)
Soil and water conservation (1 if adopter, 0 otherwise)	-3.490 (2.726)	7.611 (3.054)**
High yielding crop variety (1 if adopter, 0 otherwise)	5.666 (2.894)**	-2.732 (3.242)
Improved livestock breeds (1 if adopter, 0 otherwise)	-5.938 (3.039)*	-4.394 (3.404)
Extension contact	-0.039 (0.022)*	0.042 (0.025)
Credit access (binary)	5.523 (2.440)**	7.476 (2.734)***
Distance to nearest market	0.124 (0.059)**	0.042 (0.066)
Constant	-1.102 (6.935)	6.942 (7.769)
R^2	0.139	0.071
F	59.97***	28.57***
N	370	
Breusch–Pagan test of independence: $\chi2$ (2) = 16.598***		

Dependent variable = Intensity of crop and livestock commercialization; ***, ** and * show the values statistically significant at the 1%, 5% and 10% levels, respectively.

Improved livestock breed significantly and negatively influences the extent of crop commercialization at the 1% significance level. Adopting improved livestock breeds decrease the extent of crop commercialization by 5.93%, implying that crop enterprises are highly vulnerable to natural hazards compared to the livestock sector.

Credit access positively influences both crop and livestock commercialization at the 5 and 1% levels of significance, respectively. This implies that households that receive credit services increase the extent of crop and livestock commercialization by 5.5% and 7.5%, respectively. This implies that in most developing countries, such as Ethiopia, the main constraint to start new business-like crop and livestock commercialization is a lack of credit service/capital. Therefore, credit is a key instrument to enhance both crop and livestock commercialization in northwest Ethiopia. The study is in line with the finding of Gebremedhin et al. (2007), *who* revealed that credit is an important input for enhancing agricultural enterprise production and commercialization.

3.3 Interdependency of Crop and Livestock Commercialization Status

The interdependence of households' participation decisions in their crop and livestock commercialization is estimated by a bivariate probit model, as indicated in Table 2. The null hypothesis of independence of crop and livestock commercialization status of households is rejected at the 1% level. The signified that the crop and livestock commercialization statuses of households were interdependent with each other. Moreover, the households are considered both enterprises to their commercialization decisions. Consequently, the commercialization status of households was determined by various common underlying factors.

The bivariate probit model results have endorsed that crop commercialization status significantly determined various factors, such as the sex of households, land allotted to cash crops, improved livestock breeds, and the number of oxen held. On the other hand, the probability of households participating in livestock commercialization is significantly influenced by access to credit, access to extension, and the number of oxen held.

The joint marginal effects have endorsed that the common determinants of crop and livestock commercialization decisions of households in northwest Ethiopia are farming experience (0.2%), land allotted for cash crops (4.5%), quantity of fertilizer used (4%), adoption of improved livestock breeds (9.6%), access to credit (5.8%), access to extension (5.4%), and number of oxen held (6.6%).

The predicted probabilities of households participating in crop and livestock commercialization are 40.3% and 50%, respectively. The likelihood of households participating in the commercialization of both enterprises is 14.1%, implying that households are less likely to simultaneously participate in both crop and livestock commercialization in northwest Ethiopia.

The sex of the household significantly and positively influences the decision to participate in crop commercialization at the 1% significance level. Compared to female-headed households, a male-headed household increases the likelihood of participating in crop commercialization by 24.2%. This implies that crop production and commercialization are mainly dominated by males due to the high ownership of production resources.

Land allotted for cash crops significantly and positively influence crop commercialization status at the 5% significance level. A unit change in land size allotted for cash crops in hectares increases the likelihood of participating in crop commercialization by 13.3%. A possible explanation is that households allotted more land to produce cash crops for marketed purposes in most parts of Ethiopia. The study is in line with the finding of Goshu et al. (2012a), who revealed that cash crop production and the crop commercialization status of households have direct relationships.

The quantity of fertilizer significantly and positively influences the decision to participate in crop commercialization at the 5% significance level. A unit increase in the quantity of fertilizer used in quintal soil increased the likelihood of participating in crop commercialization by 10.9%. This implies that an efficient application of fertilizer on a given plot size can increase crop production and productivity in turn enhance its income source.

Improved livestock breed significantly and negatively influences the decision to participate in crop commercialization at the 1% significance level. Adopting improved livestock breeds decreases the likelihood of participating in crop commercialization by 24.4%, implying that crop enterprises are highly vulnerable to risk compared to livestock production and commercialization.

Credit access positively and significantly influences the likelihood of participating in livestock commercialization business at the 5% level of significance. As a household received credit services, the likelihood of participating in livestock commercialization business also increases by 12%. This implies that livestock production and marketing are highly capital-intensive businesses. Similarly, in Ethiopia, the main constraint to start a new business-like livestock production and marketing is inadequacy of credit service/capital. Therefore, credit is a key instrument to enhance livestock production and commercialization in Ethiopia. The study is inline with the findings of Goshu et al.,(2012) and (Jaleta et al., 2009), who have revealed that credit is an important input for enhancing agricultural production and commercialization.

The number of oxen positively and significantly influences the likelihood of participating in both crop and livestock commercialization businesses at the 5% level of significance. As the amount of oxen possession increases, the likelihood of participating in crop and livestock commercialization business also increases by 9.5% and 8.6%, respectively. This implies that oxen are one of the key assets for farmers and is used for both crop and livestock production and marketing purposes. Moreover, crops and livestock are complementary enterprises.

Table 2: Bivariate probit estimation results of crop and livestock commercialization status

	Coefficients		Marginal Effects		
Variables	**Crop**	**Livestock**	**Crop**	**Livestock**	**Joint Effect**
Sex of households (1=male,0 otherwise)	0.617***	-0.202	0.242***	-0.067	0.030
Farming experience (year)	0.008	0.007	0.003	0.002	0.002*
Literacy status (1=literate, 0 otherwise)	0.127	-0.235	0.049	-0.082	-0.019
Land allocated to cash crops(ha)	0.345**	0.026	0.133**	0.009	0.045**
Quantity of fertilizer used (Qt)	0.282**	0.043	0.109**	0.015	0.040*
High yielding crop variety (1 if adopter, 0 otherwise)	0.171	-0.075	0.066	-0.026	0.008
Improved livestock breeds (1 if adopter, 0 otherwise)	-0.676***	-0.178	-0.244***	-0.060	-0.096***
Extension access	-0.225	0.530***	-0.088	0.167***	0.054*
Credit access (binary)	0.052	0.343**	0.020	0.120**	0.058**
Number of Oxen held	0.245**	0.248**	0.095**	0.086**	0.066***
Constant	-1.105***	-1.394***			
Ath rho					0 .154*
Rho					0.153
N					370
Log pseudolikelihood = -434.964					
Wald c 2 (20) =79.63***					
Wald test of r = 0, Pr > c 2 (1) = 2.745*					
Predicted probability			0.403	0.297	0.141

Dependent variable = interdependency of crop and livestock commercialization status; ***, ** and * show the values statistically significant at the 1%, 5% and 10% levels, respectively.

Access to Extension service positively and significantly influences the likelihood of participating in livestock commercialization business at the 10% level of significance. As a household received extension services, the likelihood of participating in livestock commercialization business also increases by 16.7%. This implies that agricultural extension services are the main driver in the agricultural production system if they are implemented at the right time and in the appropriate ways. Moreover, it is also important to produce and supply quality products to the market at affordable prices.

4. Conclusion and Recommendation

In North-western Ethiopia, most households practice a mixed farming systems for both consumption and commercial purposes. Although empirical evidence is lacking, agricultural commercialization is influenced by various internal and external factors, such as socioeconomic, demographic, agronomic, environmental, and institutional factors, in north-western Ethiopia. Thus, to improve households' economy and livelihood, an analysis of agricultural commercialization is necessary. The study results have endorsed that both the crop and livestock commercialization indices are left-skewed and that the mean index is less than 25%, implying no significant difference in the scale of commercialization. The seemingly unrelated regression model result has revealed that the intensity of agricultural commercialization is significantly influenced by the sex of household, age of household, land allocated to cash crops, quantity of fertilizer used, extension contact, credit access, distance to the nearest market, adoption of high-yielding crop variety, and improved livestock breeds.

The bivariate probit model has also endorsed that various factors significantly influenced the crop and livestock commercialization decisions of households. The study has indicated that crop production and commercialization are mainly dominated by males due to the high ownership of production resources. In most parts of the country, a household allottes more land for the production and marketing of cash crops. The application of the recommended rate of fertilizer enhances crop productivity and commercialization. Crop enterprises are highly vulnerable to risk compared to livestock production and marketing. Similarly, crops and livestock are also found to be complementary enterprises. Moreover, agricultural extension and credit service are the main driver factors in both crop and livestock production and marketing systems if implemented at the right time and in the appropriate ways.

In general, both crop and livestock commercialization are left-skewed which implies that most households are mostly produced agricultural enterprises for consumption and non-commercial purposes.

Given the potential of the study area in crop and livestock production and its substantial role for households in consumption and commercial purposes, the following implications have been given to the development of agricultural production and commercialization.

In northwest Ethiopia, smallholders have small and fragmented land sizes. Therefore, to mechanize and commercialize the farming system, a new land utilization policy should be designed. Similarly, to reduce the dependency on rainfed systems, small-scale irrigation projects should be constructed and developed at the district and kebele levels. Moreover, to enhance agricultural commercialization, there should be strong and nonbureaucratic financial and marketing institutions.

In general, various stakeholders, such as research and development organizations, traders, producers, policy-makers, extension service providers, financial institutions, governmental organizations, and nongovernmental organizations, should have great ties and integration in developing, designing, and implementing effective policies and strategies to transform the subsistent *commercial* farming systems.

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Households' Willingness to pay for Improved Cookstove Attributes in the Case of Basona Worena District, Ethiopia

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Abstract

Biomass is the dominant source of energy in Ethiopia accounting for more than 90% of the domestic consumption resulting in forest loss and environmental degradation. In response to this challenge, the dissemination of improved biomass cookstoves (ICS) is considered to be one of the main interventions. Despite the efforts of the government, a significant proportion of rural households have not adopted fuel-efficient ICS. Although there are many studies on the adoption of ICS, there is limited information on the willingness to pay (WTP) for particular attributes of Tikikil ICS that is vital for designing effective stoves and improving its adoption. This study, therefore, aims to explore households' preferences to Tikikil ICS using a choice experiment (CE) approach. The study used primary data collected from 305 household-level surveys in the Basona Worena district. Data were analyzed using Multinomial logit (MNL) and Conditional logit (CL) discrete choice models. The findings of this study show that the proportion of fuel sources for cooking was about 40.8%, 34.9%, and 23.6% for firewood, dung, and charcoal, respectively. The main source of firewood for households is from their own plantation which accounts for 66%. Households' preference for ICS is positively influenced by the reduction in smoke, fuelwood reduction, cooking time reduction, and durability of the stove. Households' marginal WTP calculated from the CL model for each attribute were 4.16, 7.29, 2.17, and 6.89 ETB for smoke reduction, fuelwood reduction, cooking time reduction, and durability of the stove, respectively. The finding also shows that

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the interactions of age with fuelwood reduction, sex with durability, family size with smoke reduction, and distance to the nearby forest with fuelwood reduction of the stove are significant. Relevant agents and other stakeholders should consider important attributes such as product-specific and socio-economic to achieve viable ICS adoption. Finally, *the study recommends that policymakers and stove designers should use the marginal WTP for the different attributes as a benchmark for stove design and pricing that fit households' reality and preferences, and ability to pay.*

Keywords: Attribute, Choice experiment, Improved cookstove, Preference

1. Introduction

Energy is an important developmental tool currently at the forefront of the global economic and political agenda (IEA, 2019). Energy-related policies and strategic interventions have become the center of debate among politicians, academicians, policymakers, and others who want to deal with energy issues in developing countries. However, more than three billion people worldwide depend on biomass fuels with the inefficient traditional stoves (Jan *et al.,* 2017; WHO, 2018). In Sub-Saharan Africa, there is a much higher dependence where up to 90% of the households depend on biomass fuels and mostly use traditional stoves (Callo-Concha *et al*., 2020). According to WHO (2018), cooking by using the inefficient stove is primarily done by women, and so women and children bear the health burden associated with burning solid fuels as well as the hazards while collecting fuels.

To reduce the effects associated with cooking using biomass fuels by traditional cookstove; ICS is being promoted in many developing countries (Anenberg *et al.,* 2013). Consequently, the global development community has attempted to induce a transition from traditional biomass-burning cookstoves to cleaner and more efficient alternatives (WEO, 2019). Hence, different energy-related institutions (for example GIZ, SNV, World Vision, etc.,) have worked to promote the diffusion and adoption of cleaner cooking solutions in recent decades. However, the dissemination and adoption of ICS were not well achieved (Urmee and Gyamfi, 2014; Hewitt *et al*., 2018). As a result, the majority of households in developing countries including Ethiopia continue to depend on biomass fuels and use fuel-inefficient stoves (Beyene *et al.*, 2015; Kshirsagar and Kalamkar, 2016).

In Ethiopia, the predominant source of energy to meet households' energy demand is biomass which accounts for about 96% (Beyene and Koch, 2013). The dependency of this biomass is associated with several environmental and health-related problems such as forest degradation, household indoor air pollution, emission, and seasonal climate variability in the country (Mohapatra, 2019). The government is now focusing more on the integration of other alternatives and has devised supply and demand management strategies to reduce pressure on forests and plantations, and the adverse impacts of indoor pollution.

However, many studies and practitioners claim that ICS technologies are not widely adopted because they do not fit into users' preferences and local cooking environments (Lewis and Pattanayak, 2012; Whittington *et al*., 2012). Furthermore, literature on ICS in Ethiopia tends to focus mostly on the role of the socio-economic factors and technological aspects of ICS, with few studies that investigate the product-specific attributes (Takama *et al*., 2012). The available empirical studies (for example, studies by Gebreegziabher *et al*., 2012; Beyene and Koch, 2013; Daniel, 2016; Belachew and Danano, 2019) have focused on the determinants of adoption and performance efficiency of ICS. On the other hand, a few available studies focused on households' preference and WTP for *Mirt* stove (Takama *et al*., 2011; Kooser, 2014; Dissanayake *et al*., 2018) using CE.

However, it is worth noting that there are few studies involving non-market value assessment of ICS, particularly no such kind of study on *Tikikil* stoves related to product-specific attributes. To the best of our knowledge, there is a limited study to address households' preferences of *Tikikil* fuel-efficient cooking stove by using CE in Ethiopia. More specifically, such kinds of studies are limited in rural Ethiopia especially for *Tikikil* stoves.

Therefore, the main contribution of this study is to inform designers and implementers about households' preferences to enhance the wider adoption of ICS in the country. The distribution of ICS without the consideration of households' preferences will not lead to wider adoption of these stoves by the households. In addition, this research contributes to the existing literature by extending to other rural areas by incorporating more attributes of the ICS which match with rural household realities and way of life. These contributions are important demand-side features that are critical for developing energy products and segmenting markets, and understanding them is necessary for broader dissemination and diffusion of the ICS. Therefore, this study investigates the households' preferences when they purchase ICS and their claims on attributes. The study further assesses how households value different ICS attributes, and how different factors affect this valuation using DCE.

The rest of the paper is organized as follows. Section 2 presents the literature review and conceptual framework. Section 3 describes the methods of the study. The empirical strategies are also specified in this section. Section 4 presents the econometric estimations and discussions of the results. The last section presents the conclusion and policy implications based on the findings of the study.

2. Literature Review

2.1 Theory of Valuation Techniques

Non-market valuation methods are an important method for valuing goods and services where the conventional market does not reflect their true values. When there is a failure, the market price provides wrong signals about the economic value of a good or service under consideration. The market fails due to the existence of the perverse effect of production, information asymmetry, lack of well-defined property rights, and the existence of public goods. On the other hand, a market for some goods and services does not exist and thus it is difficult, if not impossible, to estimate the values of such goods. Economic valuation methods are divided into two broad categories: revealed preference (RP) and stated preference (SP) methods (Haab and McConnell, 2002).

Stated preference methods are a series of approaches used to estimate the value of non-marketed goods and services using individuals stated behavior in a hypothetical setting (Haab and McConnell, 2002). SP data are collected through surveys. So, SP methods provide important advantages over the RP method when historical data do not outfit the objective function. Furthermore, SP methods help to estimate both use and non-use values of products and services. The SP method can further be classified into contingent valuation (CV) and multi-attribute valuation techniques (Alpizar and Carlsson, 2003; Merino-Castello, 2003). However, a barrier to using SP results in decision-making is that the preferences stated may not predict actual behavior (Quaife et al., 2018). SP survey responses also may not predict actual behavior, leading to hypothetical bias (Decorte et al., 2021). As a result, we developed an approach that harnesses large-scale routine data to help SP surveys provide more accurate estimates of RP within a study that elicited preferences for ICS attributes. The SP survey responses were used to predict the mean household’s WTP value of each attribute.

In multi-attribute-based valuation techniques, individuals are given a hypothetical setting and asked to rank options presented, score them, or choose their preferred alternative among several alternatives in a choice set that are differentiated by attributes and levels (Hanley *et al*., 2001). Multi-attribute techniques investigate more than one attribute simultaneously. Thus, choice modeling techniques are more appropriate if multiple attributes are involved, and it is interesting to estimate the value attached to each attribute and to assess trade-offs between them (Merino-Castello, 2003). By including the price or cost of the alternative as one of the attributes of the good, the WTP to each attribute can be indirectly estimated from people's rankings, ratings, or choices. Furthermore, multi-attribute-based elicitation methods also avoid many of the bias problems associated with the CV method (Alpizar and Carlsson, 2003).

2.2 Conceptual Framework

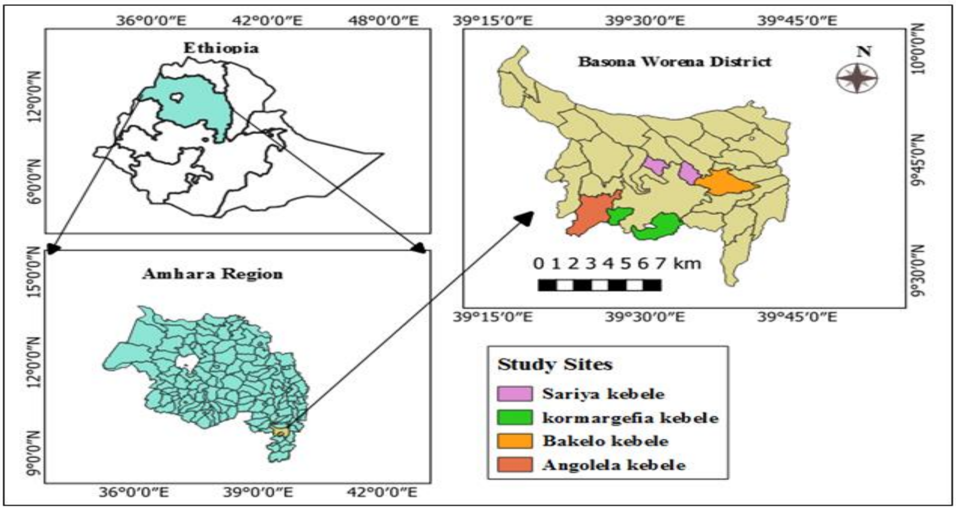
A choice experiment is a combination of the characteristics theory of value and the random utility theory ((Lancaster, 1966; McFadden, 1974). In the characteristic of value, it is assumed that consumers drive satisfaction not from the good itself but from attributes that they possess. The assumption that individuals drive utility from the characteristics of a good rather than from the good itself implies that a change in one of the characteristics (for example the price) may result in a discrete switch from one good to another which will affect the probability of choosing that specific commodity on the margin (Lancaster, 1966; Hanley *et al*., 1998). In the CE, where the respondent is asked to choose the most preferred among a set of alternatives, the random utility theory is appropriate for modeling the choices as a function of attributes and their levels. The theory says that the utility derived by individuals from their choice is not directly observable, but an indirect determination of preferences is possible and it decomposes the utility function into a deterministic part (V) and a stochastic part (ε). The stochastic part is assumed to follow a pre-determined distribution (McFadden, 1974; Hanley *et al*., 2001). An important aspect of CE is determining WTP estimates for product attributes.

3. Methods of the Study

3.1 Description of the Study Area

This study was carried out in four kebeles of the Basona Worena district. The Basona Worena district is one of the 24 districts of the North Shewa zone in Amhara national regional state of Ethiopia. It is located in the north at a distance of 130 km from Addis Ababa. The district has about 1185.63 km^2 area coverage with 30 rural and 2 urban Kebeles. It is rich in vegetation including natural forest (for example Wolf-Washa natural forest) and plantation forest that households used as main sources of fuel (DWIEO, 2019).

Figure 1: Map of the Study Area; Source: Ethio-GIS, 2015



According to CSA (2013), the total population of the district is 139,535 of which 73,860 are males and 65,675 are females. The major means of livelihood are mixed agricultural practices (crop production and livestock rearing) in the study area.

3.2 Sampling Technique

For this study multi-stage random sampling technique was employed, involving the selection of district, Kebeles, and sample households. Firstly, the North Shewa zone was selected based on access to forest resources, cooking habits of the society, and high dependence on biomass fuels and forest degradation. Secondly, the study district was selected based on the distance of forest areas and households' dependency on forest resources for cooking. Then, four rural Kebeles were selected based on areas where *Tikikil* ICS is not introduced and communities do not have awareness about this ICS as well as to account for respondents with different levels of access to forest resources which are important for biomass fuel use.

The sample size from each Kebele was determined based on the proportion of population size. The sample size for this study was calculated by using 10% proportion based on the household number share of each selected Kebeles from the total household share of the district. Accordingly, 79, 45, 80, 101 representative sample households were taken from Angolela, Sariya, Kormargefia, and Bakelo Kebeles, respectively with a total of 305 households. Finally, sample households to be interviewed were selected from each sample Kebele by using a systematic random sampling technique.[4] Inconsistent responses were ignored and the total sampled households for the empirical analysis was 297.

3.3 Survey Design

3.3.1 Selection of attributes and their levels

The CE was used for identifying households' preferences for the different attributes of the *Tikikil* stove. The households were asked to make a series of stove attributes choices that were mutually exclusive. Detailed information on attribute-specific and socio-economic characteristics was generated.

The CE design generates attributes that potentially affect the choice of the identified options. Hensher et al. (2005) suggested three criteria or approaches for the selection of attributes it should: (1) affect the choice; (2) be common across other options; (3) be relevant to research questions. The number of attributes has to be restricted for the experiment to be feasible. A compromise in the number of attributes is required to reduce experiment complexity and is typical in CE designs (Hensher et al., 2005). The starting points for attributes and their levels identification and definition were derived based on information obtained from reviewing other related empirical studies as well as through focus group discussions (FGD) with villagers and experts at the local and federal levels.

Taking all these into account, we included five attributes related to strategies judged to be of policy relevance: durability of the stove, fuelwood reduction, smoke reduction, cooking time reduction, and cost of the stove. During the pilot survey, small groups were conducted to test the clarity and relevance of the attributes, the acceptance of the payment vehicle, the amounts of the bids (cost of the stove), and the reaction to the proposed method. In addition, the number of choice sets presented was also tested to minimize potential bias. All the feedback obtained from these pilot studies was taken into account for the final experimental design. Based on the information obtained, all attributes and their levels are summarized in Table 1.

[4] Interval was determined by dividing the total household of the kebele by the sample for every 10th household from the total list of households. And the first sample household was taken between one and the interval number randomly by using the lottery method.

Table 1: Attributes and their levels of the DCE for household preference for *Tikikil* stove

Attributes	Levels
Durability of the stove	1-5 years, 6-10 years
Fuelwood reduction	25% reduction, 50% reduction
Smoke reduction	25% reduction, 50% reduction
Cooking time reduction	15 minutes reduction, 30 minutes reduction
Cost of the stove	150 ETB, 250ETB, 350ETB

3.3.2 Experimental design

After attributes and their levels were identified, the next step is the construction of choice sets via experimental design using different levels of the attributes. The experimental design of the DCE was comprised of two alternatives, four attributes with two levels each, and one attribute with three levels (Table 1), thus resulting in a full-factorial design with [(2*2*2*2*3) choice 1 * (2*2*2*2*3) choice 2] = 2,304 possible choice sets. In this design, all possible main and interaction effects were included (Rose and Bliemer, 2009). However, for the sake of practicability, this design was determined to be too extensive and therefore, the number of choice sets was reduced. To minimize the simultaneous and unavoidable loss of information when reducing the full factorial design, a so-called "efficient design" was applied. According to Rose et al. (2008), efficient designs require exante information regarding the population's utility parameters since these designs aim to minimize the standard errors of the utility parameters for the estimation process. This information for the final experiment was obtained by conducting a pilot survey from 23 households.

As a result, a D-efficient design was found to be appropriate for our study. Then, the choice sets were randomized into blocks. The final design consisted of 16 choice sets, which were split into two blocks of eight choice sets each. The choice sets consisted of two alternative improvements to the *Tikikil* stove's current status and status quo level. Thus, the number of choice sets presented to the respondents in the final survey was reduced to eight. Finally, 16 choice sets were randomly assigned to the respondents to avoid biases and each respondent was confronted with the choice sets with three options as the sample is presented in Table 2. The STATA version 16 software was used to construct the CE design, for testing the efficiency of the design, and for the empirical data analysis.

Table 2: Sample choice set

Attributes	Choice 1	Choice 2	Status-quo
Durability	6-10 years	1-5 years	No improved stove
Smoke reduction	25% reduction	50% reduction	No reduction
Fuelwood reduction	25% reduction	50% reduction	No reduction
Cooking time reduction	30 minutes reduction	15 minutes reduction	No improved stove
Cost of the stove	350 ETB	250 ETB	No improved stove
Your choice (please tick only one)	☐	☐	☐

3.4 Data Source and Collection Method

The data for this study were obtained from primary and secondary sources. The final survey was conducted using a direct face-to-face interview method. Structured questionnaires were employed to collect the necessary data from sample households. The survey questionnaire includes information on household characteristics, village-level characteristics, and preferences of the improved cookstove and their energy consumption behavior. To complement the household level data with villagers' perception, we also conducted FGD in each sample Kebele. Each FGD consists of 8-12 members who include men and women participants' of different age and wealth status.

3.5 Empirical Models Specification

To derive WTP values for the attributes of the DCE with the ultimate goal of giving recommendations for policymakers and the energy sector, an approach that could produce realistic WTP values as needed. In this context, models in preference space are the current standard method for estimating the WTP of individuals.

Models of discrete choice data are grounded in the theoretical underpinnings of the characteristic theory of value (Lancaster, 1966) and random utility theory (McFadden, 1974). The household is assumed to have a utility function of the form:

$$U_{\mathrm{ij}} = U\left(X_{\mathrm{ij}}, S_{\mathrm{i}}\right) \tag{1}$$

Where for any household *i*, a given level of utility, U_{ij} will be associated with any ICS j. Utility derived from the ICS depends on the attributes of the ICS, X_{ij}, and the social and economic characteristics of the household, S_i, hence different households may receive different levels of utility from these attributes.

In the random utility model, the utility of a choice is comprised of a systematic component, V_{ij}, and an error (unexplainable or random) component, ε_{ij}, which is independent of the deterministic part and follows a predetermined distribution.

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad \textbf{(2)}$$

The systematic component can be explained as a function of characteristics of the ICS and of the social and economic characteristics of the household as explained above, in Equation (2). That is:

$$U_{ij} = \mathrm{V}\,(X_{ij}, S_{i}) + \varepsilon_{i} \qquad \textbf{(3)}$$

Given that, there is an error part in the utility function, predictions cannot be made with certainty and analysis becomes a probabilistic choice. The parameters for the relationship can be introduced by assuming that the relationship between utility and attributes and characteristics follows a linear path in the parameters and variables function, and by assuming that the error terms are identically and independently distributed (IID) with a Weibull distribution (Greene, 2002). These assumptions ensure that the probability of any particular alternative j being chosen can be expressed in terms of the logistic distribution. This specification is known as the conditional logit (CL) model (McFadden, 1974; Greene, 2002), and it takes the general form:

$$P_{ij} = \frac{e^{V_{ij}}}{\sum_{n \in c} e^{V_{in}}} \qquad \textbf{(4)}$$

The CL model can be simplified as a form:

$$V_{ij} = \beta_o ASC + \beta_1 \mathrm{X}_1 + \beta_2 \mathrm{X}_2 + \cdots + \beta_n \mathrm{X}_n + \varepsilon_i \qquad \textbf{(5)}$$

With specific attributes included in this study, the model takes the form:

$$V_{ij} = \beta_o ASC + \beta_1 \mathrm{X}_{\text{price}} + \beta_2 \mathrm{X}_{\text{durability}} + \beta_3 \mathrm{X}_{\text{smoke reduction}n} + \beta_4 \mathrm{X}_{\text{Fuel wood reduction}} + \beta_5 \mathrm{X}_{\text{Cooking time reduction}} + \varepsilon_i \qquad \textbf{(6)}$$

To better understand observed heterogeneity in the sample, socioeconomic interaction effects with key-controlled variables are important.

Based on this, Equation 3 above can be extended and the conditional indirect utility function generally is given by:

$$V_{\mathrm{ij}} = \beta_{\mathrm{o}} ASC + \beta_1 \mathrm{X}_1 + \beta_2 \mathrm{X}_2 + \cdots + \beta_{\mathrm{n}} \mathrm{X}_n + \beta_{\mathrm{a}} \mathrm{S}_1 + \beta_{\mathrm{b}} \mathrm{S}_2 + \beta_{\mathrm{m}} \mathrm{S}_{\mathrm{k}} \quad \textbf{(7)}$$

Where, alternative specific constant (ASC) accounts for choice 1 or choice 2 are both improved stoves and closer substitutes than the status quo (choice 3).

With specific to this study, conditional indirect utility function takes the form:

$$V_{\mathrm{ij}} = \beta_{\mathrm{oj}} ASC + \beta_{1\mathrm{j}} \mathrm{X}_{\mathrm{price}} + \beta_{2\mathrm{j}} \mathrm{X}_{\mathrm{durability}} + \beta_{3\mathrm{j}} \mathrm{X}_{\mathrm{smoke\ reduction}n} + \beta_{4\mathrm{j}} \mathrm{X}_{\mathrm{Fuel\ wood\ reduction}} + \beta_{5\mathrm{j}} \mathrm{X}_{\mathrm{Cooking\ time\ reduction}} + \beta_{\mathrm{kj}} \mathrm{X}_{\mathrm{n}} * \beta_{\mathrm{mj}} \mathrm{S}_{\mathrm{kj}} \quad \textbf{(8)}$$

The marginal willingness to pay estimates for each attribute for the model by holding other attributes constant. Implicit prices are determined by using the following formula:

$$\text{Implicit price (MWTP)} = -\frac{\beta\ \text{non-monetary attributes of ICS}}{\beta\text{monetary attributes of ICS}} \quad \textbf{(9)}$$

Where, β is the estimated coefficients of the attributes in the CL model.

The assumption of independence of irrelevant alternatives (IIA) in the MNL model is tested to check whether or not it meets the real choice models. As a result, the assumption of IIA is accepted or not violated which was tested using the Hausman and McFadden (1984) procedure. So, the MNL and CL models are enough to analyze the data and not required to use other models further.

4. Results and Discussion

4.1. Descriptive statistics

Table 3 below presents the descriptive statistics of variables used in the empirical analysis. Of the surveyed households, 15% are female-headed and the rest are male-headed households. The average age of the sampled households is 47.93 years old, and the average year of schooling is 2.26 years of schooling. About 79% of households are married and the average family size of the sampled households is about 4.61 individuals with a minimum of 1 person and a maximum of 12 household members.

Regarding resource endowment, on average, households have 6.56 livestock with a minimum and maximum of 0 and 28.2, respectively. The sample households also own, on average, 1.77 ha of total land size as well as earn an average annual income of 30,735 ETB. Most of the sampled households (57%) have access to credit while the remaining do not have access to credit for the purchase of ICS. Access to infrastructure such as distance from the nearest forest, town, and all-weather road is also included to understand the effect of these variables on households WTP. The average distance from household residence to the nearest forest, town and all-weather road, and back to home is about 37.8, 199.0, and 36.7 minutes, respectively.

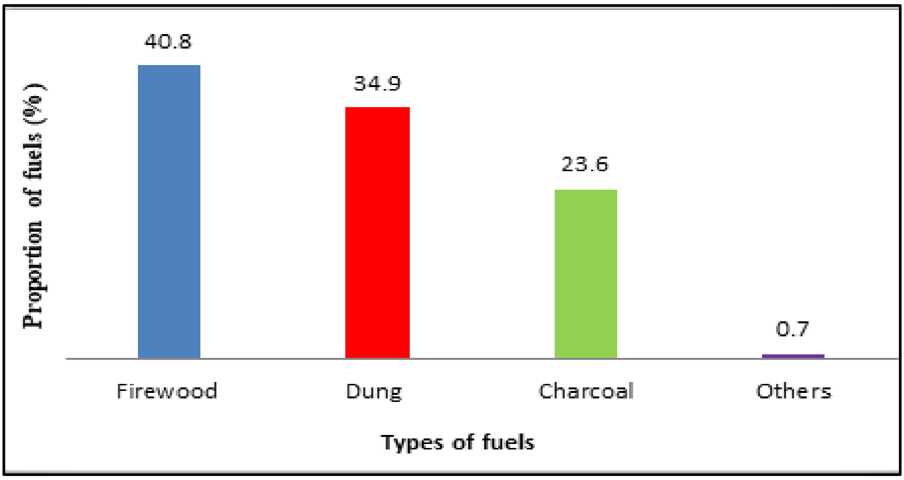
Table 3: Summary of descriptive statistics

Variables	Description	Mean	SD.	Min	Max
SEX (%)	Sex of household head (1 if female)	0.15	0.36	0	1
AGE	Age of household head in years	47.93	14.08	20	88
EDUC	Education level of head of the household in years of schooling	2.26	3.35	0	12
MART (%)	Marital status of HH head (1 if married)	0.79	0.41	0	1
FAMS	Number of people in the HH	4.61	1.70	12	1
TLU	Total livestock holding of the household in tropical livestock units	6.56	4.19	0	28.2
LAND	Total land holding of the household in hectares	1.77	1.18	0	4.75
INCOM	Annual income of the household in ETB	30734.8	29677.82	1080	102920
FRST	Distance from HH residence to nearest forest and back to home (in a minute)	37.77	57.35	0	480
TOWN	Distance from HH residence to nearest town and back to home (in a minute)	199.01	110.82	0	540
(ROAD)	Distance from HH residence to all-weather road and back to home (in a minute)	36.71	46.27	0	300
(CRDT (%)	Access to credit for *Tikikil* ICS purchasing (1 if having access)	0.57	0.50	0	1

4.2 Types of Fuels Used and Fuel Sources for Cooking

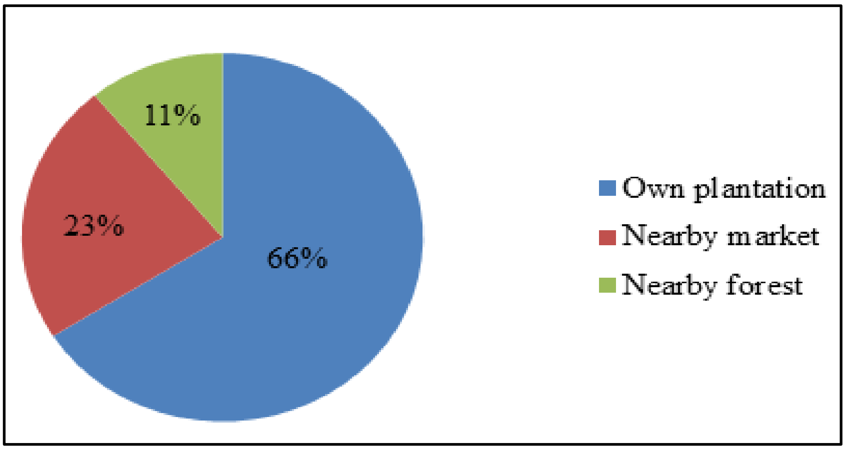
Households fuel sources used for cooking are firewood, dung, charcoal, and others as per their proportion in the study area (Figure 2). The household probably used more than one fuel type. As a result, the result presented using the proportion of fuel sources for cooking which was about 40.8%, 34.9%, and 23.6% for firewood, dung, and charcoal, respectively. While other fuel types (including biogas, solar PV, electricity, leaves, and branches) are used, they account for a small proportion of cooking energy consumption in the study area (Figure 2).

Figure 2: Types of fuels used for households' cooking purposes



The result also indicated that households obtained their fuelwood from their own plantations, nearby forests, and nearby markets. From the total sampled households, about 66% obtained their fuelwood from their own plantations (homestead trees and plantation forests) as a major source of fuelwood. This was followed by purchasing from the nearby markets (23%) and collecting from the nearby natural forests (11%) as shown in Figure 3. This result is in-line with the study conducted by Bekele *et al.*, 2013 who found that the proportion of plantation forests was the highest among fuelwood sources to households.

Figure 3: Distribution of households' fuelwood sources



4.3 Choice Experiment

The estimated coefficients derived from the MNL and CL models are shown in Table 4. The attribute level coefficients were consistent in terms of sign and level of significance. The goodness of fit of the MNL (pseudo-R^2=0.343) was not as high as the equivalent CL model estimations with a pseudo-R^2= 0.335. However, the log-likelihood value of the function of the MNL model (Log-likelihood= -1081.32) was much higher than the CL model (Log-likelihood = -840.04), indicating that the MNL provides better estimates than CL. Therefore, there is improvement in the model fit with the use of both CL and MNL models for the collected data. The MNL model is estimated and tested under the assumption of IIA by using the Hausman test by excluding one of the alternatives. The Hausman test results in the chi-square value of 8.43 with a p-value of 0.2165 shows that the IIA assumption was not violated in the MNL model. As a result, this study estimated the main, marginal, and interaction effects using MNL and CL models.

These results provide important information about the way households value ICS. The estimated results revealed that all attributes namely durability of the stove, fuelwood reduction; smoke reduction, cooking time reduction, and monetary attribute are statistically significant at 1% level of significance. Each of the attributes considered (except the cost of the stove) has a positive correlation with the household's likelihood of choosing a certain alternative, which means each of these attributes was important in determining households' choices of *Tikikil* stove. This positive sign implies that an increase in the levels of these attributes increases the probability of choosing improved scenarios.

Table 4: Parameter estimates from main effects models

Variables	MNL Model		CL Model	
	Coef.	Std. Err.	Coef.	Std. Err.
ASC	0.114	0.113	0.072	0.128
Durability of stove	2.497^{***}	0.138	3.471^{***}	0.218
Smoke reduction	1.471^{***}	0.127	2.097^{***}	0.196
Fuelwood reduction	2.986^{***}	0.150	3.678^{***}	0.225
Cooking time reduction	1.012^{***}	0.112	1.096^{***}	0.126
Cost of stove	-0.380^{***}	0.023	-0.504^{***}	0.041
Observations.	2,376		2,376	
Log-likelihood	-1081.32		-840.04	
Pseudo R^2	0.343		0.335	
Chi-squared	1130.06		846.34	

Note ***represents the level of significance at 1%

On the other hand, the sign of the cost attribute coefficient is negative as expected and significant at 1% level of significance in both models. That is, the higher the payment level in the alternative scenario the less preferred by households, other things constant. This implies that a significant and negative coefficient of cost indicates that households are very sensitive to the cost of the stove. The result of this study is similar to the findings of Dissanayake *et al*. (2018) who found a positive coefficient on fuelwood reduction, durability of the stove, smoke reduction, and cooking time reduction, but a negative coefficient for the cost of stove attribute. Similar findings also showed a positive coefficient on fuelwood saving and durability of the stove (Bersisa et al., 2021). On the other hand, the study findings contradict the findings of Kooser (2014) who conducted the CE method on the *Mirt* stove and found a positive coefficient for the cost of the stove.

4.3.1 Estimation of marginal willingness to pay

Besides the coefficient estimates, the CL model also provides information about households' marginal WTP for each attribute. For a better interpretation of the result, it is important to calculate the sample households' WTP for each attribute.

The marginal WTP is the marginal rate of substitution between cookstove attributes and the monetary attribute (cost). It is the rate at which households are willing to pay for the improvement of the attributes. The value of the marginal WTP of different attributes revealed the relative importance of the attributes of ICS to the household. Households made trade-offs when they took decisions about accepting the ICS (Table 5).

Table 5: Estimates of marginal willingness to pay (in ETB) for the attributes

Attributes	MWTP_CL	Std. Err.
Durability of stove	6.89***	6.13
Smoke reduction	4.16***	3.69
Fuelwood reduction	7.29***	6.51
Cooking time reduction	2.17***	1.68

*** represents the level of significance at 1%

The household's marginal WTP for fuelwood reduction attribute is about 7.29 ETB on average for each additional percentage of fuelwood reduction. This is followed by durability with a marginal WTP of 6.89 ETB on average for each additional year of use; smoke reduction is 4.16 ETB on average for each additional percentage of smoke reduction and cooking time reduction at 2.17 ETB on average for each minute of cooking time reduction. The finding of this study contradicts the finding of Kooser (2014) and Dissanayake *et al*. (2018) who found the highest marginal WTP on durability of the stove for *Mirt* stove. Households cook up to three times per day and consume more fuelwood especially in households with large family size. In addition, the study area is now prone to forest degradation and hence fuelwood is relatively scarce. These factors may force households to pay more for the fuelwood reduction attribute of the cooking stove. Therefore, we conclude that households have different preferences and WTP for fuel-efficient ICS attributes.

Besides the parameter estimates from main effects and marginal WTP for attributes of ICS, it is important to include interaction terms between attributes and socioeconomic variables and determine what characteristics of households lead to the fuel-efficient ICS being more attractive. The specific interactions were selected based on household demographic and other factors such as distance to the nearby forest that may influence the selection of the stove based on households' access to fuelwood sources.

Most of the socio-economic interaction terms are not significant except age, sex, family size, and distance to the nearby forest with some attributes of the specified *Tikikil* stove (Table 6). The log-likelihood of the specification of attributes interaction with demographic variables shows that the model fit is better.

The interaction between the sex of the household head with durability of the stove is positive and statistically significant at 10% level of significance. Similarly, the interaction of fuelwood reduction and age variable is positive and statistically significant at 5% level of significance, indicating that old age households have more preference of fuelwood reduction of the stove. In addition to this, the smoke reduction interaction terms with family size variable is positive and statistically significant at

10% level of significance, indicating that households having more family size are more likely to choose the smoke reduction of an ICS and more willing to pay for the ICS.

Table 6: Interaction effect computed from CL Model

Choice	Coef.	Std. Err.	Z	P>z
ASC	0.046	0.14	0.33	0.744
Durability of stove	2.772***	0.402	6.89	0.000
Smoke reduction	1.179***	0.442	2.67	0.008
Fuelwood reduction	4.774***	0.497	9.6	0.000
Cooking time reduction	0.589***	0.147	4.01	0.000
Cost of stove	-0.129***	0.009	-14.44	0.000
Durability of stove ×sex	0.202*	0.121	1.66	0.097
Durability of stove × family size	-0.07	0.075	-0.93	0.350
Fuelwood reduction × family size	-0.523	0.341	-1.53	0.125
Fuelwood reduction × age	0.022**	0.011	1.99	0.047
Smoke reduction × income(log)	-0.015	0.034	-0.45	0.654
Smoke reduction × family size	0.091*	0.053	1.71	0.086
Fuelwood reduction × distance to forest	0.09**	0.042	2.13	0.033
Cost of stove× distance to forest	0.002	0.001	1.55	0.122
Observations	2,376			
Log-likelihood	-698.28			

Note ***, ** and * represent the level of significance at 1%, 5%, and 10%.

In addition to demographic variables, distance to the nearby forest interaction with fuelwood reduction attribute is positive and statistically significant at 5% level of significance. This implies households far from the forest are more likely to prefer fuelwood reduction attribute because they may take more time for collecting firewood.

5. Conclusion and Policy Implications

5.1. Conclusions

Renewable energy technology particularly ICS development in Ethiopia presents a solution to addressing climate change and forest degradation to build a sustainable environment. The findings of this study show that a household's main source of fuel for cooking is fuelwood which is collected mainly from its own plantation forest. This study used the CE method to analyze households' preferences and WTP for the *Tikikil* stove and the result provides information about the approach of the value of ICS by households. The study aimed to give particular attention to product-specific factors and thus the model design incorporated five attributes (durability of the stove, fuelwood reduction, smoke reduction, cooking time reduction, and cost of the stove).

We used both MNL and CL models in the CE to evaluate households' preferences on ICS attributes for the data generated using the CE. Results from discrete choice models used for the analysis of WTP show that ICS-related attributes were vital in determining preferences for adopting the ICS. The results indicate that rural households in the study area put significant value for each of the attributes of the *Tikikil* stove that the study considers: quantity of fuelwood reduction, durability of the stove, smoke reduction, cooking time reduction, and cost of the stove.

We find that the fuelwood reduction attribute has the highest marginal WTP per unit of each attribute; followed by durability of the stove, smoke reduction, and cooking time reduction attributes but hence units of those attributes are different, cannot be directly comparable. Our results further show that ICS–related attributes and the respondents' socioeconomic characteristics were important in determining preferences for adopting the *Tikikil* ICS. The interaction of *Tikikil* stove attributes with different demographic (example: age, sex, family size of households) and other biophysical factors (for instance|: distance to the nearby forest) show a significant influence on the WTP to purchase for the ICS.

5.2. Policy Implications

Policymakers, development partners, ICS designers, producers, and distributors should give due attention to scale up and disseminate ICS based on the needs and preferences that households make in choosing the ICS attributes to sustain the use of ICS. In particular, they should emphasize the development and improvement for effective production and distribution of ICS.

To accelerate the switch from traditional to ICS, implementers should consider both socio-economic and stove-specific attributes and give a greater emphasis on *Tikikil* stove attributes to compensate for what has been lacking in the past ICS adoption.

Unavailability of the *Tikikil* stove in the community or nearby area is one of the main problems of adoption of the stove. The local people are willing to pay for the *Tikikil* stove and there is a need to train local stove producers for sustained production, distribution, and maintenance of the ICS. There is a need to create awareness among the households regarding the socioeconomic, health, and environmental benefits of using ICS. Therefore, government and other development partners should consider awareness creation and capacity building before they plan to disseminate the ICS.

Future studies on the production side for scale-up of the *Tikikil* stove technology in the market, and may offer valuable insights to better match demand and supply.

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Unemployment and Economic Growth Puzzles in Ethiopia: Okun's Law Perspective

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Abstract

A well-known inverse relationship between unemployment and economic growth was first set by Arthur Okun in 1962. Even if many studies have been conducted to verify Okun's law, mixed results have been produced and the issue remain highly debatable. Also, studies that have focused on empirical validity and policy implication of Okun's law are hardly available in Ethiopia. Therefore, the objectives of the study are assessing the linkage between unemployment and economic growth and studying the existence of Okun's law in Ethiopia. The study uses mainly the WB: ...WDI data for the period between 1990 and 2018. The difference version technique of Okun's law has been employed for analysis. In the study; however, both the short and long run regression results show the absence of Okun's law in Ethiopia. Albeit, the speed of adjustment to long run equilibrium is reported as 25%, it is not statistically significant at a reasonable interval. The fast-double-digit economic growth is not able to reduce the joblessness strain of Ethiopia. Perhaps a substantial volume of unemployment is structural and frictional not cyclical, the demand side policies that the Ethiopian government rely on after Okun's law are not effective. Consequently, an alternative supply side–demand side integrated policy such as government spending focuses on buyers, lowering corporate taxes and deregulation will be helpful to achieve stimulation and expansion in the economy. Furthermore, relaxation of labour market mobility, employment exchange in urban and pastoralist areas and city administrations, birth rate control and structural changes should be implemented to curb the widespread problems of unemployment in the country.

Keywords: Ethiopia, economic growth, unemployment, Okun's law, Policies.
JEL Classification: E24, E62, J21, J64, O47

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Acronyms

ADF	Augmented Dickey Fuller
ARDL	Autoregressive Distributed Lag
ECM	Error Correction Model
GDP	Gross Domestic Product
HGER	Homegrown Economic Reform
LRGDP	Log Real Gross Domestic Product
UR	Unemployment Rate
WB: WDI	World Bank: World Development Indicator

1. Introduction

In academic and policy making realm, it is allegedly deep-rooted to state that a boost in economy leads to a reduction in unemployment. Albeit many factors are responsible for variation in output, unemployment is singled out as the most important one since it has a direct implication on the output. It serves in many nations as one of the most prominent indicators for economic status. Many scholars believe that a reduction in cyclical unemployment will increase the output. To support the above claim, in his article in 1962 Arthur Okun designated a well stablished inverse relationship between economic growth and Unemployment Rate (UR) (Okun, 1962). The law states that “if Gross Domestic Product (GDP) grows rapidly the UR declines and if growth is very low or negative, the UR rises. When the actual growth equals the potential, UR remains unchanged”. The difference version of Okun’s law shows that a 1% variation in UR leads to a 3% inverse alteration in real GDP. The rule has been famous since then in macroeconomic theory and it has been confirmed to hold in many developed and developing countries. It is not deniable that the law is more of a statistical rather than structural, but the overall inverse relationship could be used as a yardstick to measure the connection between UR and real GDP growth. Furthermore, this rule of Okun is empirically verified and become one of the stylized facts in macroeconomics.

Okun’s law could also assist to make a choice between a focus area of polices either in demand side or supply side. If the law holds in a reasonable interval, it is a good sign for government to use demand management policies aimed to substantially reduce unemployment. However, if it does not hold for a given economy, policy makers should resort to other ways such as supply-side policies. Does Okun’s law exist in Ethiopia so that Ethiopia rely on demand side policies or should it turn away to other categories of policies is a concern in Ethiopia's policy debate.

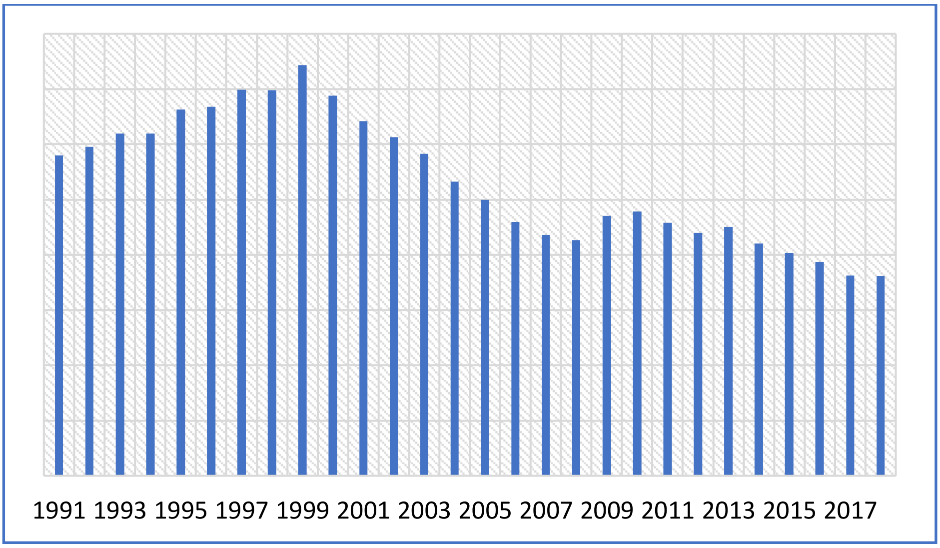
The attempt made to justify the empirical alignment of Okun's law in the Ethiopia economy and the alternative policies that are recommended, if in case to suggest demand management policy is not an option, were not addressed properly and studies are critically short. Then, the study has been motivated to examine the empirical validity of Okun's law and its possible policy recommendation on the Ethiopian economy.

Unemployment in Ethiopia is the prominent feature of the labour market. It has undesirable social, economic and psychological influences. The least developed countries like Ethiopia in which physical capital is in short, the labour resource plays significant role for economic growth. However, a significant portion of the labour force is under the unemployment category which poses a huge burden on the current economic growth of the country. Unemployment has prevailed in Ethiopia for many decades which is mainly caused by political instability, operational problems in industries, volatile investment and inefficient growing flow of new graduates to labor market. Several strategies of macroeconomy in Ethiopia was not able to realize the anticipated target of a sustainable economic growth and low UR. However, in spite of the social and economic consequences of high UR, issues such as what factors are responsible for unemployment are still mysterious.

As presented on Figure 1, the intensified unemployment rate in Ethiopia remains high after the downfall of Derg regime in 1991. It has even increased further in the mid 1990's. Besides, unemployment has shown a tendency to rise in 2009-2010 following the global financial crises that partly hit the Ethiopian economy. From 2004-2018, upon the broad based polices and continuous achievement in double digit economic growth, the employment rate in the country slightly improved.

The efforts to curb the unemployment rate in Ethiopia should focus on demand side and/or supply side policies. In the then regime earlier April 2017 in Ethiopia the demand side policy of a government contains government expenditure focuses on buyers, spending on education and infrastructure, money printing, social outlay, huge grant and fund. Then, the emphasis before 2017 was on demand side factors (Keynesian style). However, the regime afterward April 2017 by its supply side has inclined policies (Classical style) rather focuses on lowering corporate taxes, deregulation through ease of doing business and reforms on borrowing rate among other things. It seems, in Ethiopian policy making, a pronounced shift has been made towards supply side factors. However, before moving further on policy formulation and implementation by current administration to reduce unemployment, how are the performances of demand side polices of past regime, and in what manner the supply side polices of current administration be effective, need to be assessed as per Okun's law.

Figure 1: Trends of Unemployment Rate in Ethiopia



Source: Own computation based on the WB: WDI, 2020 dataset[2].

In line with the supply side policy, the new Homegrown Economic Reform (HGER) agenda is set by the Ethiopian government for ten years. The HGER has three pillars which articulated centered on past low performances of the economy (PMOE, 2019). The pillars are addressing macroeconomy imbalances, institutional change and sector focused reforms. The goals are employment generation, poverty reduction, debt lessening and stimulating the economy which all directs to achieve prosperity. The instruments that help to achieve the HGER agenda encompasses improved domestic saving, address macroeconomic imbalance to be prudent, reforms in foreign currency (privatization, concessional loan, inspire remittance, reforms liberalization of FOREX), financial sector reform (access to finance and capital market), public sector reform (agricultural input, finance and insurance), irrigation, land use, manufacturing, mining and tourism), and monetary and fiscal policies reforms.

[2] The unemployment rate figures are acquired from the WB: WDI database, which is the "modeled ILO estimate".

Total labor force in Ethiopia was reported at 53,746,763 in 2019 (WB: WDI, 2020; ILO, 2020). Set the UR 19.5%, the total unemployed people in Ethiopia are 10,480,619. According to the Ethiopian Prime Minister's report to the House of People Representative (Ahmed, 2020), 2.4 million new hires are expected in the fiscal year 2019/2020. Oppositely, in the same year, 2.0 million new entrants join the labor market. That means, making other factors constant, 25 more years[3] are required to substantially lower the unemployment problems of the country.

Overall, the 19.4% tall UR in Ethiopia remain high as compared to other countries. The degree of progress in employment status achieved due to economic growth remains unclear and controversial. Studies that have focused on empirical validity and policy implication of Okun's law and efforts to address the unemployment-economic growth puzzles are hardly available in Ethiopia. Therefore, the objectives of the study are to: assess the linkage between unemployment and economic growth in Ethiopia and examine the existence of Okun's law in Ethiopia in the period 1990 to 2018.

2. Related Studies

Since its inception in 1962 several studies have been conducted on the connection between UR and economic growth. Academicians, researchers and policy makers have employed the so-called Okun's law as a rule of thumb to observe the relationship between economic growth and unemployment. The studies have considered various regions of world and level of economic development but produce a mixed result on the interrelatedness between economic growth and unemployment. On one hand, there are studies which confirm the existence of Okun's law. However, other studies refute the inverse construction between unemployment and economic growth.

Since Okun's law commencement, several studies have been done to validate the Okun's coefficient. Some adopt an approach to address one country (Caraiani, 2006; Evans, 1989; Weber, 1995), others consider a pool of countries (Fouquau, 2008) and regional data (Guisinger, Ruben, Owyang, and Sinclair, 2015; Freeman, 2000). The remarkable stable result has been observed in the United States, but in Organisation for Economic Co-operation and Development countries the estimates are less stable.

[3] Ceteris paribus

The study by Karfakis, Katrakilides and Tsagana (2013) has examined the output and unemployment connection in Greece. The results have indicated output growth Granger causes UR. Then, the Okun's ratio indicates a 1% rise in unemployment rate results a 3% reduction in real output.

A study by Nurudeen (2017) employs the Autoregressive Distributed Lag (ARDL) bounds testing technique to examine whether Okun's law exists in Nigeria during 1970-2014. The study has found a cointegrating relationship between UR, economic growth and oil prices. In the long run UR has a negative and significant effect on economic growth. The coefficient of unemployment (0.18%) for this study is far less than the result reported by Okun and other studies that have focused on developed countries. This suggests that the Okun coefficient is not only unstable but varies for different countries, and does not remain constant for Nigeria. In the study it is recommended to take steps to reduce unemployment and enhance economic growth in Nigeria.

An empirical study by Fuad (2011) uses a cointegration test to find that Okun's law cannot be confirmed for Jordan. Lack of economic growth does not explain the unemployment problem in Jourdan and policies are not effectively working in reducing UR.

Overall, studies that have been conducted in relation to Okun's law can produce a mixed result. studies such as Izyumov and Vahaly (2002); Noor, Nor, and Ghani (2007); Silvapulle, Moosa, and Silvapulle (2004); Farsio and Quade (2003); Ball, Leigh, and Loungani (2013); Sögner (2001); Moosa (1997) and Hamada and Kurosaka (1984) confirmed an inverse relationship between UR and economic growth. On the other hand, studies by Kargi (2014) and Evans (1989) found a relationship contrary to the above inverse construction. Furthermore, Zagler (2003) study has revealed the absence of connection between unemployment and output.

3. Materials and Methods

3.1 Theoretical Framework

Unemployment is the macroeconomic problem that affects people most directly and severely. It is triggered by various reasons and the types and sources of causes are among the most extensively discussed issues by economists. Basically, there are four types of unemployment; namely cyclical, frictional, voluntary and structural but economists differentiate among several overlapping theories of unemployment. To investigate the relationship between unemployment and economic growth, it is obvious to observe the types/causes of unemployment. Table

1 presents other related categories of unemployment.

Macroeconomic theory produces a hardly few models that links the UR with economic growth. A simple law of empirical association between cyclical UR and economic growth was first introduced in the early 1960s. That law by Okun has indicated a short run inverse relation of those variables in United States of America economy in the period from 1947: quarter 2 to 1960: quarter 4. The association is not directly derived from macro-economic theory rather purely statistical and empirical. The law has helped academicians, researchers and policy makers a lot for macroeconomic and policy analysis since its inauguration.

Table 1: Categories of Unemployment

Categories	Types	Description
A	Frictional/Seasonal	Between jobs and laid off
	Voluntary	Leave financially unfulfilling jobs
	Structural (Jerome, 1934)	Occupational and geographical immobility, automation and structural change in the economy
B	Classical/ real-wage/ induced/ disequilibrium (Hayek, 1960)	Competitive labour market, minimum wages, trades unions, longer contracts push wages above equilibrium
	Marxian (Marx, 1863)	Due to nature of the capitalist system
C	Disguised	Left without work and zero worker productivity
	Hidden	jobless but official figures do not include them
	Underemployment	Has job (e.g., part-time) but not working at full capacity, working in low-paying jobs
	Long-term vs. Short-term (Marx, 1863)	Long term contains actively looking for a work over 27 weeks and the effects are devastating
D	Natural (Chang, 1997)	Explains why always some level of unemployment (frictional and structural) in a healthy economy (4.5-5%.)
	Real	Used instead of "official" UR
E	Demand side (Keynesian)	Lowered demand during recession, high interest rate, multiplier effects, financial crises and rigidities
	Supply side (Classical)	Frictional, structural immobility, real wage unemployment and technological changes

As of Javeid (2007), Okun's law has four types of estimation techniques. They are presented as follows.

a) Difference version/growth rate form: it relates change in output to change in unemployment as follows:

$$\frac{\Delta Y}{\bar{Y}} = \mathrm{k} - \mathrm{c}(\Delta \mathrm{u}) + e \qquad \textbf{(1)}$$

Where: Y – actual output, ΔY – the change in actual output from one period to the next, Δu – the change in actual unemployment from one period to the next, k – the average annual growth rate of full-employment output and e – error term.

b) Gap version: this version contains the deviation of actual output and URs from their respective potential (natural) rates:

$$\frac{\bar{Y}-Y}{\bar{Y}} = \mathrm{c}(\mathrm{u} - \bar{u}) + e \qquad \textbf{(2)}$$

Where: Y – actual output, $\bar{Y}$ – potential GDP, u – actual UR, $\bar{u}$ – Natural rate of unemployment, and e – error term.

The gap version of Okun's law is difficult to use in reality since $\bar{Y}$ and $\bar{u}$ cannot be measured but rather estimated.

c) Dynamic version: it relates current UR with current and past values of output and past values of UR.

$$\Delta u_t = \beta_0 + \beta_1 Y_t + \beta_2 Y_{t-1} + \beta_3 Y_{t-2} + \beta_4 u_{t-1} + \beta_5 u_{t-2} + e \qquad \textbf{(3)}$$

d) Production function version: as of this approach output is a function of labor, capital and technology:

$$\mathrm{Y} = \alpha(k + c) + \beta(\gamma n + \delta h) + \tau \qquad \textbf{(4)}$$

Where: Y – GDP growth, k – capital input, c – utilization rate, n – number of workers, h – number of hours they work, α *and* β – output elasticities, γ *and* δ – contribution of the workers and weakly hours to the total labor input and τ – disembodied technology factor

3.2 Data

The study has used World Bank (WB) World Development Indicator (WDI) data (WB: WDI, 2020) as a primary source of information; however, International Labor Organization (ILO), National Bank of Ethiopia (NBE) and Ethiopian Central Statistical Agency (CSA) data have also been consulted. The variables considered include UR and economic growth in Ethiopia for the period between 1990 to 2018.

3.3 Model Specification

The study has employed the *difference version/growth rate* approach of Okun's law for analysis. This *difference version* is appropriate and convenient over other models in terms of methodology and data usage. The data gathered on UR and economic growth of Ethiopian economy in the period 1990 to 2018 went through various tests.

Unit root test: The first task in analysing econometric time series data shall be tested for the presence of unit roots. The normal stochastic process is fully specified by its two moments, the mean and the variance (Gujarati and Porter, 2008). Augmented Dickey Fuller (ADF) test were used in this study to test the status of unit root in data series (Dickey and Fuller 1979, 1981). ADF test is presented as follows:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \sum_{i=1}^{n} \beta_1 \Delta Y_i + \varepsilon_t \quad \textbf{(5)}$$

Where: Y- linear time series, *n* - optimum number of lags and $\boldsymbol{\varepsilon}$ - random error term.

Autoregressive Distributed Lag (ARDL) bounds testing for co-integration: The study has used Akaike information criterion (AIC), which are the widely applied criteria for selecting the lag order (Akaike, 1973). If the unit root tests demonstrate a mixture of various orders of integration such as I(0) (order of integration at level) and I(1) (order integrations at first difference), the ARDL bounds testing techniques is an appropriate tool to estimate the status of long run relationship among the variables (Pesaran 1997; Pesaran and Shin 1999; Pesaran, Shin and Smith 2001). It is a better tool for finding cointegrating relationship that exists in small sample size. The single reduced form ARDL bounds testing equation that simultaneously estimate long run and short run parameters is specified as follows:

$$\Delta \mathrm{GDP_t} = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta \mathrm{GDP_{t-i}} + \sum_{i=0}^{m} \alpha_{2i} \Delta UNEMPL_{t-i} + \delta_{1i} \mathrm{GDP}_{t-1} + \delta_{2i} \mathrm{UNEMPL}_{t-1} + \varepsilon_{it} \quad \textbf{(6)}$$

*Granger causality tests***:** It examines whether a variable with its lagged values has any predicting ability on another variable. The F-statistic value determines the parameter under consideration is zero or different from zero (Granger 1969). It was employed in our study to examine the causal relationship between economic growth and unemployment.

Error Correction Model (ECM): It is intended to estimate a long run co-integration of variables based on non-stationary series. It explains the achievement of the long run equilibrium of endogenous variables through short run adjustments. The co-integration term, known as error correction term, works to correct the long run deviation through short-run adjustments. Given the variables are co integrated, the error correction term should be entered into the system to avoid misspecification of constraints. Thus, as of Lütkepohl (2005), ARDL can be reparametrized as ECM and the model looks as:

$$\Delta \mathrm{UNEPL_t} = \alpha_0 + \sum_{i=0}^{m} \beta_{1i} \Delta UNEPL_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta GDP_{t-i} + \lambda \mathrm{ECT}_{t-1} + \varepsilon_t \quad \textbf{(7)}$$

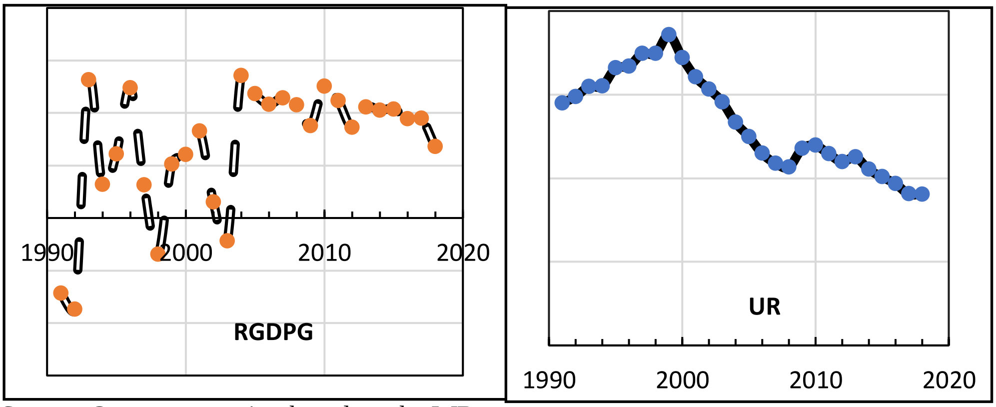
Where: ECT_{t-1} - error correction term,
λ – the speed of adjustment parameter is negative and statistically significant as a condition for long run co-integration (Kremers, Neil and Juan 1992)

Diagnostics test: The pre- and post-estimation tests applied in this study include: serial correlation test (Breusch 1978; Godfrey 1978), heteroscedasticity test (Pearson 1905; Goldberger 1964; Johnston 1972) and outlier detection test. Furthermore, Jarque-Bera normality (Jarque and Bera, 1980), the cumulative sum of recursive (CUSUM), and cumulative sum of squares of recursive residuals (CUSUMSQ) (Brown, Durbin and Evans, 1975) tests were used to check the data distribution and post estimation stability, respectively. Furthermore, Engle's (1979) LM test for autoregressive conditional heteroscedasticity ARCH, Ramsey's (1969) RESET test for omitted variables and functional misspecification and chow breakpoint test (Chow, 1960) has been conducted.

4. Results and Discussion

The descriptive statistics of the association between real GDP growth rate and UR in Figure 2 show high economic growth but enormous UR as well. From Figure 2 the typical inverse relation between economic growth and unemployment are not easily traceable.

Figure 2: The Relationship between the Unemployment Rate and Economic Growth Rate.



Source: Own computation based on the WB: WDI, 2020 dataset.

The normality test shows the data series are normally distributed. The summary statistics elements such as minimum and maximum values and the status of missing values prove the absence of outliers in the data series. The chow test in Table 2 reveals a data break on 2004. Then, in the course of the analysis the structural break point has been taken care by incorporating dummy variables.

Table 2: Chow Structural Breakpoint Test

Chow Breakpoint Test: 2004

F-statistic	6.587518	Prob. F(2,23)	0.0055
Log likelihood ratio	12.22763	Prob. Chi-Square(2)	0.0022
Wald Statistic	13.17504	Prob. Chi-Square(2)	0.0014

4.1 Unit Root Test and Bounds Test for Co-integration

To conduct the test, the maximum lag length for each variable were determined. Accordingly, the maximum lag length for real GDP growth and UR, which this research apply in all models of the analysis are 1 and 2, respectively (see Appendix 1). ADF test was used at level and first difference, to examine whether the data series contains a unit root or not. The results in Table 3 indicate that Log Real Gross Domestic Product (LRGDP) and UR are I(1) order of integration, i.e. stationary at first difference. The statistical probability values in Table 3 is turn out to be statistically significant at first difference for UR and RGDP growth.

Table 3: Augmented Dickey-Fuller Test

Variables	ADF Test	
	Level	**1st difference**
LRGDP	(-2.012294) [0.5687]	(-6.096726) [0.0002]*****
UR	(0.223815) [0.9691]	(-3.451721) [0.0181]****

Note: *** and ** symbolize rejection of the null hypothesis (unit root) at 1% and 5% level of significance, respectively.
: ( ) and [ ] present Augmented Dickey-Fuller t-statistic and probability values, respectively.

ARDL bounds test for co-integration method is used to observe the long run relationship. The co-integration test in Table 4 delivers the appearance of long run relationship between UR and real GDP. The F-statistic and t-statistic values indicate the existence of long run relationship.

Table 4: Bounds Test for Co-integration

Dependent variable	F-statistic and t –statistic	Co-integration	Estimation procedure
LRGDP	F_{RGDP} = 19.35, t_{RGDP}= -8.92	YES	ECM (Long run model)
UR	F_{UR} = 2.71, t_{UR} = -1.86	NO	ARDL (Short run model)

4.2 Short Run Estimates

The short run estimation results are presented in Table 5 by considering UR as dependent variable. The variables are denoted by differences and lags such as

D(LRGDP(-1)) is the differenced real GDP lagged by one period, D(LRGDP(-2)) is differenced real GDP lagged by two periods. In the short run, UR and real GDP do not exhibit any causal relationship. Okun's law is generally acceptable as a tool for trend analysis between unemployment and real GDP; however, as can be seen from Table 5 none of the coefficients are negative and significant.

Table 5: A Short Run Estimates of UR

Dependent Variable: D(UR)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.078419	0.071704	-1.093648	0.2894
D(UR(-1))	0.244744	0.229401	1.066883	0.3009
D(UR(-2))	0.239080	0.239703	0.997401	0.3326
D(LRGDP(-1))	0.112861	0.819773	0.137673	0.8921
D(LRGDP(-2))	1.045565	0.634554	1.647716	0.1178
DUM	-1.129066	6.364855	-0.177391	0.8613
DUM_UR	0.092047	0.373277	0.246591	0.8082
DUM_LRGDP	0.031528	0.203222	0.155142	0.8785
R-squared	0.290194	Mean dependent var	-0.051480	
Adjusted R-squared	-0.002080	S.D. dependent var	0.144174	
S.E. of regression	0.144324	Akaike info criterion	-0.779171	
Sum squared resid.	0.354101	Schwarz criterion	-0.389131	
Log likelihood	17.73964	Hannan-Quinn criter.	-0.670991	
F-statistic	0.992885	Durbin-Watson stat	2.047280	
Prob(F-statistic)	0.468794			
Normality: JB – 0.56 (0.76)				
Heteroskedasticity Test: Breusch-Pagan-Godfrey – 0.65 (0.71)				
Breusch-Godfrey Serial Correlation LM: Test - 0.35 (0.71)				
CUSUM and CUSUM of squares: Do not cross the 5% significance level (see Appendix 2)				

4.3 Granger Causality Analysis

The Granger causality test results in Table 6 depict the effect of variables on one another. The test was conducted to predict whether the former variable Granger causes the later variable or otherwise. Accordingly, the hypothesis that real GDP Granger causes UR, was rejected. Then, real GDP does not Granger causes UR. The other way around does also not work, i.e., UR does not Granger cause real GDP. Therefore, all the variables do not show any causal relationship. In relation with this, the findings about causality have a significant and important implication for policy makers.

Table 6: Granger Causality Tests

Null Hypothesis	F-Statistic	Prob.	Conclusion
D(UR) does not Granger Cause D(LRGDP)	0.11534	0.7372	Accept Null
D(LRGDP) does not Granger Cause D(UR)	0.55031	0.4657	Accept Null

4.4 Long Run Estimates

Regression result of long run estimates in Table 7 indicates UR and real GDP have negative relationships. Yet, the coefficient is statistically insignificant. The long run result confirm that Okun's law does not exist in Ethiopia.

Table 7: Long Run Estimations

Dependent Variable: D(LRGDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.034893	0.012878	2.709543	0.0128
D(UR)	-0.004160	0.064313	-0.064683	0.9490
DUM	0.198353	1.715859	0.115600	0.9090
DUM_LRGDP	-0.007602	0.055148	-0.137844	0.8916
DUM_UR	0.034348	0.099835	0.344045	0.7341
R-squared	0.401734	Mean dependent var		0.070624
Adjusted R-squared	0.292959	S.D. dependent var		0.053051
S.E. of regression	0.044609	Akaike info criterion		-3.216198
Sum squared resid	0.043779	Schwarz criterion		-2.976229
Log likelihood	48.41868	Hannan-Quinn criterion.		-3.144843
F-statistic	3.693239	Durbin-Watson stat		2.080625
Prob(F-statistic)	0.019044			
Normality: JB – 9.3 (0.00095)				
Heteroskedasticity Test: Breusch-Pagan-Godfrey – 1.90 (0.15)				
Breusch-Godfrey Serial Correlation LM: Test – 1.196 (0.29)				
Heteroskedasticity Test: ARCH – 0.98 (0.33)				
Ramsey RESET Test – 0.03 (0.87)				
CUSUM and CUSUM of squares: Do not cross the 5% significance level (see Appendix 2)				

4.5 Long run equilibrium and short run adjustments

ECM is an amalgamation of short run equation and long run representation. The regression coefficient and probability values in Table 8 exhibit the error correction term is not statistically significant. Even though, the speed of adjustment to long run equilibrium is recorded as 25%, the coefficient is not significant at a reasonable interval. Then, it proves the non-existence of the long run relationship and short run dynamics.

Table 8: Error Correction Model

Dependent Variable: D(LRGDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.047615	0.010486	4.540974	0.0002
D(UR)	0.005158	0.051093	0.100952	0.9206
DUM	0.343154	1.333347	0.257363	0.7995
DUM_LRGDP	-0.011918	0.042848	-0.278134	0.7838
DUM_UR	0.016819	0.078080	0.215409	0.8316
ECM(-1)	-0.245341	0.173099	-1.417349	0.1718

R-squared	0.479635	Mean dependent var	0.076829
Adjusted R-squared	0.349544	S.D. dependent var	0.042962
S.E. of regression	0.034649	Akaike info criterion	-3.687906
Sum squared resid	0.024011	Schwarz criterion	-3.397576
Log likelihood	53.94278	Hannan-Quinn criter.	-3.604301
F-statistic	3.686918	Durbin-Watson stat	1.637401
Prob(F-statistic)	0.015835		

Normality: JB – 7.31 (0.026)

Heteroskedasticity Test: Breusch-Pagan-Godfrey – 1.72 (0.18)

Breusch-Godfrey Serial Correlation LM: Test – 0.93 (0.35)

CUSUM and CUSUM of squares: Do not cross the 5% significance level (see Appendix 2)

In this study, the short run and long run regression results demonstrate the non-existence of Okun's law in Ethiopia. The coefficient values are far below than the standard Okun's one-to-three relation between unemployment and output.

The demand side policies that the Ethiopian government rely on following Okun's law are not effective. Moreover, the policies in Ethiopia in the last decades has not been able to significantly reduce the unemployment problems of the country and the fast-economic growth does not curb the unemployment problems of the country as well. It might be due to a substantial volume of unemployment is structural and frictional not cyclical. The less flexible labour market could be another reason for the absent inverse relationship between RGDP growth and variation in UR. In addition, the change in output might be caused by factor other than unemployment such as hours worked and capital utilization.

Overall, statistically insignificant Okun's coefficient means demand management policies are not effective and an alternative supply side–demand side combined policy might be helpful, in stimulating production and effective demand, mounting volume of output and improved capacity of productivity. The policy package could include government spending focuses on buyers, money printing, social outlay, corporate taxes revision, deregulation (e.g., through Ease of Doing Businesses) and sector focused intervention.

5. Conclusion

The rule of Okun is empirically verified and become one of the stylized facts in macroeconomics. The level of improvement in unemployment that has been achieved due to economic growth in Ethiopia remain unclear and controversial. Studies that focused on empirical validity and policy implication of Okun's law are hardly available in Ethiopia. In line with that, the objective of this study is to assess the link between economic growth and unemployment and to evaluate Okun's law existence in Ethiopia.

The chow test reveals a data break in 2004. Therefore, in the course of the analysis the structural break point has been taken care of by incorporating dummy variables. The short-run and long-run analysis delivers coefficient outcomes which are not statistically significant. Likewise, the coefficient figures confirm the non-existence of Okun's law in Ethiopia. The results detected in this study are much lower than the typical 1-to-3 relation between real GDP growth and unemployment of Okun's law.

The momentous shift in output and double-digit economic growth in the last decade have not been able to reduce the joblessness difficulties of Ethiopia as well. Since the major amount of unemployment in Ethiopia is not cyclical, the demand side policies that the Ethiopian government rely on following Okun's law are not effective. Furthermore, statistically insignificant Okun's coefficient means demand management policies are not effective and an alternative supply side–demand side shared policy such as government spending focuses on buyers, social outlay, lowering corporate taxes, deregulation and empowerment, will be helpful to achieve stimulation and expansion in the economy. Furthermore, relaxation of labour market mobility, employment exchange in urban and pastoralist areas and city administrations, birth rate control and structural changes should be implemented to curb the widespread problems of unemployment in the country.

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Appendix 1: VAR Lag Order Selection Criteria

Endogenous variables: LOGRGDP
Exogenous variables: C
Date: 08/06/19 Time: 12:19
Sample: 1991 2018
Included observations: 26

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-23.37449	NA	0.381792	1.874961	1.923349	1.888895
1	46.76198	129.4827*	0.001872*	-3.443229*	-3.346452*	-3.415361*
2	46.83368	0.126855	0.002012	-3.371821	-3.226656	-3.330019

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

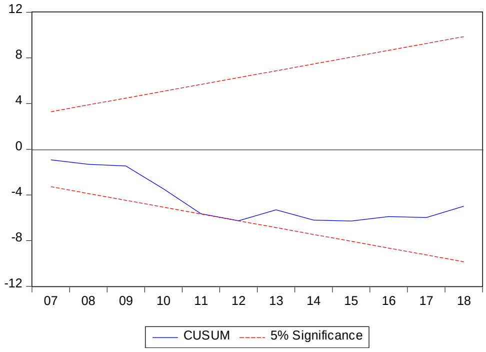
Endogenous variables: UR
Exogenous variables: C
Date: 08/06/19 Time: 12:19
Sample: 1991 2018
Included observations: 26

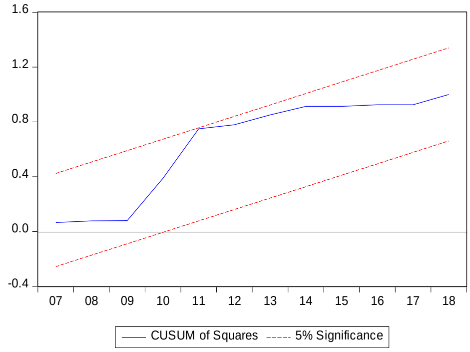
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-23.04626	NA	0.372273	1.849712	1.898100	1.863646
1	13.80185	68.02728*	0.023626	-0.907835	-0.811058	-0.879967
2	15.61630	3.210171	0.022207*	-0.970484*	-0.825319*	-0.928682*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

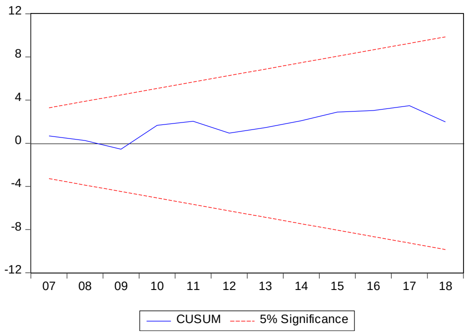
Appendix 2: Stability Test

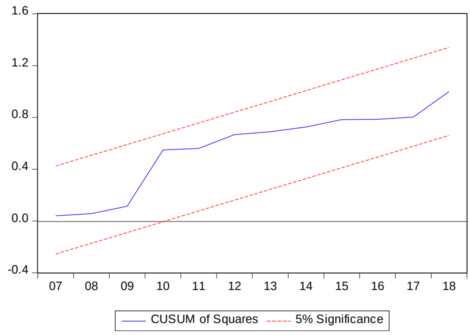
Stability tests of short run estimates



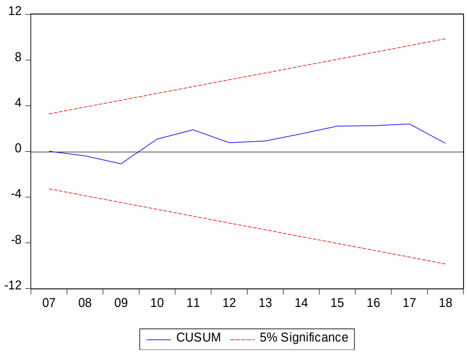


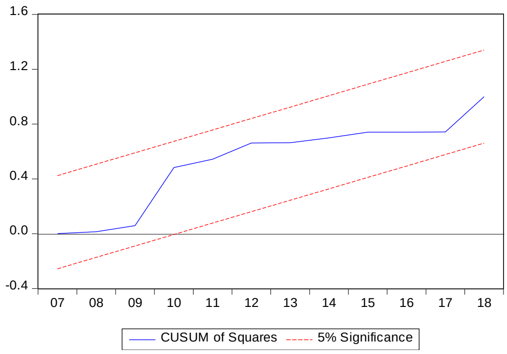
Stability tests of long run estimates





Stability tests of ECM estimates





Digital Divide in Sub-Saharan Africa: A Panel Analysis of Internet Diffusion

Andualem Assefa Welde[1]

Abstract

The objective of this study is to investigate the sources of the differences in digital technologies diffusion in Sub-Saharan Africa. Based on previous literature and economic theory, we selected relevant macroeconomic and telecommunication variables as the determinants of Internet diffusion. The study examines panel data for 41 SSA countries over the period 2006-2016. We applied the dynamic panel estimation technique using data obtained from the World Bank and International Telecommunication Union. The two-step GMM estimation result shows income, mobile subscriptions, lagged Internet users and urbanization exerted a positive effect on internet diffusion. The result implies that SSA countries need to invest in telecommunication and technology infrastructure to bolster digital technologies diffusion. Moreover, to reduce the magnitude of the digital divide, countries should promote affordable digital services.

Keywords: Digital divide, Information and communication technologies, Internet diffusion, Telecommunication policy, Sub-Saharan Africa

1. Introduction

1.1 Background of the Study

As they are fast becoming an essential tool for economic activity, digital technologies became a vital engine of economic performance. While the use of digital technologies is expected to transmit information easily and less costly, rapid diffusion (especially due to price decreases) has raised the issue of the so-called "digital divide". Digital divide refers to unequal diffusion and use of digital technologies among individuals, groups, or countries which creates leaders and followers of a digital society. The term first appeared in the mid-1990 in the United

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States and represents a crucial research issue in the field of economics of innovation. Investment in digital technologies in developed countries helped to improve productivity, job quality and to reduce significant transaction costs. In Sub-Saharan Africa (SSA), the wider development impact of most digital technologies is still low since access to the mass population is a challenge.

The data on Internet diffusion reveal, at a given time, there is a significant difference among countries. Developed countries have well-established infrastructure and hence a high level of Internet diffusion. On the other hand, most of the population in developing countries is not connected to digital technologies. When we say technology diffusion, we refer to the definition of the process in which technologies are adopted to use across individuals. In that regard, diffusion and penetration of the Internet are used alternatively in the study.

Digital technologies adoption by firms, people, and governments has spread rapidly in much of the world although the more sophisticated technologies like e-commerce, inventory management, enterprise network, and secured servers are much lower in developing countries. The digital technology revolution in developing countries results in a lot of benefits in different sectors. Agriculture is one of the sectors taking benefit from digital transformation. Digital technologies helped farmers to enhance on-farm productivity by improving agricultural extension services in SSA, South Asia, and Latin America. In that regard, extension agents use a combination of voice, text, videos, and the Internet to reduce transaction costs and increase interactions with farmers. Moreover, digital technologies improved agricultural supply management especially in deep rural areas with limited transportation infrastructure.

1.2 Statement of the Problem

Despite many individual success stories in many sectors of the economy, there has been limited evidence of aggregate improvements in important economic outcomes. Therefore, digital dividend, the broader development benefits from using digital technologies, has lagged. One of the reasons for that is since half of the world's population is without internet access. Moreover, the digital divide inside countries is high as between countries. The convergence between low-income and high-income countries is also very slow and widening in some digital technology sectors.

As witnessed by a very large number of publications, the subject matter is extensively studied in developed countries. Despite the growing number of studies in recent times, the concept of the digital divide is still not clear according to some sources. Given the fact that basic digital technologies are used as infrastructure for advanced ones, studying the dynamics of the diffusion process is germane for discussions and policy implications.

This study provides some attempts to fill three gaps in the literature. First, most Cross-country studies are either at the global level or categorize countries as low and high-income to study Internet diffusion (Andres et al., 2010; Hargittai, 1999). In this regard, our focus is limited to SSA countries with similar economic conditions and low research penetration. Secondly, to circumvent data problems, previous studies focus on a panel of very short periods (Myovela, 2020; Asongu et al., 2017; Donou-Adonsou, 2019; Cirera et al., 2016). Despite the data problem for important variables in our sample, our study has a relatively long period covering the most important stage of Internet diffusion. Finally, from the econometric point of view, the study addresses endogeneity, one of the major problems in the technology diffusion model. To solve the problem, we adopted a robust two-step dynamic panel approach incorporating the lag of the dependent variable into the regression equation. We use panel data for 41 SSA countries over the period 2006-2016 to shed light on the main factors governing Internet diffusion and obtain implications for the digital divide.

The major objective of the study is therefore to investigate the pattern of the digital divide across sub-Saharan African countries by focusing on Internet diffusion. Specifically, first, we investigate the determinants of Internet penetration rate differences across SSA countries. Secondly, we carry out a comparative analysis of the selected Africa countries by looking at their recent trends.

The remainder of this paper is organized as follows: The second section consists of the methodology of the study. The third section describes the econometric results. The fourth section provides a summary and conclusion.

2. Methods

Based on the discussion above, we construct an econometric model for the determinants of Internet diffusion. We use the statistics of Internet users for Internet diffusion rates. Although the diffusion itself cannot cover the issue of the quality of connection and services, processing speed, and other capabilities of the computer used, it is widely available for many countries in SSA and for a reasonable length of time, The average number of Internet users over the period 2006-2016 is regressed on a set of explanatory variables to assess their relative contribution to Internet diffusion.

We used a panel of macroeconomic and digital technologies data to carry out the empirical analysis. Digital technology data (number of Internet users, broadband, and mobile subscriptions) are obtained from International Telecommunication Union (ITU). Macroeconomic data on the other hand are obtained from World Bank's World Development Indicators database. Our data covers a decade of the Internet era with a considerable diffusion in SSA.

The sample consists of 41 countries in Sub-Saharan Africa. The study adopted the World Bank's list of SSA countries since this is the major source of our dataset (World Bank. 2019). The time series for the variables consists of 11 years from 2006 to 2016. SSA countries with missing data values and countries in North Africa are excluded from our analysis[2.] The list of countries used for the study is mentioned in the appendix. This sample has been the focus of many research works (Myovela, 2020; Asongu et al., 2017, 2018; Haftu, 2019; Penard et al., 2015; Birba and Diagne, 2012; Murthy et al., 2015; Ojuloge and Awoleye, 2018). However, our data covers a longer period with considerable expansion of Internet technology in most SSA countries. Moreover, previous studies focused on the impact of digital technologies on economic growth and development. Our analysis focuses on the technology itself since it is overlooked in the literature. Despite the longer time advantage, data unavailability limits our focus on the most important economic and technology variables (price, spending on technologies, education).

The empirical analysis is made using the dynamic panel data econometrics technique. Panel data analysis has several advantages over cross-section and time series. The dynamic panel data model is based on the Generalised Method of Moments (GMM) used in situations when the number of panels is greater than the number of periods aiming to address endogeneity concerns (Roodman, 2006). Using the Arellano-Bond (1991) estimator, higher lagged values of the dependent variable and the exogenous regressors from all periods can be used as instruments for the individual-specific effects. According to Roodman (2006), the Difference GMM is used to improve the efficiency of estimators as well as to avoid finite sample biases that result from weak instruments. Therefore, we applied Difference GMM (two-step) to identify the determinants of Internet diffusion for asymptotic efficiency. We also employed a fixed-effect approach to exploit the information contained in the

[2] The 7 SSA countries not included in the sample are Cape Verde, Republic of Congo, Djibouti, Eritrea, Sao Tome and Principe, Somalia, and South Sudan. These countries are characterized by small population size and low Internet diffusion. The countries excluded in the North African are Algeria, Egypt, Tunisia, and Morocco.

dataset of the cross-country variation in the sample. Finally, we also employed an OLS model as a benchmark of our analysis.

To ensure the robustness of the results of this study, the validity tests of the instruments used in the GMM estimation were carried out (a scenario whereby the instruments are correlated with the error process makes the validity of the instruments questionable). One of such tests is Arellano and Bond's (1991) specification test for lack of second-order serial correlation in the first-difference residuals. The second specification test is Sargan's test of over-identifying restrictions. To check the validity and the robustness of our results, the two tests are employed. Finally, time dummies are included in the regression to prevent any possible cross-individual correlation.

To explore the determinants of Internet diffusion in SSA, we used the following dynamic panel data model.

$$Int_{it} = \alpha_i + +\beta_{1t} lnGDPpc_{it} + \beta_{2t} Mob_{it} + \beta_{3t} Urbn_{3t} + \beta_{4t} Broad_{it} + \beta_{5t} Int_{it-1} + \eta_i + \varepsilon_{it}$$

Where Int is the number of Internet users expressed as a percentage of the population to measure access and use. In our data, Internet users are those who have used the Internet within the last 12 months from any device (ITU, 2019). lnGDPpc denotes the log of GDP per capita, Mob represents mobile subscription, Urbn represents urbanization, Broad represents broadband subscriptions and ηi represents the country fixed effect term and ε is an error term. Letters i and t are individual country and time-specific indicators. Including the lag of the dependent variable (Int_{it-1}) is important to measure the network effect. Even if network analysis is relevant in most technology diffusions, the feature of the Internet is more open for this kind bolstered by social networking i.e. current number of users of the Internet may depend on the past number of Internet users.

We used GDP per capita, mobile subscriptions, broadband subscriptions, and urbanization as important variables for the digital divide based on economic theory and findings presented in previous literature (Andres et al., 2010; Li and Shiu, 2012; Myovela, 2020; Haftu, 2019; Murthy et al., 2015; Wunnava and Leiter, 2009; Stier, 2017). Variables such as education, access to energy infrastructure, and income inequality are found to be relevant for the paper. However, data unavailability and methodological problems (high collinearity) obliged us to exclude these variables from the analysis. The dependent variable is the percentage of the population using the Internet as shown in Table 2.1 below.

Table 2.1: Definition of variables

Variable name	Definition
GDP per capita (GDPpc)	GDP per capita (constant 2010 US$)
Urbanization (Urbn)	Urban population (% of the total population)
Broadband subscriptions (Broa)	Fixed broadband subscriptions (per 100 people)
Mobile subscription (Mob)	Mobile cellular subscriptions (per 100 people)
Internet user (Int)	Individuals using the Internet (% of the population)

We expect the higher the country's GDP per capita the higher the diffusion rate of the Internet. Income allows countries to invest in innovation and cover the cost of Internet diffusion (Wunnava and Leiter, 2009). Information and communication infrastructures are also expected to be a significant contributor to higher digital technology diffusion. Telecommunication and information infrastructures are key determinants of Internet adoption because the Internet requires a proper telecommunications network to operate (Li and Shiu, 2012; Wunnava and Leiter, 2009). Urbanization is expected to have a positive effect on Internet use since cities are better networked than rural areas (Murthy et al., 2015). Lag of Internet use is also expected to have a positive effect on Internet use (Andres et al., 2010; Li and Shiu, 2012).

Table 2.2: Correlation coefficients matrix for SSA sample

GDPpc	Urbn	Broad	Mob	Int	
1.0000	0.6143	0.3704	0.4330	0.5409	GDPpc
	1.0000	0.1166	0.5635	0.3977	Urbn
		1.0000	0.3949	0.5377	Broad
			1.0000	0.7742	Mob
				1.0000	Int

Source: International Telecommunication Union and the World Bank, 2020

Table 2.2 above reports the correlation coefficients of variables. Internet use has a strong positive correlation with the rate of mobile subscriptions, GDP per capita, and broadband subscriptions with correlation coefficients of 0.8, 0.54, and 0.53, respectively. Internet use has also a moderate positive correlation with urbanization. It is interesting to find that the Internet has a stronger correlation with mobile phones than a broadband subscription.

3. Results

3.1 Digitalization and its economic implications

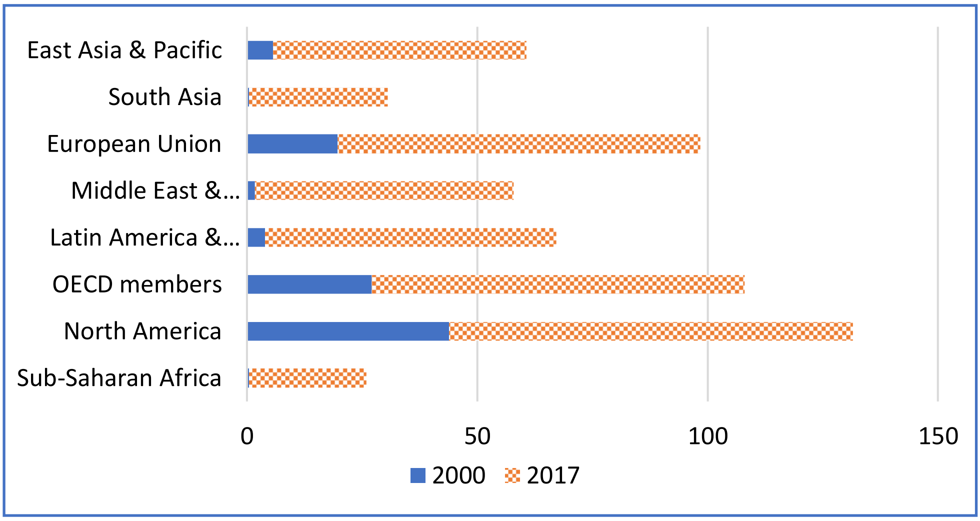
The unequal diffusion of technologies has created leading and following economies. According to United Nations for Industrial Development Organization (UNIDO, 2020), 10 economies account for 91% of global patenting in advanced digital technologies which include artificial intelligence, cloud computing, the Internet of things, and big data analytics, among others. This substantial "digital divide" is also a common phenomenon in Information and Communication Technologies. Hence, technology is one of the many factors for exacerbating global inequality and polarizing the labor market (UNCTAD, 2019).

Digital technologies contribute to economic growth on both the demand and supply sides (Myovella et al., 2020). Digital technologies reduced the cost of storage, computation, and transmission of data (Goldfarb and Tucker, 2019). The main channels of development are innovation, efficiency, and inclusion of many services impossible before the advent of the Internet (World Bank, 2016; Kpodar and Andrianaivo, 2011; Sassi and Goaied, 2013). Before the advent of the Internet, some transactions were impossible, and the Internet allows them to be carried out and, hence promotes inclusion. Moreover, the Internet lowers the cost of existing transactions. The most dramatic effect of the internet is the fact that once the Internet is adopted, in many instances, the marginal transaction cost is zero.

The improvement of communication infrastructure is also found to be one of the most important drivers of international trade (Riker, 2014). For instance, the advent of the Internet reduced significant transaction costs for firms, consumers, and governments by enhancing opportunities for global value chain participation (World Bank, 2016). In addition to the above effects, the increased use of digital technologies has a positive environmental effect by lowering CO_2 emissions (Ozcan and Apergis, 2018).

The problem, however, is the divergence of diffusion among different regions as shown in Figure 3.1. In 2017, the most recent year for which data are available, for instance, the average number of Internet users in Sub-Saharan Africa (SSA) was 25%.

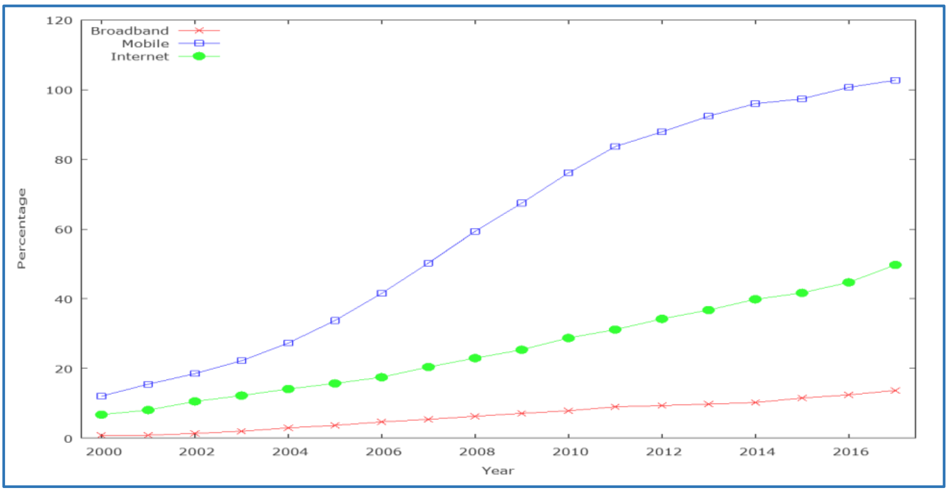
Figure 3.1: Percentage of Internet users across different regions



Source: World Development Indicators, 2020

Figure 3.2 shows that the share of the global population using the Internet increased from 7% in 2000 to 50% (3.9 billion people) in 2017. The highest penetration is observed in the number of mobile subscriptions which increased from 12% in 2000 to 103% in 2017. On the other hand, broadband subscriptions are low, reaching only 14% of the global population in 2017.

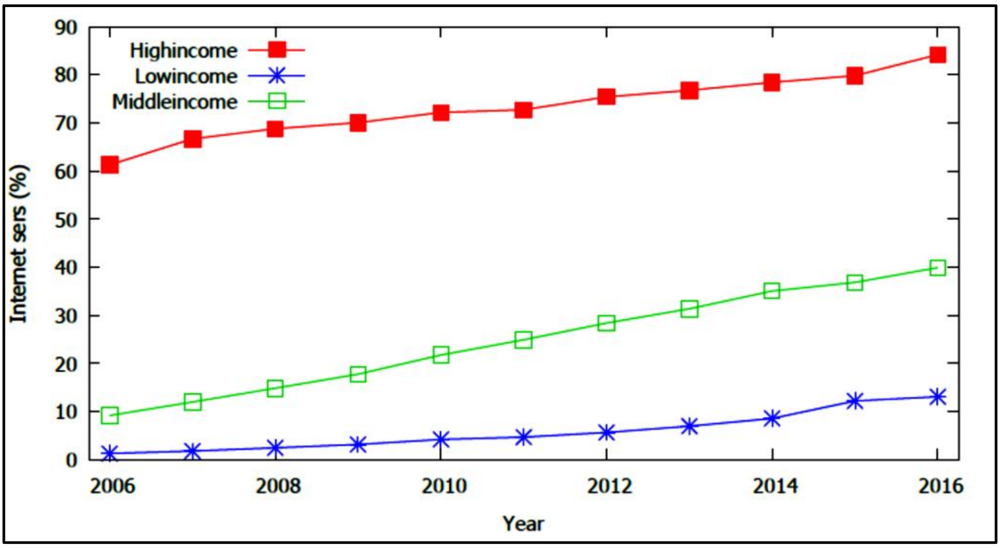
Figure 3.2: Global mobile, Internet, and broadband users



Source: International Telecommunication Union, 2020.

As already stressed in the introduction, digitalization exerts a diversified impact among countries based on the level of economic development, among others. The effect of broadband Internet is minimal for SSA compared to the Organization for Economic Cooperation (OECD) countries, whereas the impact of mobile telecommunications is higher in SSA compared to the OECD counterpart (Myovella et al., 2020). In SSA, unlike phone penetration, Internet did not contribute to income per capita growth which implies further research and policy measures needed to unlock the potential of the technology. During the period 2006-2016, a 10% increase in mobile phone penetration resulted in a 1.2% growth of real GDP per capita in SSA (Haftu, 2019).

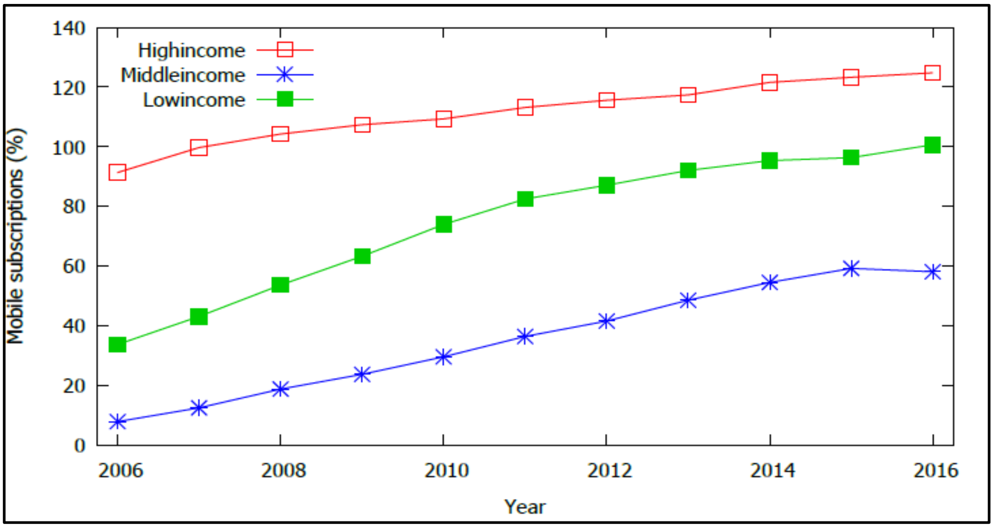
Figure 3.3: Internet diffusion in different income groups of countries



Source: International Telecommunication Union, 2020

The diffusion pattern of access to technology is characterized by convergence looking at mobile phone diffusion while for Internet diffusion countries tend to diverge (World Bank, 2016). For example, in 2016, the number of mobile cellular subscriptions per 100 inhabitants in low-income countries (58%) was lower than half of that in high-income countries (125%) while it was 1% and 48% in 2006 as shown in Figure 3.4. The convergence is even strong between high and middle-income countries. On the other hand, for the Internet, the trend shows rather a divergence as shown in Figure 3.3. The growth of Internet penetration has been also slow particularly in low-income countries.

Figure 3.4: Mobile diffusion in the different income groups of countries



Source: International Telecommunication Union, 2020

3.2 Economic conditions and digital divide in Sub-Saharan Africa

According to the World Bank, there are 48 countries in SSA (World Bank, 2020). The United Nations classified 33 of them as least developed countries with less than USD 1025 gross national income (GNI) per capita (UN, 2020). From 2006-2016, the compound annual growth rate[3] of SSA's GDP per capita was 1.5%.

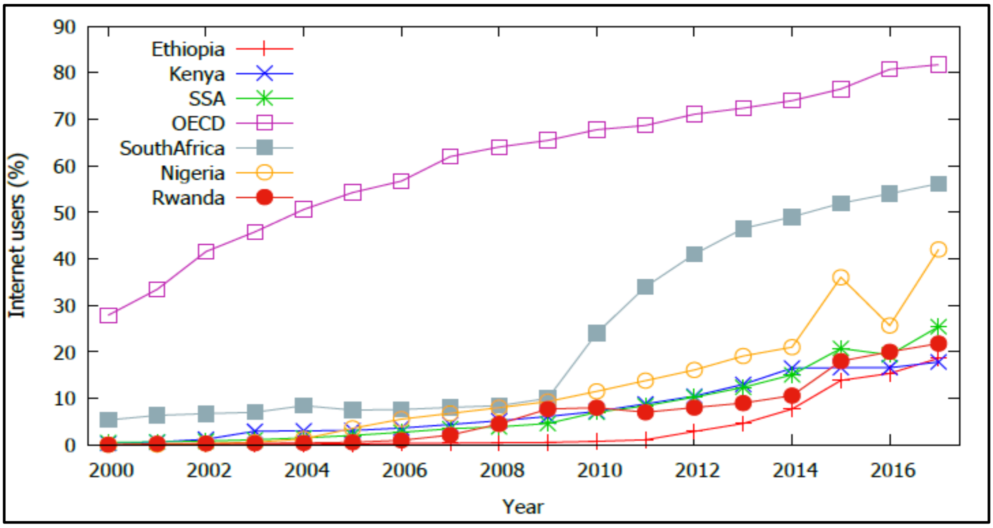
Growth accounting estimation[4] shows that, over the past three decades, physical capital growth has been the major source of growth in African countries. The contribution of employment is like the rise in years of schooling. Total factor productivity (TFP) on the other hand has either negative or zero contribution most of the time (Outlook, 2020).

[3] Compound annual growth rate is defined as the mean annual growth rate of a variable over a specified period longer than one year. Compound annual growth rate of GDP per capita over the period 2006-2016 is calculated as

$$CAGR = \{\frac{GDPpc2016}{GDPpc2006}\}^{\frac{1}{10}} - 1 * 100$$

[4] The growth accounting starts from cobb-Douglas production function of the form $Y_{it} = A_{it}K_{it}^{\alpha}(H_{it}L_{it})^{\beta}$ where Y is GDP, and H, L and K are human capital, total employment, and capital stock, respectively. Using α =0.4 and β=0.6, total factor productivity is calculated as $A_{it} = \frac{Y_{it}}{K_{it}^{\alpha}(H_{it}L_{it})^{\beta}}$

Figure 3.5: Trends of Internet penetration in SSA



Source: International Telecommunication Union, 2020

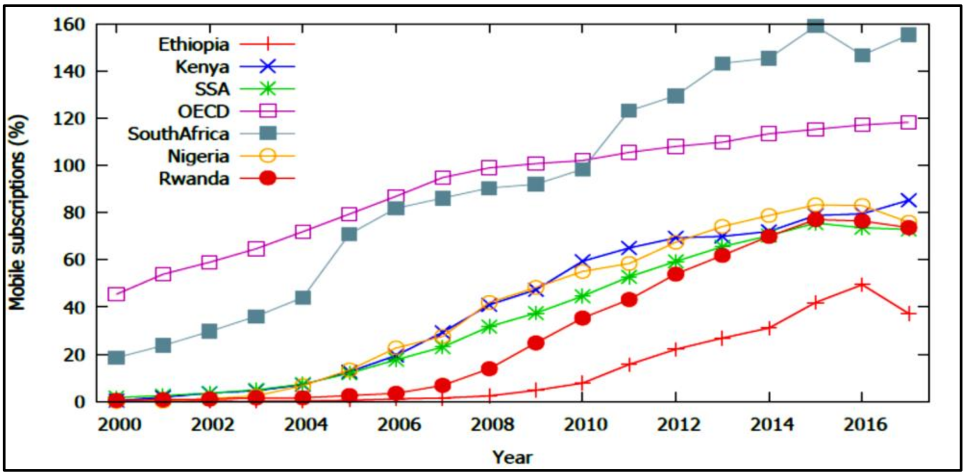
Regarding digital technologies usage in Sub-Saharan Africa, the Internet has been lagging while mobile telephony is widespread. Moreover, Internet penetration in SSA is considerably low particularly compared to OECD countries[5]. Figure 3.5 shows that the percentage number of Internet users in SSA (25%) in 2017 is lower than OECD (28%) in 2000. In OECD countries, Internet penetration leapfrogged from 28% in 2000 to 82% in 2017. Indeed, the Internet penetration rates of developed countries are significantly higher than the SSA countries. Figure 3.5 also shows the Internet penetration of five SSA countries (Ethiopia, Kenya, Rwanda, South Africa, and Nigeria). Together, these countries account for more than 40 percent of the continent's population. The Internet penetration of countries like Kenya was above the mean of SSA before 2014, while in 2017 it is lower than the regional average (17% versus 25%). In Rwanda, the Internet penetration rate was less than 10% before 2013 and reached 17% in 2017. The Internet penetration in Ethiopia (19%) is substantially lower than the average of the region with a recent convergence. In all five countries, the Internet penetration rate was lower than 10% before 2009 with a subsequent significant improvement in South Africa and Nigeria.

When it comes to mobile subscriptions, Figure 3.6 shows that there has been a considerable convergence between SSA and OECD countries. The recent average

[5] We used the OECD Internet penetration rate for the purpose of comparison with SSA countries.

in SSA is 73% in 2017 compared to 118% in OECD. In 2017, the mobile telephone penetration in Kenya (85%) is higher than the SSA average and that of other African countries. Some consider Kenya as “Silicon Savanah” with a savvy digital ecosystem. The country has a popular mobile payment system called M-Pesa and 70% of the population have a mobile money account. Mobile subscription in South Africa (155% in 2017) is higher than both in SSA and OECD average. In Nigeria and Rwanda, the rate of diffusion is closer to the regional average, 76% and 74% respectively. On the other hand, mobile penetration in Ethiopia is 37%, half lower than the SSA average. Worldwide, only a handful of countries, including Ethiopia, Djibouti, and Eritrea in the Horn of Africa region, still maintain state-run monopolies in the provision of mobile services and the Internet, and they have generally not fared as well as their neighbors. Mobile penetration is only half of the level of Kenya in the countries that have retained monopolies.

Figure 3.6: Mobile subscriptions



Source: International Telecommunication Union

To summarize, this chapter’s descriptive statistics and recent trends of digital technologies suggest that access to the technology itself is the main problem in SSA. Hence, investment in digital technology diffusion could solve many of the problems. This is not to underestimate the digital skill problem since the contribution of a lower level of education is found to be negligible for digital technologies diffusion. For instance, Penrad et al. 2015 reported a very low difference between people with formal education and primary school certificate holders of Internet use. However, access to technology could help to improve these problems.

The economic implications of digital technologies have been the focus of many development studies. The literature and recent data suggest that the impact of digitalization on the financial sector, labor market, inequality, education, and public service is appreciable. Not shown in the analysis, for instance, in the second half of the 1990s, the underlying difference of labor productivity between EU (1.4%) and US (2.5%) was attributed to low digital technologies investment and diffusion in EU countries. In Africa, only a few countries have achieved inclusive growth during this ICT era.

Moreover, digital technologies are less integrated into the economic and business environment in the region. This is clear from both mobile and Internet utilization data. As a result, both the diffusion process and its economic benefits are less than expected. Countries with mobile-money-service have better digital technology diffusion and improved their per capita consumption.

One of the unique characteristics of digital technologies is that they are relatively easy to reach the mass population, unlike other infrastructures. The reason could be the marginal cost of the Internet is close to zero once adopted particularly through its high non-rival properties. Consequently, some of them have reached many people before accessing basic infrastructures like electricity. For instance, in Kenya, while mobile phone diffusion has reached 80% in 2016, electricity access is limited to 65% of the population. The rate of growth of more advanced digital technologies is low.

3.3 Econometric Analysis

We have reported the summary statistics for the dependent and independent variables in Table 3.7 below. The mean of Internet use is 10% with a standard deviation of 12. The rate of mobile subscription is much higher than the Internet with a mean value of 59% and a higher standard deviation of 38. The mean GDP per capita is USD 2454.

Table 3.7: Summary statistics

Variable	Mean	Median	S.D.	Min	Max
GDPpc	2454	932	3598	220.	20513
Urbn	39.7	39.4	16.3	9.62	88.6
Broad	0.492	0.0789	1.69	0.00033	16.8
Mob	58.7	50.4	38.2	1.10	164
Int	10.1	5.55	11.7	0.228	56.5

Source: International Telecommunication Union, 2020

For estimating the determinants of Internet diffusion, we used OLS, fixed effects, and GMM techniques considering the importance of comparison in model selection. The results are reported in Tables 3.8, 3.9, and 3.11.

Table 3.8: Result of OLS estimation
Dependent variable: Int

	coefficient	std. error	t-ratio	p-value
Const	−22.3495	7.44068	−3.004	0.0046***
l_GDPpc	3.8008	1.35198	2.811	0.0076***
Urbn	−0.1653	0.06836	−2.419	0.0202**
Mob	0.1928	0.02511	7.679	0.0000***
Broad	1.2504	0.425160	2.941	0.0054***
R-squared	0.70			

*Significant at 10%. **at 5% and *** at 1% level Robust standard errors

The results of OLS estimation show that log of GDP per capita, and rate of mobile and broadband subscriptions have a positive effect on the percentage of internet users. Moreover, all three variables are significant at a 1% level. Urbanization showed a negative coefficient. However, GDP per capita has a strong impact (3.8) on cross-country Internet penetration differences.

Table 3.3: Result of fixed effects estimation
Dependent variable: Int

	coefficient	std. error	t-ratio	p-value
Const	−10.2776	7.74059	−1.328	0.2138
l_GDPpc	2.04229	1.11227	1.836	0.0962*
Urbn	−0.0429403	0.0588445	−0.7297	0.4823
Mob	0.190827	0.0170926	11.16	0.0001 ***
Broad	1.84314	0.372357	4.950	0.0006 ***

*Significant at 10%. **at 5% and *** at 1% level

Robust standard errors

The result of the fixed effects model shows the same result as the OLS model in terms of signs of the coefficient of independent variables. Mobile and broadband subscriptions are significant at the 1% level. The urbanization indicator has a negative coefficient and is not significant. The impact of GDP per capita decreased in the fixed effect model (2.04) compared to the OLS model and is significant at a 10% level in affecting Internet penetration differences.

Table 3.9: Result of two-step dynamic panel model
Dependent variable: Int

	coefficient	std. error	z	p-value
Int (-1)	0.67521	0.09669	6.983	2.90e-012***
l_GDPpc	6.20755	2.30249	2.696	0.0070***
Urbn	0.46154	0.19034	2.425	0.0153**
Mob	0.02914	0.01643	1.773	0.0762*
Broad	0.46622	0.43304	1.077	0.2816
Test for AR (1) errors: z = -1.92432 [0.0543]				
Test for AR (2) errors: z = 0.461202 [0.6447]				
Sargan over-identification test: Chi-square (8) = 8.30934 [0.4039]				

*Significant at 10%. **at 5% and *** at 1% level
Asymptotic standard errors
Number of instruments = 22

The result of the dynamic panel model is different from the OLS and fixed-effect model. For instance, the impact of urbanization is positive and significant in the dynamic model. The broadband subscription on the other hand has a positive but insignificant effect. The change in the sign and coefficients of the variable could arise from endogeneity bias in OLS specifications (Andres at al., 2010; Myovella,2020, Li and Shiu, 2012).

Results from the estimation procedure show that the null hypothesis of joint insignificance of the coefficients of all independent variables is rejected. This is confirmed by the Wald- test. This shows that variables selected for the estimation procedure are jointly valid. The Arellano-Bond test for zero autocorrelation in first differenced errors at orders 1 and 2 shows that errors are not serially correlated implying consistency of the parameters.

The Arellano-Bond GMM estimation shows that the diffusion coefficient (the lag of the dependent variable) is positive and highly significant indicating that the diffusion model cannot be rejected. A 10% change in the number of Internet users last year led to a change of about 7% in the number of Internet users this year. The importance of the lagged dependent variable is in line with the results of several papers including (Andres et al., 2010; Li and Shiu, 2012; Godwin, 2019; Haftu, 2019; and Shiferaw, 2015).

GDP per capita has a significant positive effect on Internet use. A 10% increase in GDP per capita is associated with a 62% increase in the number of Internet users. The result implies that economic strength is an important determinant of Internet use in developing countries. In general, GDP per capita, is one of the key determinants in explaining the global digital divide has been verified to be positively related to ICT diffusion and hence Internet as observed in previous studies (Andres et al., 2010; Wunnava and Leiter, 2009; Andres et al., 2010).

Our results also demonstrate that telecommunication infrastructure growth plays an essential role in terms of Internet diffusion. Our model shows that a 10% rise in mobile subscriptions is associated with a 3% increase in Internet penetration. Thus, an increase in the number of mobile telephones available in a country is likely to have a positive effect on Internet diffusion. The result is consistent with Oyelaran and Lal, (2005) and Birba and Diagne, (2012). Instead, the impact of broadband is negligible.

4. Concluding Remarks and Possible Recommendations

The role of the digital technologies revolution in different sectors of the global economy is a well-established fact in the economic literature. The main channels of development are innovation, efficiency, and inclusion. On the other hand, the digital divide in access, use, and skills is one of the major challenges. The diffusion of digital technology is therefore different across countries and regions depending on the level of development and the state of technology. Hence, it is germane to study the dynamics of diffusion and investigate the policy implication of different penetration rates of digital technologies across countries. Our study focuses on Internet diffusion in SSA countries using a panel data model. In SSA, the rate of digital technology diffusion has improved, especially, over the last decade. However, a lack of infrastructure and proper governance limits the diffusion process. The average number of mobile subscribers in Sub-Saharan Africa was 73% in 2017. On the other hand, the diffusion of the Internet (25%) and other digital technologies is significantly lower than in developed countries.

According to International Telecommunication Union, globally, a 10% rise in mobile broadband penetration yields an increase of 1.5% in GDP, and the impact is greater in less developed countries than in developed countries. A follow-up study focusing on the African region suggests a 10% increase in mobile broadband penetration in Africa would yield an increase of 2.5% of GDP per capita. Even if there are individual success stories, the comprehensive social, economic, and political benefits of digital technologies are less than expected. For instance, the level of e-commerce and financial inclusion in most African countries is at an infant stage.

In SSA, most countries had an Internet penetration of less than 30% in 2017 and 5% in 2010. In countries like Kenya even if 70% of the population has mobile banking, Internet users are less than 20% in 2016. In Ethiopia, the share of Internet users was less than 1% of the population until 2010 although it reached 18% in 2017. The diffusion process is hampered not only by infrastructure but also by unsustainable public financing, low market competition, lack of proper governance, and technological capabilities; these are also the most frequently mentioned factors affecting the diffusion of the Internet and other digital technologies in developing countries. The focus of this study is therefore to investigate the sources of different cross-country Internet diffusion rates.

The results show that the impact of GDP per capita and mobile subscriptions is positive and significant consistently in all three models. Broadband subscriptions and urbanization are also positive even if they are statistically insignificant in the dynamic panel GMM model. The lagged of the dependent variable (Internet) is significant in the GMM model. The results are consistent with the literature, in which economic strength, urban development, and infrastructure improve Internet connectivity.

Therefore, countries in SSA should give priority to Internet infrastructural expansion to realize the full benefit of technology. Smartphones, broadband networks, and computers are important to access the Internet. Unlike developed countries, in which 83% of households possess a personal computer, only 36% of households in developing countries own personal computers. Additionally, enhancing electricity and digital literacy would increase Internet diffusion. The World Bank report showed that the expansion of digital technologies has been faster than some basic infrastructures in SSA. For instance, the average number of populations with lack of access to electricity is 57% in 2016 lower than the mobile penetration of most countries. Improvement of infrastructure requires a strong commitment from governments and private participation.

Diversifying the use of the Internet will help to integrate the technology with economic activities and facilitate innovation. The diffusion coefficient in the GMM model confirmed that the present users of the Internet attract future users at a higher speed. To bolster the diffusion process, countries should support small transactions using mobile technologies. Mobile banking, for example, allowed farmers to access financial services and per capita consumption in some African countries.

The diffusion also highly depends on the state of the technology itself and the level of development of the countries. Therefore, the digital divide is partly a consequence of the development divide. Promoting the affordability of digital technologies by adopting appropriate policy and regulation would help countries to enhance the diffusion.

Africa is urbanizing faster than other world regions. It is projected that 60 percent of the population of Africa will live in urban areas by 2050 from 46 percent in 2017. Urbanization is usually demonstrated by the expansion of infrastructure, mainly roads and buildings. Even if the expansion of infrastructure is the positive side of urban growth, urban poverty and inequality are big challenges in developing countries. There is also evidence for a positive association between urbanization and inequality. However, the diffusion of digital technologies in urban areas is much higher than in rural areas due to the availability of digital literacy, market, and infrastructure advantages. Since the pattern of developing countries is different from developed ones, there is a gap in the backbone infrastructure, especially in rural areas. In that regard, government intervention is necessary to fill the urban-rural gap.

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Appendices

Countries used in the analysis

Angola	Ethiopia	Mali	South Africa
Benin	The Gambia	Mauritania	Sudan
Botswana	Ghana	Mauritius	Swaziland
Burkina Faso	Guinea	Mozambique	Tanzania
Burundi	Guinea-Bissau	Namibia	Togo
Cameron	Ivory Coast	Niger	Uganda
Central African Republic	Kenya	Nigeria	Gabon
Chad	Lesotho	Rwanda	Zambia
Comoros	Liberia	Senegal	Zimbabwe
Congo (Brazzaville)	Madagascar	Seychelles	
Equatorial Guinea	Malawi	Sierra Leone	

Economic valuation of the Recreational Use Value of Lake Zengena Application of the Individual Travel Cost Method

Esubalew Shitu Fekadu[1]*

Abstract

Most ecosystem services contribute a lot to human welfare; however, these services are often undervalued because their economic value is not well known. Therefore, accounting for the value of these services can help in making decisions that enable efficient use of environmental resources. This study investigates the economic valuation of recreational use-value of Lake Zengena application of individual travel cost method. The main purpose of the study was to estimate the economic use-value of the site using the individual travel cost method. The truncated Poisson regression model was employed to derive the demand function and identify determinants of recreational demand for Lake Zengena recreational site. According to the regression results, the total travel cost, total travel time, first visit, environmentalists and income were the major determinants of the recreational demand for the site. The study also found that consumer surplus per visitor per day and the annual on-site recreational benefit of the site were 250 and 1,250,000 ETB, respectively. On the other hand, the entrance fee that would maximize income was less than one Birr. The study recommended that efforts should be made by the government and other relevant stakeholders to improve the site and maximize the benefits that can be derived from the site.

Keywords: Lake Zengena Recreational Site, Travel cost method, Consumer surplus, Recreational value

1. Introduction

An ecosystem is the combination of living things and non-living things that interact with each other, and ecosystem services are the benefit that human beings consume, enjoy or use directly or indirectly from the proper functioning of nature (Boyd & Banzhaf, 2006; Defra, 2017). Following (Freeman III, et al., 2014; MEA, 2005), the paper discussed the four classifications of ecosystem services. Provisioning services are services which serve as sources of material inputs to the

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economy. These include fossil fuels, wood products, minerals, water, and fish. Life support services are services which serve for people in the form of a breathable atmosphere, clean water, and a liveable climatic regime. A regulating service is the benefit provided by ecosystem processes that moderate natural phenomena. The fourth classification and the focus of this study is cultural services. These services provide the opportunity for recreation, wildlife observation, the pleasure of scenic views, and perhaps even services that are not related to any direct use of the environment sometimes called non-use or existence values.

Though, ecosystems provide a range of services that are important for human welfare, their degradation and loss of biodiversity threaten the ability of ecosystems to continuously supply these services (MEA, 2005). Ethiopia is one of the most important biodiversity hot spots in the world, but also one of the most degraded. According to Cheever et al. (2011), natural resources are the foundation of the Ethiopia economy. Means, its economy is largely dependent on natural resource and besides, ecosystem services provide a dominant contribution. In this regard, societies increasingly place a greater demand on wilderness areas for a variety of products. For example, agricultural land use, wood fuel production, and commercial land use activities such as timber extraction, cash crop production, and mining (UNESCO, 2004). This contributes to habitat destruction and loss of species of the natural ecosystem, and further, deteriorates the state of the ecosystem, and the services it provides are likely to diminish. Gradually, a threshold may be reached. Beyond this threshold, an irreversible change to the ecosystem may occur, resulting in permanent loss of the capacity of the natural environment to provide its service (MoFED, 2002), this is due societies give low value/attention to ecosystem services. According to Mogaka et al. (2001), among the reasons that contribute to the difference between the level of ecosystem service enjoyed by people and the low value/attention attributed to them is because, these ecosystem services are not traded in the market (public nature of the good) and their economic value is not readily known and finally, this non-marketable feature of a resource significantly contributes resources to be lost by the beneficiaries without much understanding of its economic values.

Specifically, Lake Zengena is a crate lake located in Awi Zone of the Amhara region in the town of Injibara and kessa Kebele. It covers 0.5 square kilometers wide and 160 meters deep and is surrounded by evergreen indigenous and nonindigenous plants and trees. This makes the surrounding a beautiful home of wildlife including avian species, reptiles, fish species such as resilient tilapia and other mammals. The bird species include inter alia, Alopochenae gyptiaca (Dakiye), Aquila rapax (Chilifit), and Wattled Ibis (Bale-Enitiltil Gagano). The mammals include the Abyssinian Colombus monkey (Gureza), Spotted Hyena (Jib), Anubis baboon (Monkey/Zinjero), and Common bushbuck (Dikula) (Beza, 2017).

Due to the nature of the area, the lake is home to diversified tourism resources for both domestic and foreign visitors. Currently, Lake Zengena provides the following ecosystem services for visitors: sightseeing, watching different animals and birds, photography and hiking. However, despite its benefit to the society and for a long period of time, it has not been studied, and the extent to which the society benefits from this service is not understood.

On the other hand, despite the long presence of the lake, the types and the recreational services of the site has not been expanded. Hence, the due to lack of improved infrastructure facilities such as: roads, accommodation services, electricity, boats, lounges, and others. This is could be associated to shortage of sustainable income of the site. In this regard, one option is strengthening the internal sources of finance using entrance fees. According to (Tang, 2009), an appropriate entrance fee plays a crucial role in its active influence to maintain and develop the site. In the study area, an entrance fee being collected so far by the site supervisor is 3 Birr, and still it remains the same since the lake established. Therefore, it is not possible to conclude that this is the maximum entrance fee that visitors pay without valuation study. The main purpose of the study is to estimate the economic valuation of the recreational use-value of Lake Zengena application of individual travel costs. In addition, the researcher(s) have the following specific objectives. Identify factors that affect the recreational use-value of the site, estimate a recreation demand function for visiting the site and approximate its economic benefit and calculate an entrance fee that would maximize the entrance and fee income and compare it with the current one.

Estimating nonmarket values of the Lake can be useful to assign a monetary value for nature and creating awareness for resources users how much they benefited from nature and this brings sustainable managements of resources. In addition, estimation is useful for assessing the economic effects of management and policy decisions, for inclusion of nonmarket benefits in benefit-cost analyses, and aiding in financial resource allocation decisions and for managers and planners in setting entrance fees and further it helps to expand the limited empirical studies evaluating recreational ecosystem services in Ethiopia in general and the study area particularly.

2. Research Methodology

2.1 Description of the study area

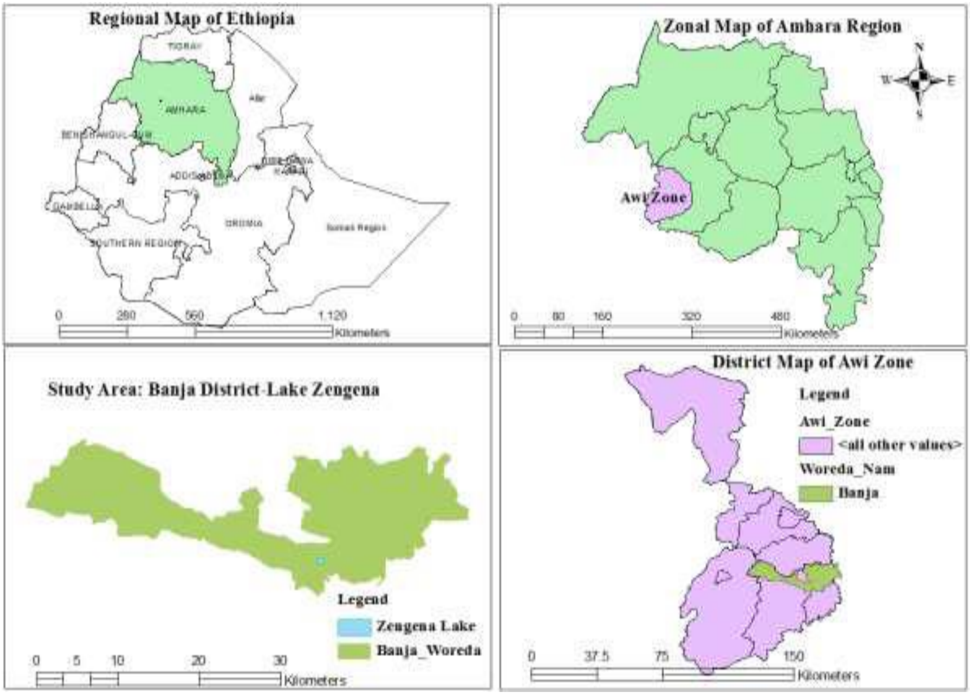
Lake Zengena is situated in Banja Woreda between coordinates 10°54′50″N 36°58′00″E, and it is 5 km away from Injibara town and 200m from the main Addis Ababa-Bahir Dar road at an elevation of at an elevation of 2500 m. The major economic activities of the community around Lake Zengena are agriculture, trade, and sale of handicrafts. Among these, agriculture takes the lion’s share (Banja Woreda Statistical Agency, 2018).

The lake is a home to a large variety of wildlife, including avian species, reptiles, fish species such as resilient tilapia and other mammals. The bird species include inter alia, Alopochenae gyptiaca (Dakiye), Aquila rapax (Chilifit), and Wattled Ibis (Bale-Enitiltil Gagano). The mammals include the Abyssinian Colombus monkey (Gureza), Spotted Hyena (Jib), Anubis baboon (Monkey/zinjero), and Common bushbuck (Dikula) (Beza, 2017).

The other natural resources include nearby mountains, such as Darkan Mountain, in the north western direction with a potentially good view point of the surrounding area. There are also the Gubil Mountains in a south-western direction of Lake Zengena, and they are covered by very dense forests comprising mainly highland evergreen trees. Bamboo plantations or ‘Kerkeha’ are also natural plants near Lake Zengena. Generally, in almost all directions, there is an abundance of fresh air and beautiful environmental. It is particularly common in the parts of the Awi Nationality Administration, including Banja Woreda and in Kessa- Chewsa Kebele, to see local bamboo products (Beza, 2017)

Moreover, the lake is not only gifted with natural resources but also it consists cultural tourism resources. Among these, the popular Monasteries of Felege Hiwot Kidus Gabriel and Debre Mihret Kidus Michael, are located in the area. The monasteries have a close connection with religious practices of the lake, such as the Coptoc Church Timket/Epiphany festival, and monthly celebrations of St. Gabriel. The lake is often used as a source of ‘Holy water’ for day-to-day church services (Beza, 2017).

Figure 1: Location of the study area



2.2 Sampling Technique and Sampling Size

Sampling on-site can be challenging. Think about randomly selecting a user on a beach. When and where do you sample? A strategy must be devised. For example, randomly drawing several weekdays and weekends during the season for interviewing and then, once on-site, interviewing every tenth person one encounters is a strategy that attempts to approximate a random sample. Clear entry points, such as gates, help in on-site random sampling (Boyle et al., 2017)

In this study, a complete random selection of sample respondents was not possible because all visitors during the survey period could not be identified at the beginning of the survey. As an approximation to a random selection, sample respondents were selected after a regular interval when entering the site, an approach suggested by (Boyle et al., 2017). On each survey day, the first respondent from visitors was randomly selected from the first 10 visitors, and subsequent respondents were sampled every 3rd when passing the thicket office into the lake. After each interview, the next 3rd person had approached, and selection continued following the regular interval. Finally, due to time and budget constraints, 250 visitors participated. During the sampling procedure, all sample respondents were above 18 years of age.

2.3 Method of Data Collection

The survey has been conducted through on-site survey from 5 -25 April, 2019 with a selected sample of people visiting a site. This study used primary and secondary source of data. The primary data gathered from onsite visit about the total trip cost (round trip transportation cost, the respondent's opportunity cost of time spent during travelling and staying on the site, entrance fee) and socio-economic variables (age, sex, income …) through questionnaire and face to face interview. Whereas, the secondary data concerning the number of previous visitors and the total actual amount of money the site collected in the year 2018 were collected from Awi Zone cultural and tourism office.

2.4 Method of Data Analysis

This study used both descriptive statistics and econometrics model. The descriptive statistics is used to explain the different socio-economic characteristics of the sample respondents. Regarding the econometrics model, the researcher(s) adopted Truncated Poisson regression to derive the demand function and identify determinants of recreational demand to Lake Zengena recreational site. On the other hand, to estimate the economic use-value of the site, the manuscript employed Individual travel cost method.

2.2 Model Specification

2.2.1 Travel cost method

In this study, the researcher used the travel cost method (TCM) to estimate economic use- value of Lake Zengena recreational site because, recreational activities benefited from ecosystem services such as natural reserve parks, beaches and Lakes are not traded in markets and have no market prices. Therefore, travel cost method is a proxy to value it (Zhang et al., 2015; Ferraro et al., 2012). In this method, a demand function was estimated using the number of trips to a site as the dependent variable and the travel cost associated with the trip and household socioeconomic characteristics as independent variables. There are three classifications of travel cost methods namely: Individual; Zonal and random utility travel cost method.

The individual travel cost method (ITCM) entails survey data from individual trips to a recreation site and helps to elicit the value of the site. It provides more information about individual consumer behaviors and gives more precise results than the ZTCM. Generally, instead of ZTCM, ITCM is preferable because, it provides statistical efficiency; theoretical consistency in modeling individual behavior; avoiding arbitrary zone definitions, and increasing heterogeneity among populations within zones. Furthermore, recently, individual travel cost method has been frequently used (Ezebilo, 2016; Zhang et al., 2015). On the other hand, the RUM is often used to estimate benefits associated with specific site characteristics and quality changes particularly, when there are many sites. In this study, the researcher(s) wants to estimate only the use-value of a single site, individual travel cost method is appropriate.

The study adopted a basic count data model. A count model is used to find the recreational demand function, and the consumer surplus for the use-value of the lake uses information from the travel cost method. In single-site recreation demand, this model has become the standard model (Coxe et al., 2009; Creel & Loomis, 1990). Since recreation demand behavior is only defined for nonnegative (0, 1, 2, 3...) values, ordinary regression methods require that dependent variables take on values over the full real line. Thus, the estimation of site visitation behavior using ordinary regression procedures leads to biased coefficient estimates (Bockstael, 2007; Coxe et al., 2009; Gillespie et al., 2017; Pradhan & Leung, 2006). Therefore, in the case where the dependent variable only includes integers, count data models is appropriate (Cameron & Trivedi, 2013; Creel & Loomis, 1990). The most common model is the Poisson regression model, which is estimated by the maximum likelihood method. This model was first used by (Shaw, 1988), and consequently, different researchers also used it in a number of recreational demand analyses. For example, (Gillespie et al., 2017; Zhang et al., 2015)

Given the count nature of the dependent variable (number of trip), the basic count data model to establish the recreation demand function is a Poisson regression. The variable number of trips taken by a person in a period of time is assumed to be generated by a Poisson process (Cameron & Trivedi, 2013). The probability of observing an individual taking (y) trips in a period of time is given by the Poisson probability distribution:

$$\Pr(Y = y) = \frac{\exp(-\lambda)\lambda^{y}}{y!} \qquad \textbf{(1)}$$

Where Y = 0, 1, 2…, and λ is the expected number of trips = E(Y), which is taken as equal to the variance of the random variable = Var (Y).

I.e., E(y) = λ = Var (Y) which is equal to;

$\lambda = \exp(X\beta)$ in matrix form. **(2)**

The expected number of trips (λ) is assumed to be a function of the variables specified in the recreation demand function. For each respondent in the sample, all the independent variables are known, and the probability of observing the number of trips actually taken by the respondent is given by Equation (1). For each respondent in the sample, it is possible to construct the probability of observing each respondent's actual number of trips taken. The likelihood of observing the actual pattern of visits made by all respondents in the sample is then, the product of the individual respondent's probability given by (Cameron & Trivedi, 2013).

$$L(\beta / Y, X) = \prod_{n=i}^{N} \frac{\exp(-\lambda_i)\lambda_i^{y_i}}{y_i!} \quad \textbf{(3)}$$

Where individual respondent is denoted by i = 1..., N, so yi is the number of trips taken by respondent i. Therefore, the parameter β, which determines the value of λ, is chosen to maximize L through a process of iteration. The log-likelihood function for the above Poisson process of recreation trip events is given by:

$$\ln L(\beta / Y, X) = \sum_{i=1}^{N} [y_i X_i^{'}\beta - \exp(X_i^{'}\beta) - \ln y_i!] \quad \textbf{(4)}$$

However, this likelihood function assumes a sample obtained from the general population, including those who did not take recreational trips. It assumes that Zero trip observations are included in the sample. However, this is not the case in on-site sampling at a recreation site, in which case sample values do not include Zero trips; rather, it begins from one since each respondent has made at least one recreation trip to the study site. Therefore, the above equations must be corrected to account for the truncated value of the dependent variable at Zero. In this case, the conditional probability of observing y is:

$$\Pr(Y = y / Y > 0) = \frac{\exp(-\lambda)\lambda^{y}}{y!} \left[\frac{1}{1 - \exp(-\lambda)} \right] \quad \textbf{(5)}$$

This study used the truncated Poisson model to estimate the use value of the Lake Zengena recreational site. This model was selected as an appropriate model because it fits for the data used in this study due to the absence of an over dispersion problem. As the data indicated, the mean value of the dependent variable (Trips) is

2.8, and the variance is 1.65. As a result, the mean value is higher than the variance (see, Summary statistics for dependent Variable (TRIPS) in Table 3)

2.3 Functional form of ITCM

In empirical estimation of recreation demand models, researchers used several functional forms. The most popular functional forms are linear, quadratic, semi-log and log-log. Economic theory does not suggest any particular functional form for TCM (Gürlük & Rehber, 2008). In this study, to describe the relationship between the dependent variable and the travel cost and other explanatory variables of the ITCM, the researcher(s) selected a double linear form. This is due to the consistency of the data in the study, and it is the most commonly estimated and easy to interpret and explain to policymakers (Gürlük & Rehber, 2008).

Based on Equation 2.1, TRIPS = exp (β0+β1TTC + β2TRAVT + β3SEAS + β4DPREF + β5MDT + β6FIRVIS + β7OTHERVIS + β8ENVA + β9DGR + β10FAMSIZ + β11AGE + β12GEN + β13MAR + β14EMP + β15OCC+ β16INCOM) **(6)**

Then, the double linear forms of the equation are defined as:
TRIPS = F (travel costs, travel time, demographics)

TRIPSi = βXi + εi **(7)**

Assume that TRIPSi/xi ≈ N (u: δ2), u= β’X.

Where TRIPSi, is individual i’s number of visits to the site, Xi is vector of explanatory variables, βi is a parameter vector to be estimated, and Ɛi is an error term.

TRIPSi = β0 + β1TTC + β2TRAVT + β3PSEAS + β4DPREF + β5MDT + β6FIRVIS + β7OTHERVIS + β8ENVA + β9GR + β10FAMSIZ + β11AGE + β12GEN + β13MAR + β14EMP + β15OCC+ β16INCOM (8)

2.4 Estimating Consumer Surplus from the Method of Count Data Models

The net benefits of recreation users obtained from visiting the study site was estimated using consumer surplus at average values of the independent variables used in the recreation demand function (Perman, 2003). This benefit measure associated with Truncated Poisson is derived using the estimated parameter on the travel cost variable (βtc). Following Creel & Loomis (1990); Champ et al. (2003), the CS of truncated Poisson model per trip and per person is measured by:

$$CS = \frac{-1}{\beta Tc} \qquad \textbf{(9)}$$

This consumer surplus formula indicates that based on the fact that if the coefficient of TTC is denoted by β, then the gross consumer surplus per trip per person is obtained taking the negative inverse of β (i.e CS per trip= $-\frac{1}{\beta^{\wedge}}$) (Blackwell, 2007; Zhang et al., 2015). Then, once the demand function is estimated, individual consumer surplus value in the sample is calculated. Finally, total recreational benefit of the site can be computed by multiplying individual consumer surplus by the annual number of visits.

3. Results and Discussion

3.1 Descriptive Statistics

Based on the survey data, a summary statistic of the variables used in the empirical analysis is presented in Tables 1 and 2 below.

Table 2: Socioeconomic characteristics of sample visitors for continuous variable.

Variables	Mean	Std. Dev	Min	Max
TRIPS	2.8	1.285	1.	6
TTC	58.728	42.796	17.97	188
TRAVT	60.067	71.957	14	240
FAMSIZ	4.587	3.48	1	15
AGE	28.767	6.484	19	49
INCOM	4,046.647	3,959.384	0	20,000

Sources: Own computation based on survey data, 2019

Table 3: Socioeconomic characteristics of sample visitors for dummy variables

FIRVIS	N	(%)	MAR	N	(%)	ENVA N	(%)	GEN (%)
No	76	50.67	Single	91	60.67	No 125	83.3	Female 45 30
Yes	74	49.33	Married	59	(39.33)	Yes 25	16.67	Male 105 70
Total		150			150		150	150

Sources: Own computation based on survey data, 2019

Table 3: Summary statics for dependent Variable (TRIPS)

Variable	Mean	Std. Dev	Min	Max	Variance
TRIPS	2.8	1.285	1	6	1.65

Sources: Own computation based on survey data, 2019

3.2 Econometric Results and Analysis

The econometric model presented in this section attempts to make some analysis and make inferences based on the information obtained from the sampled respondents. This econometric method was employed to estimate the consumer surplus of visitors using ITCM, which would help to find the total economic value of the study area.

3.2.1 Results of the Travel Cost Method

The travel cost and other socio-economic variables are taken as independent variables; trips per individual per year is taken as the dependent variable. After estimating the regression parameters in such a manner, we would have the estimated recreation demand equation. This study used truncated Poisson model to estimate the use- value of Lake Zengena recreational site. The truncated Poisson model was selected as an appropriate model that fits the data in this study because of the absence of over dispersion problem. In this data, the mean value of the dependent variable (Trips) is 2.8 and the variance is 1.65. The values indicated that the mean value is higher than the variance. Therefore, there is no over dispersion problem. (See, the summary statistics of the dependent variable in Table 3).

To test the overall significance of Truncated Poisson regression model, the researcher(s) used the log likelihood ratio (LR). LR = -2(Restricted Log-likelihood - Unrestricted Log Likelihood); where the restricted Log likelihood is the log likelihood with only constant (β=0) which is -246.44261. Unrestricted Log

Likelihood is the log-likelihood of the full models which is equal to -208.22265. Therefore, LRTPM = -2(-246.44261-(-208.22265)) = 76.07754. The critical value of the chi-square distribution for 16 degrees of freedom at one percent is found to be (χ216) 32. Since the calculated value is higher than the tabulated value at one percent significant level, the null hypothesis that all the explanatory variables are irrelevant in the determination of the variation in the dependent variable can be rejected at one percent level of significance. This implies that the estimated model exhibits an overall significance.

3.2.2 Determinants of recreational demand to the site

One of the specific objectives of this study was to identify determinants of recreational demand on Lake Zengena recreational site using a truncated Poisson regression model based on the significance value of the independent variables in Table 4.

Based on the regression results in Table 4, most of the variables have the expected sign. These are total travel cost, income, total travel time, first visit and membership in environmental groups. All of the above variables are significant and have a negative effect on the number of trips to the Lake Zengena recreational site, except income, which has a positive and significant effect on the number of trips.

Total travel cost (TTC) has a registered expected sign (negative) and a significant effect on the number of trips at the five percent level of significance. The result revealed that an increase in travel cost associated with a decrease in the number of trips to the area. In terms of marginal effect, other things remain constant, an increase in total travel cost by one birr was associated with a decrease in number of trips to Lake Zengena by 0.008. This means that people living closer to the site made many trips while those living far from the site made fewer trips because travel cost for them is relatively low.

Total travel time (TRAVT) has a negative and significant effect on the number of trips at the one percent level of significance. Other things remain constant, an increase in 1 hour in the time spent in the site decreases the number of trips to the lake Zengena recreational area by 0.0015. The results of these two variables are consistent with demand theory and are a necessary condition for the TCM model to be valid. This result is similar to (Blaine et al., 2015; Chae et al., 2012; Chen et al., 2004; Ezebilo, 2016).

Table 4: Maximum Likelihood Estimation of Truncated Poisson Model (Robust)

VARIABLES	TRIPS	Mfx(dy/dx)	Mean value
TTC	-0.004**	-0.008**	58.728
	(0.002)	(0.004)	
TRAVT	-0.007***	-0.015***	60.067
	(0.002)	(0.003)	
PSEAS	-0.034	-0.070	2.44
	(0.089)	(0.185)	
DPREF	-0.012	-0.026	2.173
	(0.073)	(0.152)	
MDT	-0.076	-0.157	0.493
	(0.096)	(0.200)	
FIRVIS	-0.172**	-0.357**	0.493
	(0.087)	(0.181)	
OTHERVIS	0.278	0.57	0.08
	(0.275)	(0.571)	
ENVA	-0.275*	-0.572*	0.167
	(0.145)	(0.297)	
GR	0.040	0.083	0.867
	(0.110)	(0.229)	
FAMSIZ	0.014	0.030	4.587
	(0.010)	(0.022)	
AGE	0.003	0.007	28.767
	(0.008)	(0.016)	
GEN	-0.039	-0.081	0.7
	(0.079)	(0.163)	
MAR	-0.130	-0.271	0.393
	(0.094)	(0.195)	
EMP	-0.137	-0.285	0.507
	(0.091)	(0.189)	
OCC	0.089	0.185	0.727
	(0.094)	(0.196)	
INCOM	2.21e-05**	4.59e-05**	4046.647
	(1.02e-05)	(2.13e-05)	
Constant	1.342***		
	(0.241)		
Observations	150		

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses

Sources: Own computation based on survey data, 2019

Income has registered the expected sign (positive) and a significant effect on the number of trips at the five percent level of significance. An increase in income was associated with an increase in the number of trips. However, its effect on demand is quite small. On the other hand, it is natural that people are willing to pay more for normal goods when their income increases. This small marginal effect of income may be because the entrance fee to the site is very small, which is three Birr and it could be a condition that an individual could visit the site with free. At Lake Zengena, most of the visitors who made trips were those who came from a place nearest to the site, particularly, from Injibara town. As a result, they value their on-site expenses, including entrance fees, for their decision to visit (see Figure 7). This finding is consistent with (Alam et al., 2017; Chen et al., 2004; Ezebilo, 2016; Tang, 2009)

First visit (FIRVIS) has a negative and significant effect on the number of trips at the 5 percent level of significance. This suggested that respondents who were visiting the site for the first time were likely to take fewer trips. This result is consistent with (Shrestha et al., 2002). On the other hand, membership in any environmental group has a negative and significant effect on the number of trips to the site. In terms of marginal effect, visitors who have membership in the environmental group associated with decreases in the number of trips to the site approximately by 0.0572

3.2.3 Recreational Benefit Estimation of the Lake Zengena Recreational Site

The second objective of this study is to estimate the recreational demand function and approximate the economic benefits of the site. To calculate recreational benefit, a simple demand function can be estimated by using the coefficients and the mean values of significant variables reported in Table 4. The estimated demand function of the site is based on Equation 8 is;

$$\text{TRIPS} = 0.88 - 0.004\text{TC} \qquad \textbf{(10)}$$

Once the demand function has been estimated, the consumer surplus provides an approximation of the welfare associated with visiting the site. Formally, based on Equation 10, the consumer surplus is equal to:

$$\text{CSi} = - -\frac{1}{\beta tc}, \qquad \textbf{(11)}$$

The above consumer surplus formula indicates that based on the fact that if the coefficient of TTC is denoted by β, then, the gross consumer surplus per trip per person is obtained taking the negative inverse of β (i.e., CS per trip= $-\frac{1}{\beta^{\wedge}}$).

$$CSi = \frac{-1}{\beta tc} = -(-\frac{1}{0.004}) = 250 \text{ ETB} \qquad \textbf{(12)}$$

The total recreational benefit of the Lake is calculated by multiplying the individual consumer surplus and the number of visitors registered within a year. The total number of visitors to the site in the last 12 months were 5000 (Zone tourism and cultural office, 2010).

The aggregate annual recreational benefit 250*5000 = 1,250,000 ETB.

3.2.4 Maximum Entrance Fee Determination

The third objective of this study was to suggest an optimal entrance fee that would maximize revenue for site. To obtain a price which maximize the revenue from the entrance fee, an assumption is given in this study that when the entrance fee changes, the rest of the trip costs remain the same, which can be obtained from the sample. The maximum entrance fee that can be charged depends on how responsive the trip demand function is to price changes (travel cost). This is what is referred to as the price elasticity of demand. Price elasticity is the sensitivity of the quantity of trips to changes in prices. It describes the amount of percentage trips that will change if the price changes by 1%. With a linear function, the price elasticity coefficient is between 0 and infinity. The maximum entrance fee occurs at a point where price elasticity is one or total revenue reaches its maximum (Tang, 2009). With the individual demand function given in Equation 9, it can be estimated as follows: the trip elasticity of trips cost (price elasticity) is given as:

$$\frac{\Delta T}{\Delta P} X \frac{P}{T} \ldots \qquad \textbf{(13)}$$

Let DAYS spent on site=T and TC=P, then from the given equation, ΔT/ΔP = ӘT/ӘP = -0.004 $\approx$ ӘT/ Әf

Where f =is the entrance fee per annum. We can write the trip elasticity of entrance fee as: $\frac{\Delta T}{\Delta f} X \frac{f}{T}$

Now, using the individual function above and the trip elasticity of entrance fee, we determined the revenue maximizing price or new entrance fee for the site by incorporating different entrance fee in birr and number of days spent at the lake. This is an entrance fee in which the elasticity coefficient becomes one. Accordingly, we found 110 birr annually and 9.167 per month or less than one birr per day. However, the new entrance fee is much lower than the existed price.

4. Conclusion

Nature-based outdoor recreational sites have a significant economic role in economic development. These include foreign exchange earnings, employment generation, and individual income sources. On the other hand, beyond its economic importance, it also makes a significant contribution toward maintaining a natural ecosystem and quality for sustainable development.

The study estimated the recreational use-value of the Lake Zengena using individual travel cost method based on face-to face interview with 150 sample respondents. For this study, individual travel cost method was used because it has several advantages over zonal travel cost method. The survey results obtained from this individual travel cost method were analyzed by using both descriptive and econometric analyses. Since the data for the dependent variable (Trip per year) are count data (integer), count data models were used. The dependent variable is truncated at a point where number of visits is greater than or equal to 1. Furthermore, the statistical test showed that the data has no over dispersion problem. Thus, the truncated Poisson model was used in the empirical analysis instead of the negative binomial model and other count models.

The result from the Truncated Poisson regression model shows that, total travel cost, total travel time, first visit, membership in environmental group and income were found to be basic determinants of the recreation demand of the site. This study also computed recreational demand function; TRIPS = 0.88– 0.004TC and estimated the aggregate recreational benefits of the site. The study found that the mean consumer surplus per individual per trip was about 250 ETB, and the expected total annual on-site recreational benefit of the site was estimated to be 1,250,000 ETB.

The introduction of a new entrance fee was calculated using the individual demand function, whereas, the trip elasticity of entrance fee was calculated based on the travel cost method. Even though a higher entrance fee supports the improvement and expansion of the types and varieties of recreational services, this study found a lower entrance fee (lower than one birr when compared with the existing one (three birr).

5. Recommendations

Based on the findings of this study, the following recommendations were suggested.

The study recommended that efforts should be made by the government and other relevant stakeholders to improve the site and maximize the benefits that can be derived from the site. On the other hand, the study found a lower entrance fee compared with currently in use. Therefore, the researcher suggested that increasing an entrance fee beyond this could bring a lower trips and revenue to the lake.

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Profitability Analysis and Determinants of Rural Households' Land Use Decisions: The Case of Farmers around Wof-Washa Forest, Central Highlands of Ethiopia

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Abstract

Understanding rural household's' land use decision is a critical input to policy makers, rural land users, and scientific communities to foster food security for allocating rural households land resources efficiency. The aim of the study was to analyse the determinants of rural households' land use decisions in the case of farmers around Wof –Washa forest, central highlands of Ethiopia. The study was based on three-stage sampling procedure to select the study area and out of which 185 sample households. The research has used both primary and secondary source of data. The obtained data are analysed by using descriptive statistics and financial analysis as well as multivariate probit model. The results have revealed that financial profitability of Eucalyptus woodlot land is significantly higher than cropland and grazing land as shown by the three performance indicators (NPV, BCR and AEV). The study has also revealed that age of households, household size, on-farm income, land tenure security, land size, access to extension services, land ownership, access to market, and tropical livestock unit were significantly affecting the determinants of rural household land use decisions. Therefore, attention is needed for the designs of polices and strategies for encouraging of Eucalyptus woodlot-based land use which is economically feasible and less risky enterprise compare to the two land uses without undermining the food security status of rural households.

Keywords: Cost benefit analysis, Land use decisions, Multivariate probit, Wof- washa forest

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1. Introduction

1.1 Background of the Study

Understanding rural households' land use decision is of a special issue for policy makers and scientific societies (Rutten et al., 2014), as safeguarding worldwide food security for an increasing population remains one of the critical obstacles of development (Grote, 2014; De Janvry and Sadoulet, 2010). Human activities have transformed land use throughout the world driven primarily by increasing demand for agricultural products (Lambin & Meyfroidt, 2011; Van Vliet et al., 2015). Population growth, rising demand, and globally changing preferences are the main drivers of agricultural demand and projections of future trends that do not yet indicate any turning point (Alexandratos & Bruinsma 2012; Schmitz et al., 2014). People land use decisions depend on the economic opportunities and constraints as shaped by markets, policies and also facilitated through institutions (Lambin et al. 2001).

According to Miao et al. (2014), economic returns from different land use options directly affect land use decision implying that factors which increase land use profitability rapid farmers convert to cropland. The determinants of land use decisions made by rural households vary in their social, economic, cultural and demographic characteristics (Geist and Lambin ,2002). There is a common practice among rural households to cultivate a plot of land for a long period and consequently the soil nutrients have been depleted. Owing to this, the farmer relocates to a virgin land in Ethiopia. Such an act brings about deforestation and opens forestland to other land use activities like grazing, fuel wood collection and agricultural land expansion etc. (Adekunle et al., 2011).

The demand for spatial expansion of land to increase agricultural production frequently creates the conflict of interest between agriculture and other land use options. Such options might put the economic sectors in a different state of competition rather than complementing one another. In addition to improving agricultural intensification and biotechnological innovation to meet the growing demand for food, natural resource management deserves significant focus in the face of growing competition for cultivable land.

Nevertheless, cropland is not a sole land use practice by rural households. Rather, it is one of the land uses that the households practice. In such a situation comparisons of the land uses so as to allocate the fixed resources to best alternative uses is very important. To compare the attractiveness of different land uses, it is better to analysis cost and benefit of each land use. Since different land uses practiced by individual households involve different levels of benefits and costs, it is important to identify which land use practices better serve them to improve the livelihood of rural households. Besides, in order to formulate strategic interventions by responsible bodies that enhance productivity and sustainable land uses, it is vital to know the profitability of the rural households land use decisions (Rasul and Thapa, 2006). The decision requires detailed information about costs and benefits and analysis of the financial profitability of each alternative land use practices.

Some studies conducted on financial analysis of fruit trees and moringa trees are based on agroforestry practice in Southern Ethiopia (Anisho et al, 2017; Shode, 2016). The financial profitability and determinants of fruit trees are based on agroforestry practices in Wondo district (Kassa ,2015), comparative economic analysis of three competing land use types in Southern Ethiopia: tools for informed decision-making on land use Choices (Ayana, & Lejissa, 2018). However, none of the practices have focused on the profitability analysis and determinants of rural households land use decisions in different part of Ethiopia, particularly in the study area. Previous studies have used to focus on maximization of productivity (Deininger et al., 2011). Most studies of land use decisions have overlooked the place of forest and tree based land uses.

A robust understanding of the determinants of rural household's land use decisions regarding to rural household's land use practice and efficient allocation of households land resources are still a critical knowledge gap in Ethiopia particularly in the study area. In Ethiopia, lack of comprehensive information on environmentally, socially and economically feasible land use options is often mentioned as a key problem for the inefficient allocation of scarce land resources. For this reason, little is known about the forest of Wof- Washa are threatened by agricultural land expansion and livestock overgrazing which would ultimately leads to deforestation of forest. This is true because inefficient allocation of household land resources and lack of adequate knowledge regarding their land use decisions.

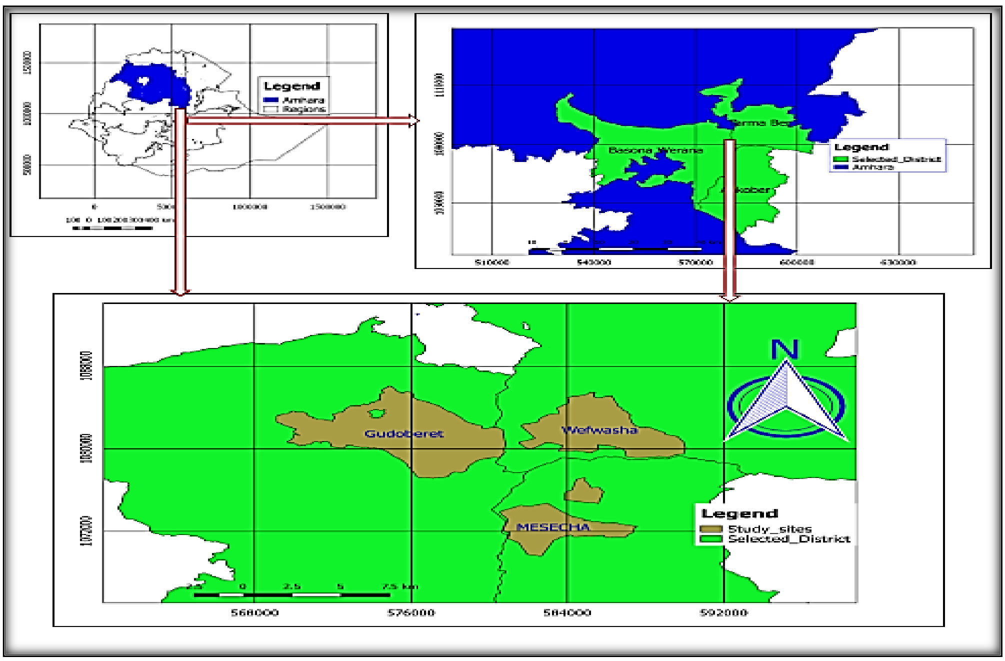
The objectives of the study are: to assess the major types of households' land use practice on their land holdings, to analyze and compare the financial profitability of households' land use practices, and to identify factors determining rural households land use decisions.

2. Research Methodology

2.1 Description of the study area

The study area, Wof-Washa natural forest, is found in North Shewa Zone of Amhara Regional State of Ethiopia. The forest is the oldest state forest of the country, set aside by the Shoan King Zera Yacob in the 14th century (Action Ethiopia, 2010). The capital city of North Shewa Zone is Debre Birhan, which is found 130Km to the North East of Adiss Ababa and located at 9° 36' 8"N, 39° 10' 29" E. It is situated at elevation 2830 of m.a.s.l. Wof-Washa forest is located 30 Km far from Debre Birhan city at 9044'32" – 9046'26"N and 39044'00"-39047'19"E, with an elevation ranged between 1,650 and 3,700 m.a.s.l. The forest is surrounded by Tarmaber, Bassona Worrana and Ankober districts. The agro ecological composition of Wof-Washa forest consists of Weyna Dega (cool sub- humid), Dega (cold and humid) and Wurch (cold and moist) regions (MOA, 2010). The mean monthly maximum temperature at Debre Sina is 27.1°C and the corresponding mean monthly minimum temperatures are 6.0°C. Thus, the average, mean monthly temperature of the area is 16.5°C. There are often dry winds during the day, ices may occur at night and snow sometimes settles on the summit of Wof-Washa (Friis et al., 2011).

Figure 2.1: Location map of the study area



2.2 Sampling Technique and Sample Size Determination

For the study, multi-stage sampling procedures are employed. In the first stage three districts (Tarmaber, Ankober and Basona Worrena) are selected purposively. This is because the location of Wof- Washa forest is across the three districts. In the second stage, three kebeles (Wof- washa genet, Mescha and Gudoberet kebele) are selected randomly out the kebeles that near to the forest. In the third stage, simple random sampling technique are employed to draw households from selected sampled kebeles. This random selection is based on the proportionate sampling technique to the respective population size of selected kebeles.

In the study, the rule-of-thumb that $N \geq 50 + 8$ m was adopted, where N is the minimum required number of households and m is explanatory variables (Green, 1991) to limit the size of sampled households for the interview. The explanatory variables are sixteen. Thus, the minimum sample size is 178. For the study, a total sample of 185 individuals is selected and interviewed.

2.3 Data Sources and Methods of Data Collections

Both primary and secondary sources of data are used in order to get relevant information. The Primary data are collected from sampled households through households survey interview, focus group discussion, key informant interview and direct observations as well as market assessments to gather both qualitative and quantitative data by using structured questionnaires. Focus group discussions are conducted with group of farmers with the total of eight persons from each selected kebele, those who have good knowledge and experience about land use practice and with employees of the resource bureau head of the selected kebele. Two groups are formed for the discussion within the compositions both males and females households in each kebeles. Households who have lived in the area for long periode of time, active and knowledgeable of their localities and land use practices are selected as key informant (four individuals for each kebele) by adapting the snow-balling method and one to one interview were conducted with the selected key informant. The secondary data sources are collected from published materials (books, journals and reviews) and unpublished materials (MAs, PhD, reports and studies).

2.4 Methods of Data Analysis

The data collected during the study are analyzed by using descriptive statistics and econometric model. Descriptive statistics such as mean, maximum, minimum, standard deviation, frequencies, percentage, graph etc. are used in order to have a clear picture about the socio-economic, institutional and demographic characteristics of the households and to analyse types of households land use practices.

2.4.1 Econometric data analysis

For econometric data analysis, multivariate probit model (MVP) are employed to analyze the factors affecting rural households land use decisions. The decisions are based on the evidence that households are more likely to practice a combination of land use simultaneously to increase their agricultural productivity by improve their livelihoods. Multivariate probit (MVP) modeling approach which simultaneously allows estimating interdependent multiple adoption decisions while allowing the unobserved and unmeasured factors (errors terms) to be correlated freely and estimates a set of binary probit models simultaneously (Cappellari & Jenkins, 2003).

Dependent variable: The dependent variables (Yim) are the determinants of rural households land use decisions which are categorical limited dependent variable and correlated or inclusive for the choice of household land use for cropland and Eucalyptus woodlot land, mixed and Eucalyptus woodlot land, and mixed land use. The dependent variable of MVP model consists of three binary choice equations, namely mixed land, cropland and Eucalyptus woodlot land, mixed land and Eucalyptus woodlot land use.

The MVP model is specified as:

$$Y^*im= \beta mXim + \varepsilon im \quad m = 1\ldots3 \qquad \text{Equation (1)}$$

$$Yim =1 \text{ if } Y^*im >0 \text{ and } 0 \text{ otherwise} \qquad \text{Equation (2)}$$

Where, Y*im is a dependent variable that captures the unobserved preferences associated with the choice of land use (m =1, 2, 3). This dependent variable is assumed a linear combination with Xim (the independent variables) and unobserved characteristics captured by the stochastic error terms, εim. The vector of parameter to be estimated is denoted by βm: Given the latent nature of Y*im ; estimation is based on observable binary variables Yim; which indicate whether a households used a particular land use. The error terms εim; m = 1, 2, 3 are distributed multivariate normal each with mean 0 and a variance covariance matrix V, where V has 1 on the leading diagonal, and non -zero correlation ρjk = ρkj as off diagonal elements (Cappellari & Jenkins, 2003).

$$\begin{pmatrix} \varepsilon A \\ \varepsilon B \\ \varepsilon C \end{pmatrix} \quad \begin{pmatrix} 0 & 1 & \rho 12 & \rho 13 & \rho 14 \\ N= 0 & \rho 21 & 1 & \rho 23 & \rho 24 \\ 0 & \rho 31 & \rho 32 & 1 & \rho 34 \end{pmatrix} \qquad \text{Equation (3)}$$

$$\begin{gathered} E(\varepsilon/X)=0 \\ V(\varepsilon/X)=1 \\ Cov(\varepsilon/X)= \rho \end{gathered} \qquad \text{Equation (4)}$$

Independent variables and hypotheses. The study incorporated the following explanatory variables that listed in Table 1 based on the review of different existing literature on determinants of rural land use decisions.

Table 1: Hypothesis of the variables

Variables	Descriptions	Types of variables	Prior expectation
Dependent	***Determinants of rural households land use decisions***		
Independent			
Age	Number of years	Continuous	+
Sex	0 for Male, 1 for Female	Dummy	-
Households size	Numbers of households members	Continuous	+
Educational status	Educations in numbers of years	Continuous	+
On farm income	Incomes of households per year in birr	Continuous	+
Off -farm income	Yes 1or 0 otherwise	Dummy	+/-
Land size	Total landholding of the households in hectares	Continuous	+
Land tenure security	1 for if a household head feels secured and 0 otherwise	Dummy	+
Farming experience	Numbers of households farming experiences in year	Continuous	+
Land ownership	1 for their own ,0 for other wise	Dummy	+
Quality of land	1.Fertile 2.Poor 3.Medium 4.Very fertile	Categorical	+
Access to extension service	1 if Yes or 0 if No	Dummy	+/-
Access to market	1 if Yes or 0 if No	Dummy	+
Access to credit	1 if Yes ,0 for otherwise	Dummy	+
Slope of the land	1 = for flat 2 = for steep 3 = for gentle slope	Categorical	+/-
Livestock unit (TLU)	Total numbers of livestock unit	Continuous	+

2.4.2 Financial analysis

Financial analysis is the evaluation of costs and benefits which occur in the future. The financial analysis should define financial viability and sustainability project. Therefore, in the study cost benefit analysis and sensitivity analysis are used to compare the financial profitability of households land uses.

Cost benefit analysis (CBA): CBA is used to access the present and future costs and benefits of project. It involves the use of discounted cash flow (Khadka, 2010). Three standard measures are used in the cost benefit analysis such as NPV, BCR and AEV. These are used to evaluate and measure the financial performance and feasibility of households land use (Godsey, 2000). Data are collected on the costs of factors of production and total benefit from selling the output and then entered into a Microsoft office Excel-sheet 2013 to sum up the discounted costs and benefits for seven years. The data are used for the calculation of three financial indicators: NPV, BCR and AEV. Based on a recommendation of Ministry of Finance and Economic Development (MoFED, 2019) of Ethiopia, an interest rate of 12% are used for evaluating households land uses. The financial discount rate reflects the opportunity cost of the capital, defined as the forgone expected return by passing other potential investment activities for a given capital (Regio, 2008).

Net present value (NPV): The NPV determines the net returns of the production system by discounting the streams of benefits and costs back to the establishment year using appropriate discount rate over the lifetime. The land use with higher NPV is taken as a better option and financially feasible than with lower NPV. It is calculated by using the following formula.

$$\mathrm{NPV}=\sum_{t=1}^{n}\frac{Bt-Ct}{(1+r)^{t}} \qquad \text{Equation (5)}$$

Where; NPV= Net present value, Bt= Benefit flows at time t, Ct= Cost of production at time t, r= discount rate and t= the number of time in year.

Benefit-cost ratio (BCR): It is the relative measure of benefits obtained per Ethiopian birr (ETB) spent. It compares the discounted benefits to discounted costs by computing the ratio of discounted revenue to discounted costs (Cowdin, 2008; Godsey, 2000). The land use with higher BCR is taken as a better option and it is computed by using the following formula.

$$\mathrm{BCR}=\sum_{t=1}^{n}\frac{\frac{Bt}{(1+r)^{t}}}{\frac{Ct}{(1+r)^{t}}}>1 \qquad \text{Equation (6)}$$

Annual equivalent value (AEV): It is an estimate of a level of income stream that would have the same NPV as the actual income streams (Godsey, 2000). The AEV calculates an annuity (or an annual net payment) that would give the equivalent NPV at the same discount rate. The equation used in the NPV calculation assumes varying cash flows for each year. Whereas, the AEV equation assumes that the cash flow is the same in each year; this is computed by

$$\text{NPV=Cash flow } \left(\sum_{t=1}^{n}\left(\frac{1}{(1+r)^t}\right)\right) \qquad \text{Equation (7)}$$

$$\text{Cash flow=}\frac{NPV}{\sum_{t=1}^{n}\frac{1}{(1+r)^t}} \qquad \text{Equation (8)}$$

Cash flow is the annual equivalent value that is being calculated. The annuity discount factor of the equation simplified as follows:

$$\sum_{t=1}^{n}\frac{1}{(1+r)^t}=\frac{1}{r}-\frac{1}{r(1+r)^t} \qquad \text{Equation (9)}$$

Sensitivity analysis: It is a way taking the riskiness of an investment by analyzing the effect of change in inputs or the outcome of the alternatives land uses, in this case cropland, grazing land and Eucalyptus woodlot land use on NPV (Pannell, 1997). Sensitivity analysis is conducted by changing of the wage rate of labors per day and the discount rate and output by 10%. There are several different ways of undertaking sensitivity analysis, namely one-way sensitivity analysis and multi way sensitivity analysis. One-way sensitivity analysis is a way of examining the impact of the change of one value or inputs in the model. The one-way sensitivity analysis is useful in indicating the impact of one parameter varying in the model. Multi-way sensitivity analysis is used to examine worst and best-case scenario in this study.

Assumptions which have been undertaken during financial analysis:

- The amounts used in the CBA is the total costs and benefits per households.
- The opportunity cost of labors in the case of family labor cost is 120 ETB used.
- The land value is assumed to be the same in every year in all land uses.
- The time horizon is 7 years and tax amount are constant over time.
- 12% of discounting rate are used based on the recommendation of MoFED (2019).

3. Results and Discussion

3.1 Demographic and Socio-economic Characteristics of the Sampled Households

Table 3.1 presents the demographic and socio-economic characteristics of the sample households. The total sample size of the farm respondents handled during the survey is 185.

The result presented in Table 3.1 indicated that the mean age of sampled households are 47.36 year with standard deviations of 11.52. In terms of households size, the result indicates that the average households size of the sampled households are 4.71 with standard deviation 1.73. The average educational status of the sampled households are 3.15 with standard deviation of 3.28. This showed that the majority sampled households in the study area do not have formal education. Similarly, in terms of on-farm income the results have indicated that the mean on-farm income of the sampled households in the study area are 13,512.61 birr per year with standard deviation of 12,436.15 (Table 3.1).

The result in Table 3.1 has also revealed that the average land size of sampled households are 0.92 ha (hectares) per households with standard deviation of 0.37 which indicates that there is land scarcity in the study area. The average livestock holding of (TLU) of households is 2.93 with standard deviation of 1.57 in the study area. The average farming experiences of sampled households are 28.29 years with standard deviation of 11.42 years in the study area.

Table 3.1: Mean and proportion of sample households' characteristics.

Continuous variables	Mean	Standard deviation
Age (Year)	47.36	11.52
Educational level(Year)	3.15	3.28
On farm income (Birr)	13,512.61	12,436.15
Total land size(Ha)	0.93	0.37
Total livestock unit (TLU)	2.93	1.57
Household size (Number)	4.71	1.73
Farming experiences(Year)	28.29	11.42
Dummy variables	**Frequency**	**Percentage**
Sex(Male)	150	81.1
Land tenure security (Secured)	98	53
Land ownership (Own)	169	91.4
Access to market (Yes)	84	45.4
Off-farm income (Yes)	81	43.8
Access to extension services(Yes)	152	82.2
Access to credit(Yes)	68	36.8

Sources: Own survey (2020)

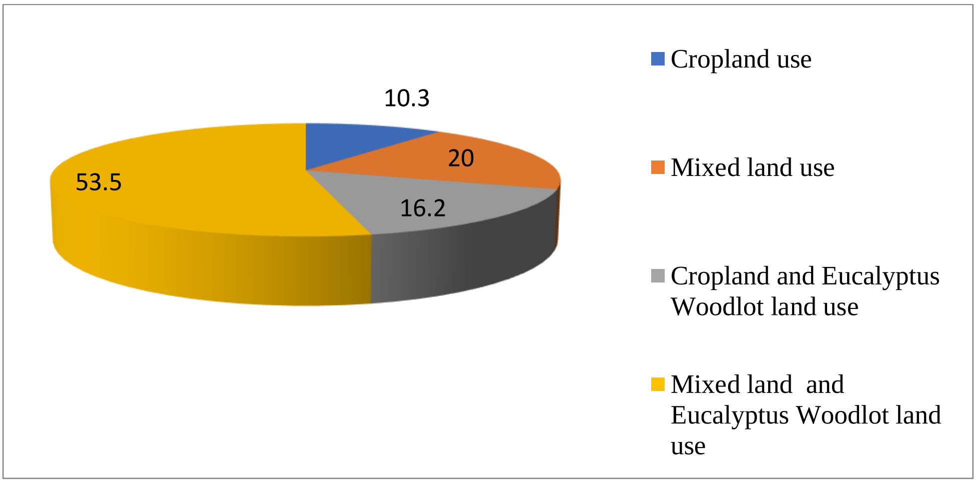
As it is indicated in Table 3.1, of the total 185 sampled households 81.1% of sampled households is male headed households and only 18.9% of households is female headed households. Moreover, out of 185 sampled households only 53% of the sampled households landholding are secured and the remaining 47% landholding of sampled households are insecure in the study area. Of the total 185 sampled households, about 91.4% of sampled households own their land, and 8.6% sampled households do not have their own land. The result has indicated that the majority of sampled households have their own land and allocate their land into different land use practices.

In terms of market access of the total 185 sampled households, only 45.4% have market access and the remaining 54.6% of the sampled households do not have access to market (Table 3.1). Of the total 185 sampled households only 43.8% of sampled households are engaged in off-farm income activities and the remaining 56.2% of the sampled households do not have engaged in off-farm income activities. Regarding to extension services, among the total of 185 sampled households, 82.2% of sampled households has extension service, and the remaining 17.8% do not have access to extension services (Table 3.1). The result has revealed that the majority of sampled households who had extension services probably has the exposure to more knowledge about their land behaviors and adopt improved agricultural technologies. Of the total 185 sampled households only 36.8% sampled households have got credit access in the last one year and the remaining 63.2% sampled households did not receipt credit (Table 3.1). This result shown that the majority of sampled households did not received credit in last one year. This might be due to fear of being able to pay it back high interest rate and little access of credit facility.

3.2 Major Types of Rural Households Land use Practices

The result in Figure 3.1 has shown that out of the total 185 sampled households 53.5% are engaged in mixed and Eucalyptus woodlot land use and 20% practiced both cropland and grazing (mixed) land use, 16.2% practiced crop and Eucalyptus woodlot and the remaining 10.3% of sampled households are engaged only in cropland use practices in the study area. The result also supplemented by Focus group Discussion and Key informant interview in which the major land use practices of the households in the study area is mixed and Eucalyptus woodlot land use practices. These results have shown that most of the sampled household's had engaged in mixed and Eucalyptus woodlot land use than the other two land use practices. This finding is consistent with Amede, T. et al.(2017) reported that the major farming system in Ethiopia was mixed farming system. And also, Dixon et al (2001) points out that the major farming practice of smallholder farmers in Ethiopia is grouped into pure livestock production and mixed farming practices.

Figure 3.1: Major types of rural households land use practices in the study area



Source: Own survey (2020)

3.3 Estimation of annual costs and benefits of households land use

The obtained yield from each land use and price of outputs sold in local market are used to calculate the revenue of each land use. Total revenue is calculated by multiplying total unit of output obtained from each component by its price in local market. After calculating the benefits of each item in the system the total revenue of the system is calculated by summing up revenues of respective land uses. And each cost incurred include management cost, establishment cost and opportunity cost and others are summed up to get total cost incurred in one single year. Then the net benefit (NB) are calculated by deducting total cost from total revenue.

As it is presented in Table 3.2, the total benefits of cropland, grazing and Eucalyptus woodlot land is 1,129,302, 416,061 and 706,844 birr per ha, respectively and the total costs of the respective land uses was 797,345, 311729 and 99,391 birr per ha. The annual profits of cropland, grazing land and Eucalyptus woodlot land is 331,957, 104,332 and 607,453 birr per ha, respectively. This result indicates that households have diversified benefit from three land uses.

Table 3.2: Total annual benefits and total annual costs of households land use

Land use	Total revenue birr/ ha	Total cost birr/ha	Profit birr/ha
Crop land	1,129,302	797,345	331,957
Grazing land	416,061	311,729	104,332
Eucalyptus woodlot land	706,844	99,391	607,453

Sources: Own survey (2020)

3.4 Comparing the Financial Profitability and Sensitivity Analysis of Households Land Uses

The decision of the households upon selecting beneficiary land use on their farmland mainly depends on the benefit reward and the essentiality of the products for the household needs. The comparison of financial profitability households land use and sensitivity analysis towards key variables are presented and discussed as below.

3.4.1 Financial profitability of households land use

The financial profit indicators, namely NPV, BCR and AEV are used in order to evaluate the financial profitability of households land use at a discounting rate of 12% based on the recommendations of (MoFED, 2019) for interest rate for private investors. Table 3.3 shows that the NPV of cropland, grazing land and Eucalyptus woodlot land is 1,514,970.93, 476,145.85 and 2,772,267.60 birr per ha, respectively. This result has indicated that the NPV of Eucalyptus woodlot land was 1.83 and 5.82 times greater than the NPV of cropland and grazing land, respectively. This NPV result shows that Eucalyptus woodlot land has better financially profitable than the other two land use. The BCR of the cropland, grazing land and Eucalyptus woodlot land is 1.42, 1.33 and 7.11, respectively at a discounting rate of 12%. The BCR indicates that the land use with higher BCR is more profitable than lower BCR. These results have also revealed that the BCR of Eucalyptus woodlot land is 5 and 5.35 times greater than the BCR of cropland and grazing land, respectively. This shows that Eucalyptus woodlot land has higher BCR and the most profitable land use (Table 3.3). The AEV of cropland, grazing land and Eucalyptus woodlot land is 331,957, 104,332 and 607,453 birr per annum, respectively. Similarly, comparison results of AEV is consistent with the same pattern for the results of NPV. Therefore, the AEV result also confirmed that Eucalyptus woodlot land has a potential to generate highest expected annual income over its production life cycle than the other two land uses (Table 3.3). In all above listed financial indicators, the results of financial analysis affirm that Eucalyptus woodlot land is more profitable land use than the other two land uses. The result might be due to low production and management cost, low requirement of input and higher value cash crop.

Table 3.3: Results of NPV, BCR and AEV per ha in ETB (Ethiopian birr)

Households land use			
Financial indicators	**Cropland birr per ha**	**Grazing land birr per ha**	**Eucalyptus woodlot land birr per ha**
NPV	1,514,970.93	476,145.85	2,772,267.60
BCR	1.42	1.33	7.11
AEV	331,957.00	104,332.00	607,453.00

Sources: Own survey (2020)

In line with the finding of the study, Rani et al. (2016) studied on the economic evaluation of different land use systems in North Western Region of Punjab, India using economic performance indicators of NPV, BCR and AEV. The result showed that tree-based land use system was economically feasible and financially profitable than pure agricultural land use system. Furthermore, a study conducted by Kebebew (2002) on profitability and household income contribution of growing Eucalyptus globulus to smallholder farmers in central highlands of Oromiya, using economic performance indicators of NPV and AEV showed that the annualized returns from growing Eucalyptus globulus was 6, 9, 14 and 23 times greater than the returns of tef, wheat, barley and livestock, respectively. He concluded that the contribution of growing Eucalyptus accounted for 50% of household income with to the remaining 50% of household income contributed by agricultural crops and livestock. The finding of the study are also in line with, Ayana, & Lejissa (2018) studied on the comparative economic analysis of three competing land use types in Southern Ethiopia tools for informed decision-making on land use choices.

3.4.2 Sensitivity analysis (SA) towards changes key variables

The Sensitivity analysis is carried out on evaluation of NPV of cropland, grazing land and Eucalyptus woodlot land use for change in some key variables, such as increase or decrease in discount rate, wage rate, and output. Households net benefit decline if the wage rate and discount rate increases, output of each land use decreases and the opposite will happen the wage rate of labors and discounting rate decreased, output of each land use increase. Therefore, Sensitivity analysis is conducted for the increase or decrease in discount rate, wage rate, and output.

As it is indicated in Table 3.4, the result has shown that an increase or decrease of discounting rate has negative or positive impact on the NPV of respective land use, respectively, but the magnitude is the same in each land use. This implies that for a 10% increase or decrease of discounting rate, the NPV of the respective land use is decrease by 25.2%, or increase by 41.8%, respectively. Similar results are reported by different researchers. For instance, Ajayi et al. (2009) reported that an increases in discounting rate negatively affected net profit for all practices (continuous maize cropping without fertilizer, continuous maize cropping with fertilizer, Gliricidia-maize intercrop, Sesbania-maize rotation and Tephrosia-maize rotation).

Wage rate of daily labors is the other key variables that is used to analyze the NPV of the respective land uses. As it is indicated in Table 3.4, for 10% increase or decrease of wage rate of daily labors the NPV of cropland and grazing land decrease or increase by 11.2% or 11.2%, and 7.6% or 7.6%, respectively. But, the NPV of Eucalyptus woodlot decreases or increases by 1.0% or 1.0%. This indicates that the magnitude of change with respective to land use for increase or decrease of wage rate by 10% is different. In this case there is more change in cropland than the other two land use. This shows that for an increase or decrease of wage rate of daily labors cropland is more sensitive and Eucalyptus woodlot is less sensitive than the other two land uses. This might be cropland needs high labors for crop production when compare with the other two land uses.

The other key variables used to analyze the NPV with respective to land use is an increase or decrease of the output. The increase or decrease of the output of the respective land use has positive and negative impacts on NPV of each land uses, respectively. As it is show in Table 3.4, the result has shown that for a 10% increase or decrease of output the NPV of crop land increase or decrease by 34% or 34%. The NPV of grazing land and Eucalyptus woodlot land also increase or decrease by 39% or 39% and 11.6% or 11.6%, respectively. This implies that the magnitude of change with respective to land uses for increase or decrease of output of each land use by 10% is different. In this case the magnitude of Eucalyptus woodlot is lower than the other two land uses. This indicates that an Eucalyptus woodlot land is less sensitive than the other two land uses for an increase or decrease output.

Table 3.4: Results of sensitivity analysis for change of key variables

Description	Cropland	Grazing land	Eucalyptus woodlot land
	NPV change %	NPV change %	NPV change %
Discounting rate increase (10%)	-25.2%	-25.2%	-25.2%
iscounting rate decrease (10%)	41.8%	41.8%	41.8%
Wage rate increase (10%)	-11.2%	-7.6%	-1.0%
Wage rate decrease (10%)	11.2%	7.6%	1.0%
Output increase (10%)	34.0%	39.9%	11.6%
Output decrease (10%)	-34.0%	-39.9%	-11.6%
Best scenario	105.9%	109.1%	59.7%
Worst scenario	-59.0%	-60.7%	-34.6%

Source: Own survey (2020)

At the best-case scenario (increase output, simultaneously decrease of wage rate and discounting rate) grazing land is more preferred. Whereas, at worst case scenario (decrease output, simultaneously increase of wage rate and discounting rate) Eucalyptus woodlot is more preferred (Table 3.4).

3.5 Determinants of Rural Households Land Use Decisions

The correlation regression among the dependent variable has indicated that there is an interdependence relationship among the three-land use choice implemented by rural households (Table 3.5). For instance, there is a negative correlation between mixed and Eucalyptus woodlot land and the remaining two land use (mixed land use, crop and Eucalyptus woodlot land uses), which implies that the former one can be substituted by the latter one. The correlation between choice of mixed land use and mixed and Eucalyptus woodlot land use are negatively correlated and statistically significant at 5% significance level. In contrast, positive correlationship is found between crop and Eucalyptus woodlot land use, and mixed land use which attests complementary. It is also important to note that an individual farmer can choose more than one land use in a given amount of landholding size.

Table 3. 5: Correlation coefficeint among the three households land uses

	Mixed land use	Crop and Eucalyptus woodlot land use	Mixed and Eucalyptus woodlot land use
Mixed land use	1		
Crop and Eucalyptus woodlot land use	0.0281	1	
Mixed and Eucalyptus woodlot land use	-0.1490**	-0.1202	1

** implies that significant at 5 % significance level (P <0.05)

Therefore, multivariate probit model is used to estimate several correlated binary outcomes jointly. In the study, the choice of households land use decisions, i.e. choosing crop and grazing land use (mixed land use), cropland and Eucalyptus woodlot land use and mixed and Eucalyptus woodlot land use are correlated as discussed above. Since the decisions are binary, the multivariate probit model is found to be an appropriate for jointly predicting these three land use choices on an individual specific basis and the parameter estimates are simulated maximum likelihood (SML) estimators.

Table 3.6 has shown that the marginal success probability of each households land use decisions. The simulated maximum likelihood (SML) estimation result has shown that the likelihood of choosing mixed and Eucalyptus woodlot land use is relatively high (39.1%) as compared to the probability of choosing mixed land use (32.1%) and probability of choosing cropland and Eucalyptus woodlot land uses (28.8%). This result has revealed that cropland and Eucalyptus woodlot land use is less likely chosen by rural households as compared to other two land uses.

The result in Table 3.6 has also revealed that the joint probabilities of success or failure of choosing three land uses decisions suggest that the likelihood of sample households to jointly choose the three land uses is low. The likelihood of sample rural households to jointly choose the three land uses are 2.7%, which is low as compared to their failure to jointly choose them (26.8%). This indicates that the possibility of choosing the joint land use is very low. This evidence suggests that choosing the correct combination of land use will be determined by different factors for the respective land uses.

Table 3.6: Probability of households land use decisions from the MVP model

Variable	Mean	Std. Dev.
Predicted Probability of mixed land use	0.321	0.158
Predicted probability of crop and Eucalyptus woodlot land use	0.288	0.189
Predicted probability of mixed and Eucalyptus woodlot land use	0.391	0.213
Probability of success	0.027	0.048
Probability of failure	0.268	0.155

To test the overall significant of the model an econometric approach (Wald test) is employed to test the effects of the independent variables on the selections of households land use decisions. The Wald test Chi2(48)=83.13 is statistically significant at 1% (P<0.01) significance level (Table 3.7), which indicates that the subset coefficients of the model is jointly significant and the explanatory power of the variables included in the model is acceptable. The result of likelihood ratio test in the model has shown that Likelihood ratio test of Chi2(3) = 10.891, Prob > Chi2 = 0.0123 is statistically significant at 5% (P<0.05) significance level, indicating that the null hypothesis is that choices of the three land uses is independent and it is rejected. This means that the likelihood ratio test of the null hypothesis of independent between the land use decisions (rho21 = rho31 = rho32=0) is significant at 5% (P<0.05) level of precision, which shows the goodness fit of multivariate probit model. Therefore, the likelihood ratio test of independency has indicated that there are different land use decisions behaviors among rural households. In the study, samples are drawn 5 times to increase the accuracy, which indicates the precision level of the sample (Table 3.7).

Age of households: Age of households is found to have a positively and statistically significant influence on choice of households towards choosing mixed and Eucalyptus woodlot land use at 10% (P<0.1) significance level. This might be as the age of the households increases the households could have a good farm experience and knowledge about better financial returns from their land. In another study, the direct proportionality of age and mixed and Eucalyptus woodlot land use is attributed to the fact that older households have larger land sizes (Sood, K.K, 2005) and have good farm experience (Ashraf, J.; et al., 2015). In contradiction to the finding of the study, the result from a study conducted by Alemayehu (2016) revealed that age of households is negatively and significantly associated with mixed farming practices. He concluded that households with older households have less preference to practice mixed land use than the other land use.

Household size: It is found to have a positively and statistically significant influence on the choice of rural households towards choosing mixed land use at 5% (P<0.05) significance level.

On -farm income: It is found to have a positively and statistically significant effect on choice of rural household's towards choosing both crop and Eucalyptus woodlot land use at 1% (P<0.01) significance level. This result shows that households who have high amount of income are more likely to choose crop and Eucalyptus woodlot land use than other land uses.

Land size: It is found to have a positively and statistically significant effect on choice of households towards choosing mixed and Eucalyptus woodlot land use at 1% (P<0.01) level of significance. This might be due to the fact that households who have large land size are more likely allocate their land into mixed and Eucalyptus land use. In consistent to the finding of the study, Alemayehu (2016) pointed out that farmers who had large farm size practiced diversified mixed land use. Similarly, a study conducted by Balana et al. (2012) indicated that household's landholding size is large enough to accommodate both agricultural crops and trees. Therefore, having large landholding size may help households to allocate parts of it for crop production and animal grazing and the remaining for planting trees.

Land tenure security: It is found to have a positively and statistically significant influence on choice of households towards choosing crop and Eucalyptus woodlot land use at 5% (P<0.05) significance level. This implies that secured land tenure is an incentive factor for households to practice crop and Eucalyptus woodlot land use. This might be because households whose land is secured more likely choose crop and Eucalyptus woodlot land than the other two land uses. In line with the finding of the study, a study conducted by Ayana, & Lejissa, 2018 pointed out that some households may plant some trees that were enough for households' consumption irrespective of the risk, insecure land tenure was not expected to encourage tree planting in Ethiopia. Moreover, this result is in consistent with Perz (2001) found that security of land tenure significantly influenced households land allocation decisions.

Land ownership: Land ownership of households is found to have a negatively and statistically significant influence on choice of households towards choosing mixed land use at 10% (P<0.1) significance level. This implies that households who have their own land are less likely choose mixed land use than the other two land uses.

Table 3.7: Estimated coefficient of multivariate probit model

Dependent variables (Determinants of rural households land use decisions)			
Variables	**Mixed land use**	**Crop and Eucalyptus woodlot land use**	**Mixed land and Eucalyptus woodlot land use**
Sex	-0.0921(0.2887)	0.1066 (0.283)	-0.042(0.279)
Age	0.0271 (0.0207)	-0.0243(0.0227)	0.0346144* (0.0202)
Household size	0.1599** (0.0673)	0.0302 (0.069)	-0.071045 (0.068)
Educational levels	0.0100 (0.0369)	0.0199 (0.0387)	0.0082 (0.0373)
On farm income	0.000001(0.000009)	0.0000326***(0.0000101)	0.000007 (0.000008)
Off -farm income	0.0513 (0.2382)	-0.0200 (0.2499)	-0.1458 (0.236)
Farm experience	-0.0258 (0.0196)	0.0232 (0.021)	-0.0225 (0.019)
Land size	0.1547 (0.3109)	0.0385 (0.3060)	1.232*** (0.312)
Land security	-0.0565 (0.2412)	0.622** (0.255)	0.097 (0.243)
Land ownership	-0.670* (0.403)	0.1115 (0.406)	-0.013 (0.439)
Land quality	-0.265 (0.236)	-0.215 (0.2498)	0.2617 (0.235)
Access to extension services	0.168 (0.294)	0.11 (0.300501)	0.5468* (0.3001)
Access to market	-0.477 ** (0.223)	0.0634 (0.227)	0.0086 (0.221)
Access to credit	-0.0065 (0.232)	0.070 (0.2445)	-0.012 (0.228)
Slope of land	0.189 (0.218)	-0.1879 (0.2270)	0.199 (0.2164745)
TLU	-0.071 (0.079)	-0.2901*** (0.0874)	0.1527*(0.085)
Constant	-1.213 (0.724)	-0.379 (0.746)	-3.301572(0.8002)

Number of observation = 185 Multivariate probit (SML, # draws = 5)
Wald Chi2(48) = 83.13 Prob > chi2 = 0.0012***
Log likelihood = -298.16299
Likelihood ratio test of rho21 = rho31 = rho32= 0
Chi2(3) = 10.891 Prob > chi2(3) =0.0123**

Note: Standard errors are given in parentheses, log likelihood ratio test of overall errors term correlations is 0 (rho21 = rho31 = rho32 = 0)
*,**, &*** indicates that significant at 10%, 5% & 1% significance level, respectively.

Access to extension services: It is found to have a positively and statistically significant influence on choice of households towards choosing mixed and Eucalyptus woodlot land use at 10% ($p<0.1$) level of significance. This shows that access of getting extension services by development agent is an incentive factor for households to choose mixed and Eucalyptus woodlot land use. This implies that households who have extension services more likely to choose mixed and Eucalyptus woodlot land use. In consistent with the finding of the study, a study conducted by Alemayehu (2016) who pointed out that households who had access to extension service are 56% more likely to practice diversified mixed land use.

Access to market: It is found to have a negatively and statistically significant influence on choice of households towards choosing mixed land use at 5% ($P<0.05$) level of significances. This indicates that households have market access have less likely choose mixed land use than the other two land uses. The finding of the study is consistent with Abid (2015) who reported that the coefficient of local market access was negative, which indicated that farmers located have market access have more chances to practice different land uses when compared with farmers who did not have market access.

Tropical livestock unit (TLU): It is found to have a negatively and positively and statistically significant influence on choice of households land use towards choosing crop and Eucalyptus woodlot land use, and mixed and Eucalyptus woodlot land use at 1% ($P<0.01$) and 10% ($P<0.1$) levels of significances, respectively. This shows that households who have a large amount of livestock holding are less likely to choose crop and Eucalyptus land use and more likely to choose mixed and Eucalyptus woodlot land use.

4. Conclusion and Recommendations

The study has analyzed the profitability and determinants of rural household's land use decisions farmers around Wof-Washa forest central highlands of Ethiopia. The output of the study is an essential implication for the formulation of land use policies and programs aims to the allocations of rural households land uses. The majority of the sampled households have participated in mixed and Eucalyptus woodlot land uses. This finding implying that depending on the total landholding size households can practiced more than one type of land uses in the study area.

Farmers around Wof-washa forest have obtained diversified benefit from three land use types. However, comparing the three land uses Eucalyptus woodlot land is the most lucrative and labor saving and less risky land use than the other two land uses. The determinants of land use decisions of rural households are influenced by age of households, household size, land ownership, on farm income of households, land tenure security, land size, access to market, access to extension services and tropical livestock unit significantly. Therefore, understanding the fators affecting households land use decision is vital for households to allocate their land resources efficiently.

Based on the finding, the following recommendations are forwarded.

- The financial indicators criteria has shown that Eucalyptus woodlot is financially more profitable and labor saving less risky than the other two land uses. Therefore, Eucalyptus woodlot land use should be encouraged by rural households in the study area and nearby localities without compromising the food security status of rural households.
- Besides, the development agents and rural land use policy makers should consider this finding in their decision making and development practices.
- It is found that inadequate market acess is one of the factors affecting the determinants of rural households land use decsions. Therefore, responsible government officials need to mitigate market access problem of households.
- The study has evaluated and considered the financial profitability and determinants of rural households land use decisions only. Therefore, further study is needed regarding the total economic profitability of households land use including the costs of environment and other social impacts with the impacts of households land use practices on Wof-washa natural forest.

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Economic Contributions of Forest Products to Household Income in Metema District, Gonder, Ethiopia

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Abstract

Dry deciduous woodland is a dominant vegetation type in northwestern Ethiopia. However, the contributions of such forests and its products to local and national communities are not empirically studied so far particularly in the study area. Hence, the study is conducted to assess the contribution of dry deciduous woodland forest products to households and to identify the determinants of forest income and level of forest dependence in the northwestern lowlands of Ethiopia. The data are collected through field observations; key informant interviews and individual interview. A total of 120 respondents are selected using systematic random sampling technique in three kebeles/villages/ selected purposively. Combinations of data analysis methods such as descriptive statistics and econometrics model (Seemingly unrelated regression model) are used. The major sources of households' income are crop production (46.91%), forest products (25.32%,) livestock farming (21.42%,), and off/non-farm activities contributed (6.32%). of the households' total income. The major dry forest products include construction materials and farm tools, grass, gum and resin, charcoal and fuel wood, contributing 23.60%, 22.77%, 17.89%, 16.56% and 12.83% of the forest income, respectively. Besides, various socio-economic and contextual factors are found that influence forest income and dependency. Therefore, it is suggested that sustainable forest management schemes should be adopted to maintain and enhance the flow of economic benefits to the surrounding communities without damaging the natural resource system.

Keywords: Forests Income; Forest Product; woodland; determinants; seemingly unrelated regression

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1. Introduction

Forests are important assets for sustainable rural development. Currently forestry is an industry wherever production and social goals handled simultaneously (Bjarstig and Stens, 2018). According to Almstedt et al. (2014), within the pattern of sustainable forestry, the alert management of forest sectors for multiple purposes is being increased. In Africa, there is a good understanding of different stakeholders on the importance of forests. The forestry sector plays a significant role in poverty reduction strategies (Oksanen et al., 2003; Yemiru et al, 2010). Rural Africans used natural forests, woodlands and planted trees for food, energy, medicine, animal feed, construction, furniture, agricultural implements and utensils to enhance their livelihood diversification (Mamo et al., 2007; Shackleton et al., 2007). Forests are used not limited in income contribution, but it also has wider contribution in regulation of environment, healthy function of environment, carbon emission abatement, to global biodiversity, to fertility of agricultural lands, and to the welfare of those who depend on them ie., forests are immensely valuable for sustainability (Arun et.al, 2013).

Similarly, the production, collection and marketing of non-timber forest products play a significant role in meeting the needs of rural population for food, poverty reduction, sustainable management of forest products, health and wealth improvement (Marshal et al., 2005; FAO, 2006; Ahenkan and Boon 2008). However, the key challenges that farmers faced to enhance marketing of forest products were lack of marketing information, lack of packaging and labeling requirement, poor harvesting and processing skill, inadequate of finance to non-timber forest product farmers, over harvesting and deforestation, and lack of policy to guide the use, management and development of non-timber forest products (Ahenkan and Boon, 2010).

In the developing world, including Ethiopia, rural communities follow a wide range of livelihood strategies. Some parts of communities diversify their livelihood strategies, while others rely heavily on one or few activities. Recently, many studies are providing more evidences on the role of forests in rural people's livelihoods. It is indicated that about one billion of the world's poor depend on forest resources to sustain their livelihoods (Scherr et al. 2003; UN, 2011; CAO, 2012; Melaku et al. 2014; Brobbey et al. 2019). Studies in sub-Saharan Africa (Babulo et al. 2008, Campbell et al. 2002, Cavendish, 2000, Fisher, 2004, Kaimowitz 2003, Mamo et al. 2007, Paumgarten 2005, and Shackleton et al. 2007) have shown that rural households regularly supplement their income from forest resources. Hence, the forestry sectors provide a substantial contribution to the welfare of many rural households. However, the level of forest use and the degree of dependence on forest products vary across households. The factors that affect a household's socio-economic dependency on forest products vary on the resource endowment, the demographic, institutional and socio-economic characteristics of households (Babulo et al., 2008).

In Ethiopia, dry forests are the most significant forest types both in area coverage and its economic contribution to GDP of the country by exporting non-timber forest products (Lemenih, and Kassa, 2011). Ethiopian forests have generated economic benefits in the form of cash and in-kind income equivalent to 111.2 billion Ethiopian Birr (ETB) (USD16.7 billion) or 12.86% of Gross Domestic Product (GDP) in 2012-13, considerably larger than previously thought. Of this, 6.09% of GDP is attributed to the forest industries. The contribution of the forest ecosystems to other sectors, particularly on agriculture, is valued at 6.77% of GDP. In addition, 2.4 billion ETB was attributed to the non-market benefits based on Ethiopians' willingness to pay to maintain forests (UNEP, 2016). Likewise, dry forests provide various goods and services to producers, traders, and consumers such as fodder, fuel, medicine, and commercial non-timber forest products (FAO, 2010; Abebaw et al, 2012). However, knowledge on the faith of Ethiopian communities on woodland forests for the purpose of fuel wood, construction materials, medicinal plants, and gums and resins and factors affecting this faith on forest income is limited (Teshome et al., 2015). The household forest income level is significantly influenced by family size, producer's cooperative membership of producers in gums and resins, and the distance to forest resource (Mamo et al., 2007; Tesfay et al., 2011; Teshome et al., 2015).

There is a high coverage of forests on northwestern lowland of Ethiopia though its economic contribution to the communities and governments are not estimated empirically. Therefore, based on the above statement the study is intended to empirically answer the following two key questions, namely) what is the economic contribution of northwestern Ethiopian lowland forests to the communities and ii) what factors that determine the forest income and forest income dependence Levels of households in the Northwestern Lowlands of Ethiopia.

2. Methodology

2.1 Description of study Area

The study was undertaken in vegetation dominated woodland area in Metema district. It is located in North Gondar Zone, Northwestern lowlands of Ethiopia. Geographically, it is situated between 36°17' E and 12°39' N. The site is characterized by undulating land configuration. The annual rainfall of the area goes up to 1128 mm and; mean monthly minimum and maximum temperature of Metema district were 19.31oc and 35.650c, respectively (Wale et.al, 2012). The dominant vegetation type is mixed dry deciduous woodland where Combretum and Terminalia species are abundant (Friis et.al, 2010, Eshete, et.al, 2011; Wale et.al, 2012). *Combretumcollinum, Combretummolle, Terminalialaxiflora, Anogeissusleiocarpa, Dalbergiamelanoxylon, Combretumharotomannianum, Acacia seyal, Balanitesaegyptiaca, Boswelliapapyrifera, Pterocarpuslucens, Lanchocarpuslaxifiora, Lanneafruticosa, Acacia Polyacantha, Sterculiasetigera, Stereospermumkunthianum and Dichrostachyscinerea* species are found in the study site. In this woodland, 36-39 woody species were existing (Eshete, et.al, 2011; Wale et.al, 2012).

2.2. Sampling and Data Collection.

Prior to the actual survey, frequent visits are made to the district and secondary information relevant to the study is gathered from a formal possible sources. Based on the base line information documented by zonal and district agricultural offices and by previous studies. Then, after a thorough discussion with expert's agricultural district office, three kebeles (Das Gunido, Kokit and Metema Yohans) are purposively selected based on the dry forest/woodland cover, representativeness, and accessibility and stratifies based on household status (low, medium and rich households).

Field data collection at the selected kebeles is carried out from January 2017 to February2018 using various methods like household survey, group discussions, market assessments, and field observation. Finally using the household list, the predetermined size which is 120 sampled households from each Kebeles are randomly selected using systematic random sampling technique.

The survey was carried out using a household interview aimed at capturing both qualitative and quantitative information. The questionnaire is comprised of such major issues as socio demographic characteristics (such as sex, age, family size, and literacy status) major assets such as land and livestock, livelihood activities, and forest product extraction. Local enumerators are recruited from the respective sample kebeles. All enumerators are fluent speakers of the respective local languages. They are trained on data collection procedures, interviewing techniques, and the detailed contents of the questionnaire. The questionnaire is pretested to check its appropriateness for gathering all the required data.

2.3. Method of Data Analysis

Data from the field are edited, coded, and cleaned to ensure consistency, uniformity, and accuracy. During the data checking, 2 of the 120 questionnaires are found incomplete and removed from data processing and analysis. Data are entered into computer software for analysis. Both SPSS and STATA computer programs are used to process the data. Two types of analysis, namely descriptive and inferential statistics are used to analyze the data collected. To identify factors influencing household income from the forest and forest income dependence (measured as the relative share of forest income in the total annual household income) estimated by seemingly unrelated regression analysis (SUR) model since the two equations have some correlation between household income from the forest and forest income dependence. Accordingly, they are estimated by a two-equation SUR model (Zellner, 1962; Greene, 2012):

$$Y_i = X'\beta + U_i \tag{1}$$

Where Yi= amount of income generated from forest and relative share of forest income in the total annual household income

β= a vector of estimated coefficient of the explanatory variables

X' =a vector of explanatory variables

Ui =disturbance term

3. Results and Discussion

3.1 Relative Contribution of Different Livelihood Options

Figure 1 below shows the relative contribution of livelihood option to household. Crop production is still the main source of income 22770.8 ETB (46.9%) for local people in the study area, and this is in line with several similar studies. For instance Mamo, et.al (2007) at Chilimo forest reported that while agriculture contributed to 40% and livestock to 27.6%, the average contribution of forest products to household income was 17%. The overall average income of respondent households derived from the forests is estimated to be 25.32% of the total household income. This finding is in line with Teshome, et.al (2015) who reported that NTFPs contributed 17% to the household income in the Northwestern and Southern Lowlands of Ethiopia. Likewise, in Chiradzulu District, Malawi, forest income constituted around 15% of the total income. Income from off- and non-farm activities accounted for 6.3% of the total household income and petty trade and working as daily laborer are the most common off-farm activities in the study area. Income from livestock accounted for 21.4% of the total household income.

Figure 1: Major source of annual household income and their contribution in Birr

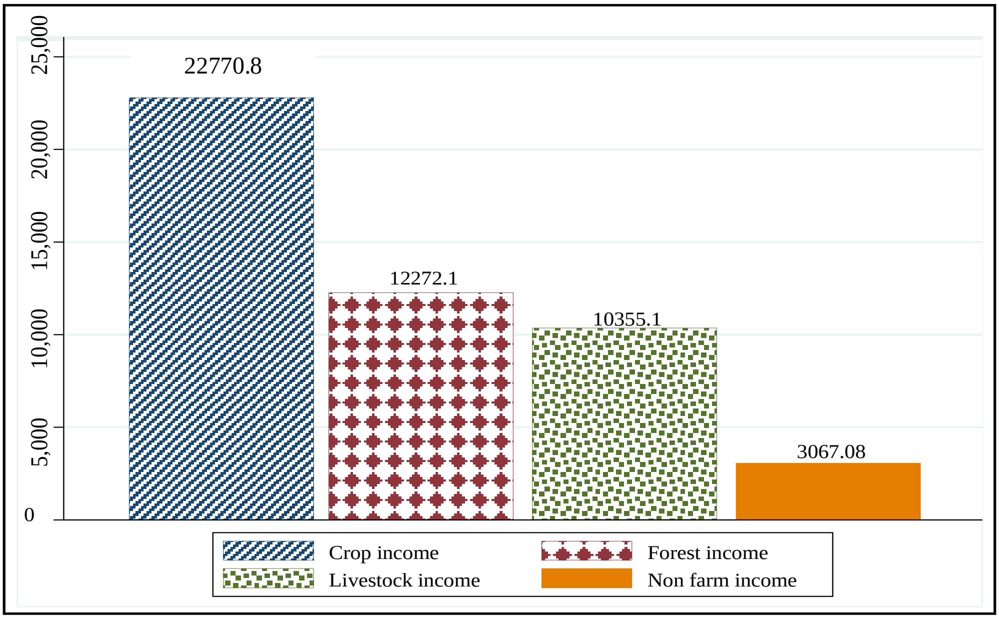


Table 1 below illustrates household activities and their (cash) contributions by different income categories. The annual income of forest income for different wealth groups of the study sites amounted to Birr 14091.2 for the rich, Birr 12089 for the medium and Birr 11718.7 for the poor. While relative percentage contribution of forest income of rich HHs is 21.4% while the contribution for medium and poor HHs is 23.4% and 33.2% respectively for the study site. The low-income households usually own less agricultural land and livestock, which make them more dependent on forest products. In terms of magnitude, forest income differes significantly ($P < 0.05$) with wealth category of house- holds the HH in the poor category benefited more than the rich. Similarly, Shackleton (2006) showed that rich households extracted a smaller amount of forest products. Shackleton (2004) found that poor households extracted greater income from NTFPs than the rich households.

Table 1: Average annual total household cash income contribution by household activities

	Rich households (n1=18)	Shared %	Medium Households (n2=61)	Shared %	Poor households (n3=39)	Shared %	Total (N=118)	F-value
Income from Crop farming	30697.2 (25539)	46.54	24277.54 (15021.4)	46.95	16755.6 (13700)	47.42	22770.7 (17157)	4.85***
Income from Livestock production	12811.1 (2218.4)	19.42	12981.9 (20570)	25.11	5112.8 (6068)	14.47	10355.1 (16258.3)	3.14**
Income from off /nonfarm	8361.1 (22813.6)	12.67	2351.5 (6239.3)	4.54	1742.82 (4635.7)	4.93	3067.1 (10379)	2.89*
Income from forest	14091.2 (11772)	21.36	12089 (10795)	23.38	11718.7 (9985.2)	33.16	2272.1 (10626)	0.32
Total	65960.6 (36457)		51700.1 (26814.9)		35330 (21589.9)		48464.9 (28693.3)	8.87***

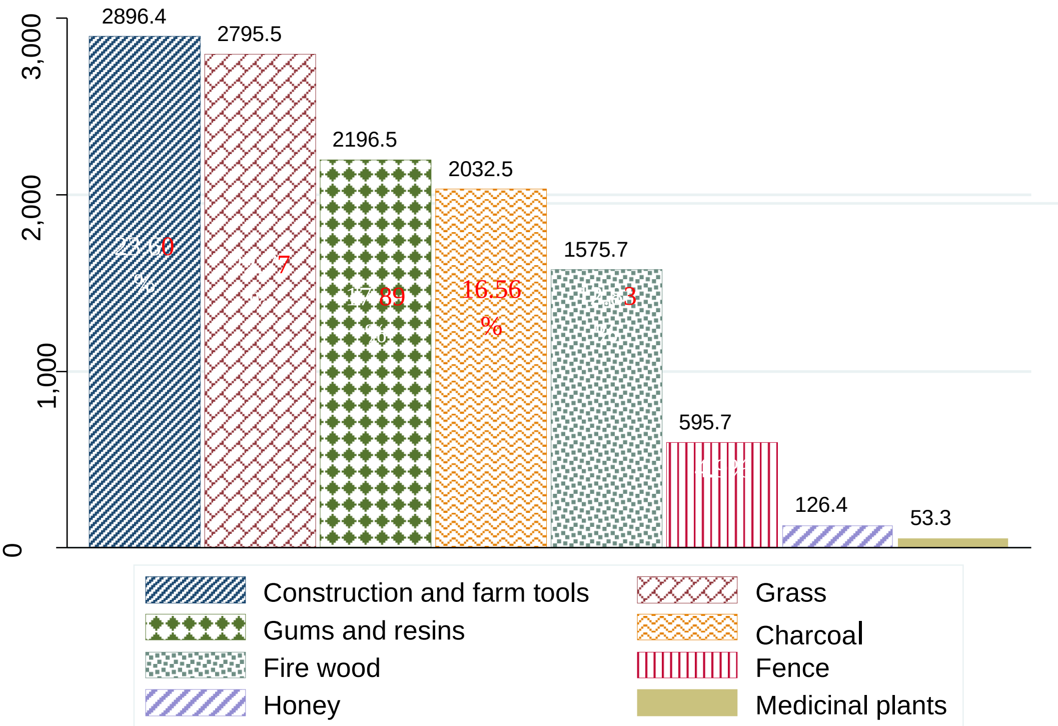
Source: computed from survey data, 2018. Note: *** significant at 1%, ** at 5% and * at 10% Parenthesis shows standard error

The work of Arnold and Perez (2011), showed that in general it was the poorer households that depended on forests for a larger share of their overall livelihood. Similar findings are reported in Chilimo forest in Ethiopia (Teshome, et.al, 2015), and in a communal area of Zimbabwe (Cavendish,2000).In addition there are significant differences ($p < 0.001$) between income group (poor, medium and rich) income from agriculture, livestock, and other income, and local people are more dependent on agriculture and other activities for cash generation. The forest income is found to contribute the second to household income among all the income sources.

3.2 Contribution of Various Forest Products to Forest Income

As Figure 2 below shows, the forest provides various products for livelihood. The major products include construction materials and farm tools, Grass, gum and resin, charcoal, fuel wood, fence, honey and medicinal plants and the first five are the top five important products in terms of their contribution to household income.

Figure 2: The contribution of different forest products to total forest income in Birr



Construction Materials and Farm tools: Timber, thatch, and bamboo are used as different building materials components. These products are used for the floor, walls, poles, rafters, beams, roofs, and other parts of the houses. Bamboo is collected not only as a building material but also for cash generation. Small wood is collected for making or repairing cattle/ buffalo carts and agricultural cultivation tools such as plows, harrows, yokes, and spade handles. The most frequently collected tree species are Yemane (Gmelinaarborea), Thitnet, and Yant-kaw(local names).Some collected small wood is also used as building material(timber)(Figure 2).

Fire Wood: Income from fire wood collection is the fourth most important forest income. It accounts for 12.8% of the annual forest income (Figure 2). Given that fire wood has remained as the major energy sources for most of the rural as well as urban households, coupled with the relentless population growth and the subsequent increase in wood demand, it might not be uncommon to find fire wood harvesting as a major forest based livelihood activity. Extraction of fuel wood from the forest is reported as a major source of forest related incomes for rural households in different parts of Ethiopia(Abebaw, et al,2012; Teshome,et al,2015).

Gums and Resins (GR): Gums and resins (GR) are one of the most economically valuable products of dry forests of several regions. In the study, collection and sale of GR products as a source of income are observed in the study site. In the study site, households extracted GR from different species. The most commonly known GR product is frankincense collected from Boswellianeglecta, which is locally named as "Tikur Etan" (meaning: black incense). Income from Gums and Resins collection is the third most important forest income; it accounted for 17.9% of the annual forest income (Figure 2). The average annual income from GR is estimated to be 2196.5 ETB.

Fodder (grass): Some types of foods collected and consumed in each studied HH are observed and their quantities are recorded as long as the HH could recall. HHs collects forest products to use as fodder for their livestock. These are used for both consumption and cash generation. Fodder products are mostly collected during the rainy season (from May to October). Fodder from the forest forms an important source for cattle and other grazing animals in the hilly and the arid regions and during a drought. It is the second most important forest income; it accounted for 22.7 % of the annual forest income (Figure 2).

Charcoal: Income from charcoal collection is the fourth most important forest income. It accounts for 16.5 % of the annual forest income (Figure 2).For the rural and urban population charcoal is an important source of energy for cooking and heating.

Honey: In the study, about 36.44% of sample households are selected in the study area which indicates the production of honey as one of their forest based livelihood activities. According to the household survey, honey production in the study areas is mainly carried out by placing hives hanged in a forest. Honey from the forest is produced/harvested three to five times annually and from which three to five Kilograms of honey can be produced in one bee hive in one harvest. As reported during the survey, households have delivered the raw honey to the nearby market, without product processing or any other value adding activity. The raw honey is reported to be sold at an average price of ETB40perkg. Income from honey has contributed less significant proportion of the annual forest income of households in the study area: of the total forest income of 126ETB is accounted which is the least contribution next to medicinal pants

3.4 Determinants of Forest Income Levels and Forest Income Dependence

The SUR model estimation results estimation results of households' annual forest income and level of dependency on forest income are reported in Table 2. As expected, the residuals from the two equations are strongly and positively correlated and the SUR model explained about 37% and 39% of the variation in annual forest income and level of dependency on forest income, respectively. The result of regression models is presented in Table 2. Forest income and forest income dependence of a household is regressed against some household characteristics that may influence income levels. The results of the study have revealed that family size has been positively related to both forest income ($P < 0.05$) and level of dependency on forest income. The result has indicated that households who have larger family sizes engage more on forest products and dependence. The work of (Hegde and Enters,2000) also showed that families with more labor tended to extract more forest resources. This is because they are either able to mobilize part of their families to undertake forest dependent activities. Furthermore, larger families have higher subsistence needs, and that may be another reason to depend more on forest resources.

The results has indicated that distance from forest and nearest market are the other factor, which are positively related to forest income and level of forest dependence. This implies that, as distance from the forest and nearest market increases, the income generated by households from the forest and forest dependence increases (unexpected sign). This is in line with the report of (Mamo, et al,2007), for Chilimo.

Being a member of a cooperative of gums and resins producers and traders has been positively related to forest income and forest dependence at one percent. This shows that those households who are the members of cooperatives get income from gums and resin and as a result they get better income and depend from forest product than non-member households. This finding is in line with the report of (Teshome, et al,2015) for Ethiopia.

Table 2: SUR regression of household forest income

	Coefficient equations	
Variables	**Forest income**	**Forest income dependence**
Sex of Household	0.04(0.267)	-5.13(5.612)
Age of H	0.01(0.009)	0.008(0.199)
Family size	0.11**(0.043)	1.81*(0.924)
Literacy status	0.16(0.191)	-5.15(4.016)
Distance to nearest forest	0.08**(0.038)	0.84(0.802)
Distance to urban market	0.14**(0.067)	2.75*(1.413)
Gum and resin Cooperative membership	0.75***(0.209)	18.61***(4.408)
Tropical livestock unit	0.002(0.011)	-0.67***(0.242)
Access to credit	-0.36***(0.165)	-9.95**(3.486)
Participation in Off/Non-farm activities	-0.30(0.186)	-3.94(3.917)
Land covered by forest	0.08*(0.046)	1.17(0.967)
Rich household	-0.09(0.275)	-8.09(5.783)
Medium household	-0.02(0.194)	-2.16(4.072)
Constant	7.58***(0.458)	26.11***(9.643)
Observation	118	118
Chi-value	70.53***	75.63***
R-square	0.37	0.39
Correlation matrix of residuals	0.53	
Breusch-Pagan test of independence: chi2(1) = 33.898, Pr = 0.0000		

Source: Computed from survey data, 2018. Note: *** significant at 1%, ** at 5% and * at 10%

The two important household assets, land covered by forest and livestock size, are found to influence forest income and dependency both positively and negatively. According to the regression result, larger livestock asset significantly decreases the level of dependency on forest income at 1% level of significance. Given that larger livestock resources may reflect higher total income and thereby less dependence on forest income. This result is in congruent with the report of (Fisher, 2004; Teshome, et al, 2015; Fikir, et al,2016).

On the other hand, the regression result for access to credit has supported the hypothesis that availability of credit access reduces the need for environmental income. Households with access to credit are found to earn lower forest income at 1% and to be less dependent on forest income at 5% than those who do not have access to credit. This could be households who have access to credit could be engagement in other income generating activities like nonfarm may reduce quantity of extraction and hence income, by competing for and taking over labor as well as time that would otherwise be invested for forest related activities.

4. Conclusions and Policy Implications

The results of the study have shown that the natural forest in the Metema District plays a significant role in rural people's livelihood, serving as the main source of primary and secondary income for rural households. The livelihood of the households in the study area depends on livestock rearing, crop production, forest product collection and off-farm activities our findings highlight the relative importance of income from forest environmental sources in overall household income. Construction and farm tools, fodder, gum and resins, firewood, charcoal, fence, honey and medicinal plant are the six major forest income sources. Forest income and dependency vary with household characteristics. The determinant of household forest income and forest income level dependence are influenced by family size, distance to forest and nearest market, cooperative membership, tropical livestock and access to credit positively and negatively. Therefore, to enhance the economic contributions of dry land forests to the households and to the national economy at large. Forest management and utilization strategies should be designed to reduce deforestation and achieve sustainable utilization of forest products. Moreover, there should be an awareness creation initiatives and capacity building activities for households on production, harvesting, and value-addition of these economically valuable forest products and strong marketing center nearest to the farmer's residence or production area particularly for gum and resin product producers. Finally future research should be made to estimate and value the contribution of other non-marketable products that have not been included in the study (such as food like vegetables, fiber and fruits etc.) to enhance the economic contributions of dry forests to the local livelihoods and to the national economy at large.

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Determinants of Market Participation for Crop Producer Farmers in Irrigated Areas of Amhara Region, Ethiopia

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Abstract

The study is conducted to identify the main determinants for crop market participation in irrigated areas of Amhara region, Ethiopia. To get the sample respondents three-stage sampling procedures are employed and finally, 544 crop producer farmers are selected. Both qualitative and quantitative data are collected from primary and secondary sources. To achieve the stated objectives, fractional probit and two-limit Tobit models are used and the results have indicated that age of household head, distance from the market place, distance from the nearest town, experience in irrigation farming, share of crop income, livestock measured in TLU, membership in marketing cooperative, proportion of irrigated land, and location are statistically significant to influence crop output market participation and commercialization among smallholder crop producers. Therefore, the findings of the study have indicated that an attempt to increase smallholder farmers' participation in the output market should give special attention to significant main explanatory variables. To enable smallholder's participation and commercialization in crop output marketing, government interventions is needed in strengthening institutional service, skill, and experience and infrastructure facilities. Thus, policies to address these factors are called for.

Keywords: Market Participation, Tobit, Irrigation, Amhara, Ethiopia
JEL Classification: C21, O13, Q12, Q18

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1. Introduction

About 1.3 billion people globally do not have enough food to eat corresponding to about one in every nine people in the world. In spite of global efforts to eradicate hunger, more than 800 million people remain chronically undernourished worldwide and Sub-Saharan Africa host 22.8% (256.1 million) of the undernourished population (FAO, 2019). Moreover, at least 2 billion people suffer from micronutrient deficiencies in the world (IFPRI, 2018; FAO, 2019). The situation is most alarming in Africa, where since 2015 the prevalence of undernourishment shows slight but steady increases in almost all sub-regions. It has reached levels of 26.5 percent (44.6 million) and 30.8 percent (133.1 million) in Middle and Eastern Africa, respectively, with rapid growth in recent years, especially in Western Africa (FAO, 2019). Agriculture is the dominant livelihood in Africa however its growth unable to feed the growing population (AU , 2013). Similarly, smallholder agriculture has long been the dominant economic activity in the sub-Saharan region, and it will remain enormously important for the foreseeable future (Douglas, 2014). A large proportion of these people are smallholder farmers in developing countries who depend on agriculture as a source of food and income.

Ethiopia is the second most populous nation in Africa next to Nigeria. In 2010, its population was 87.6 million, and by 2020, the country's population has reached about 115 million, of which a large majority over 80 percent of Ethiopia's inhabitants is located in rural areas (FAO, 2020). Agriculture is the dominant economic sector in Ethiopia that accounts for about 32.7% of the GDP, 81.5% of the foreign exchange earnings, and supports about 67.3% of the employment (NBE, 2020/21: World Bank, 2019). According to the annual report of the Central Statistics Agency (CSA, 2021), in 2020/21, over 341 million quintals of grain crops including cereals (88.36%), pulses (9.36%) and oil seeds (2.27%) are produced across 12.98 million hectares of cultivated land. The production of vegetables is 9.06 million quintals, contributing about 2.04% of the total crop production. Irrigation generates an average income of approximately US$323/hectare (ha) under smallholder-managed irrigation systems compared to an average income of US$147/ha for rain fed systems (Hagos et al., 2009). Irrigation contributed approximately 9% and 3.7% to agricultural Gross Domestic Product (GDP) and the overall GDP, respectively, during the 2009/2010 cropping season (Hagos et al., 2009).

In addition, Ethiopia has the largest livestock population in the African continent. Based on its 2019/20 annual livestock sample survey, which covered the rural agricultural population, CSA estimates that the country has about 65.35 million cattle, over 39.89 million sheep and 50.5 million goat , as well as close to 11.47 million donkeys, horses, and mules and about 7.7 million camels (CSA, 2019/20). As most of the farmers in Ethiopia are marginal and small farmers, strong agricultural growth in the country may be achieved either through improving the performance of smallholder farming by intensification using modern technologies, irrigation or commercialization of these farms. Irrigation development has been identified as an important tool to accelerate economic growth and rural development, and is considered a cornerstone to food security and poverty reduction in Ethiopia.

According to (MoARD, 2010) and NPC, 2016) the Ethiopian government, in its two-consecutive five-years Growth and Transformation Plan (GTP-I and GTP-II), has given much emphasis on agricultural commercialization, among which the second pillar intends to achieve growth and thereby improve people's livelihoods and reduce poverty. Commercialization of the smallholder farmers has been viewed by the government as the major source of agricultural growth in Ethiopia (MoFED, 2015 and NPC, 2016). The government of Ethiopia has implemented agricultural commercialization clusters with the primary goal of commercialization of smallholders' agriculture and agro-industrial development, offering a strategic entry point for private sector engagement (Pauw, 2017).

Therefore, commercializing smallholder agriculture is seen as a means to bring the welfare benefits of market-based exchange economies and is central to an inclusive development process in the government's second Growth and Transformation Plan (GTP II) for the period 2016-2020 (NPC, 2016). Hence, the development of the Ethiopian economy heavily depends on the rate that a subsistence production system is transformed into a market-orientated production system. Consequently, promoting the commercialization of agricultural production is a cornerstone of the agricultural sector growth strategies of Ethiopia (NPC, 2016; Muhamed et al., 2014). Regardless of the efforts made to commercialize and transform Ethiopian agriculture from production of staple crops to that of high value crops, performance has been considerably below expectations (NPC, 2016).

Therefore, the study has aimed toward analyzing current scale of crop market participation and identifying determinants of crop commercialization of rural households' in the major irrigated areas namely Raya kobo, Habru, Mecha and south Achefer districts of Amhara region. The rest of the paper is organized as follows: Section two presents review of related literature, conceptual frameworks and methodology for measuring market participation, commercialization and determinants, while in Section three, the data and descriptive statistics of variables are presented. The econometric results are presented, compared, and discussed in

Section four. Finally, concluding remarks and recommendations are offered in Section five.

2. Literature Review

2.1 Review of related literature

In most reviewed literature, a farm household is assumed to be commercialized if it is producing a significant amount of cash commodities, allocating a proportion of its resources to marketable commodities, or selling a considerable proportion of its agricultural outputs (Strasberg et al, 1999). However, the meaning of commercialization goes beyond supplying surplus products to markets (von Braun and Kennedy, 1994; Pingali, 1997).

According to (von Braun and Kennedy, 1994; (Eleni., 2007) commercialization has to consider both the input and output sides of production, and the decision-making behavior of farm households in production and marketing simultaneously. Moreover, commercialization is not restricted only to cash crops as traditional food crops are also frequently marketed to a considerable extent. Under the existence of favorable market environment and infrastructure, food crops could also have the potential to be commercial crops (Fafchamps, 1992). Moreover, cash crops are not necessarily supplied to the market (von Braun and Kennedy, 1994). The commonly accepted concept of commercialization is, therefore, that commercialized households are targeting markets in their production decisions, rather than being related simply to the amount of product they would likely to sell due to surplus production (Pingali and Rosegrant, 1995).

Commercialization in agriculture refers to the progressive shift from household production for consumption to market-oriented production (Abafita, 2016). Agricultural commercialization results in welfare gains for farmers through comparative advantage and increased total factor productivity growth (Johnston & Mellor., 1961) because the commercialization of smallholder agriculture leads to productivity growth, income growth, employment growth, and poverty reduction (Carletto and Guelfi, 2017). Similar studies have revealed that agricultural commercialization also improves food supply in urban areas, with broader growth and welfare effects (Ogutu & Qaim., 2019).

Smallholder farmers face various challenges to supply their products to the market and hence their level of market participation varies. Explanatory variables are related to farm and farmer characteristics such as resource endowments (social, physical, human, and financial capital), the dependency ratio, household size, age, and gender of the household head. Further determinant factors mentioned in other studies include the access to information (Omiti et al., 2009; Tadele et al., 2017; Addisu et al., 2019), the size of farmland owned and cultivated (Samuel and Sharp, 2007; Egbetokun and Omonona, 2012; Beatrice and Julia, 2014), household ownership of assets and livestock (Beatrice and Julia, 2014; Aman et al., 2014; Addisu et al., 2019), financial savings and their substitutes, social capital, group membership and participation in farmer organizations (Moti et al., 2009; Berhanu and Jaleta, 2010; (Beatrice and Julia., 2014). Access to land and assets, use of technology and amount of rainfall significantly affect the decision of the household to participate in the market (Beatrice and Julia., 2014).

Farm household's decision to participate in the market can be affected by different factors in the context of different developing countries. The scale of commercialization in one enterprise has enhanced commercialization in the other and household's scale of commercialization in the two enterprises has been determined by common factors. For example, the crop and livestock commercialization status are independent and the determinants are different (Degye et al., 2012).

Empirical literature on market participation in Africa has continued throughout the first decade of the 21st century. The analytical methodologies adopted in the past empirical literature are varied. Though majority of the studies used two step selectivity models to analyze the discrete decision of market participation and the continuous decision of market participation intensity conditional on having made the decision to participate (Goetz, 1992;Bellamere and Barrett, 2006; Mather et al., 2011), other studies have analyzed the continuous decision of market participation intensity (Melkamu et al., 2017;). Others have continued to analyze factors that condition households to participate either net sellers, autarkic or net buyers (Pender and Alemu 2007; Gabremadhin et al., 2007).

A truncated regression model has been applied with households that have not participated in the market being excluded from the analysis i.e. the lower bound of the truncation. Applying the Double Hurdle model developed by (Craigg, 1971), Mather et al., (2011) has analyzed the determinants of maize market participation in selected eastern and southern Africa countries by fitting a double hurdle model on panel data in in a random effects framework. Similarly, Nigus et al., (2019) and Abafita et al. (2016) used double hurdle model to analyze commercialization of teff and Maize respectively. Moreover, Tadele et al., (2017) analyzed wheat market commercialization in Ethiopia using Tobit model and Addisu et al., (2019) used the censored Tobit model to analyze commercialization of teff in Dendi district of Oromiya region, Ethiopia. Only a few studies have utilized such improved multivariate Tobit models (Rehima et al., 2013; Hailemariam et al., 2013; Rahman and Akter, 2014; Ting et al., 2018). Hence, the study has employed both fractional probit and Tobit models to identify factors that affect smallholder commercialization of crops.

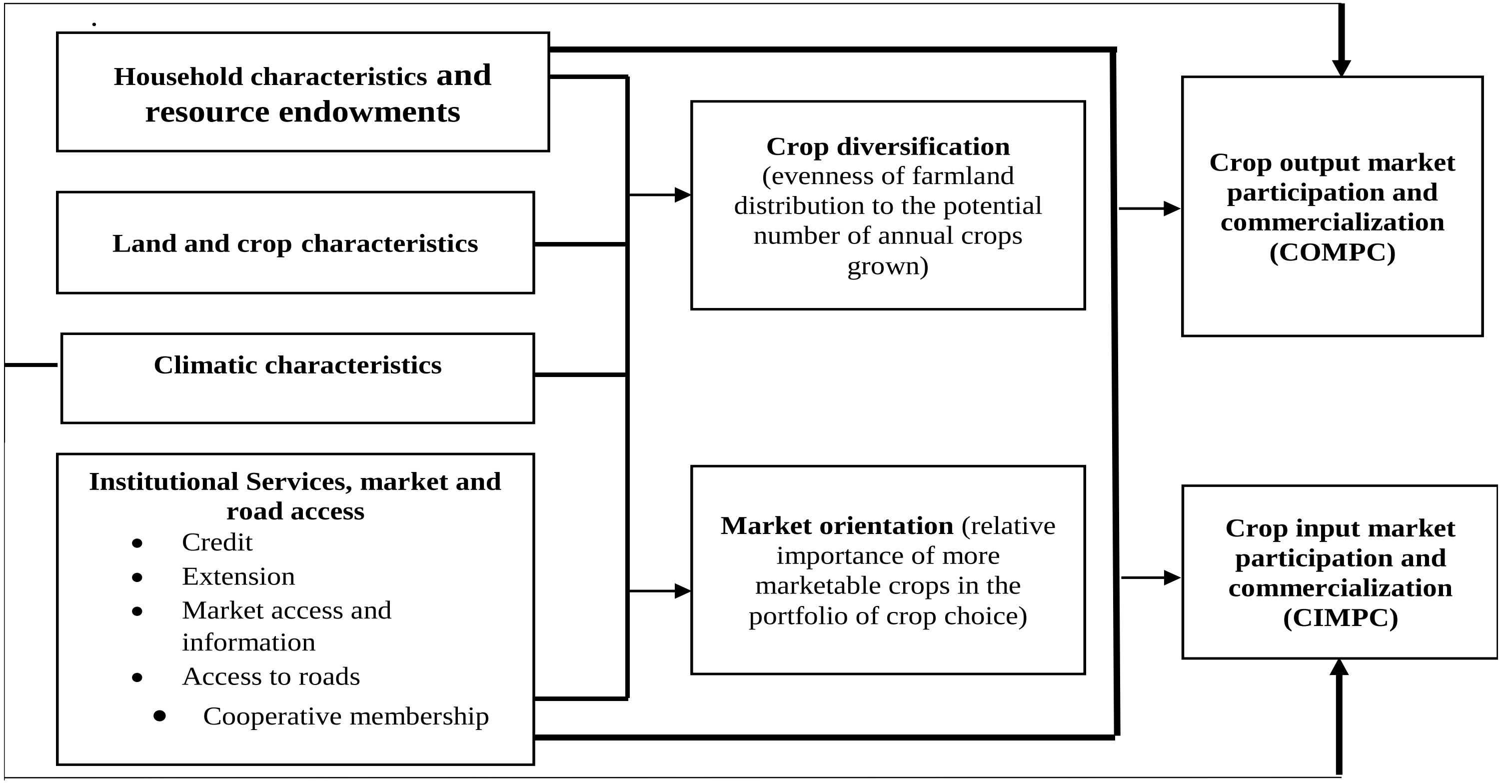
2.2 Conceptual Framework

Increasing the extent of commercialization among Sub-Saharan Africa's generally semi-subsistence, low-input, low-productivity smallholder famers is seen as playing a crucial role in poverty alleviation (Olwande et al., 2015). The majority of people living in absolute poverty are small farmers. Commercializing smallholder agriculture is seen as a means to bring the welfare benefits of market-based exchange economies to this group, and is central to an inclusive development process (WDR, 2019; Arias et al., 2013).

Agricultural commercialization can be achieved when a portion of the agriculture produce from the farmers is marketed (Osmani and Hossain, 2015). Commercialization is not only the selling of the output, but it also includes product choice and input use decisions that are based on the profit maximization principle (Pingali and Rosegrant, 1995). It can occur on both sides, either on the output side with the increased output being marketed or the input side with the increased use of inputs (Braun, 1995).

The overall conceptual framework given in Figure 1 is based on our assumption that household participation in input and output markets are influenced by factors related to household and household head characteristics, production and market related factors, and institutional support services. Moreover, the literature on household market participation and commercialization were used as benchmark to select variables affecting market participation (Goetz, 1992; Pingali and Rosegrant, 1995; Pingali 1997; Bellemare and Barrett, 2006; Omiti et al., 2009; Berhanu and Jaleta, 2010).

Figure 1: Conceptual framework of the determinants of market participation and commercialization



Source: Authors adapted from literature Omiti *et al.*, 2009; Berhanu and Jaleta, 2010

Table 1: Description and expected sign of variables in the commercialization analysis

Explanatory Variable	Measurement	Expected sign on Commercialization
Sex	Dummy:1 for male and 0 for female	+
Age	Number of years/ age of the farm household head	-
Education	In number of years of schooling or Dummy 0 for illiterate and 1 for literate	+
Family size	In number of members of the farm household family	+
Membership	Dummy: 1 if the household head is a member and 0 otherwise	+
Extension service	Frequency (number) of visits made to the farm hh by extension agents for irrigation related advice and support services	+
Credit use/access	The amount of credit in birr the farm hh utilized in the production season	+
Land holding size	Total amount of land owned by farm hh head in hectares	+
Land fragmentation index (Simpson index)	Zero value of SI indicates complete land consolidation (one parcel only), while the value closer to one indicates numerous parcels of equal size.	_
Livestock ownership	In number of livestock converted into TLU	+
Farming experience	Number of years in farming and irrigated agriculture	+
Log of Total farm income	Total farm income in log normalized form	+
Log of Assets	Total asset value in log normalized form	+
Non-farm income	In ETB of income from non-farm business, off-farm work and remittance, gift and aid	+/_
Ownership of communication assets	Dummy: 1 for household head owns at least a mobile or TV or radio; 0 otherwise	+
Training attended	Dummy: 1 if attended and 0 otherwise	+
Participation in demonstration	Dummy: 1 if participated and 0 otherwise	+
Participation in field/ farmers day	Dummy: 1 if participated and 0 otherwise	-
Fragmentation index/no-plots	Number of farm plots owned and cultivated by farm household	+
Crop diversification level	Number of farm enterprises of the farm household produce	+
Distance to output market	In Km/ minutes of walk from the residence to nearby market	+

3. Methodology

3.1 Study Area

The study is conducted at four woredas of Amhara National Regional State, Ethiopia which have different level of irrigation potential. Amhara National Regional State (ANRS) covers an area of about 153,000 km2 and according to the Central Statistical Agency of Ethiopia (CSA) the total projected population is about 21,844,000 in 2019 (CSA, 2013). The study areas are found in North Wollo and West Gojjam administrative zones of ANRS, Bahir Dar town being its capital.

3.1.1 Habru and Raya Kobo Woredas

Habru and Raya Kobo are woredas of North Wollo administrative zone. The mean annual rainfall amount is about 845 and 668 mm respectively. The districts have an agro-ecology of hot to warm Sub-moist valley and escarpment. The mean daily temperature is usually greater than 210c ranging from 130c to 29.50c. The agro-climatic feature of the woredas are inclined to be tropical with 4.5%, 37.5%, and 58% of it is Dega, Woina Dega and Kolla, respectively (WoA, 2019). The woredas have had a projected estimated population size of 557,583 (286792 male and 270791 female) in the year 2019. With an area of 3815.75 square kilometers, the woredas have a population density of 146.13 per square kilometer which is greater than the Zone average of 123.25 persons per square kilometer (WoA, 2018). The major types of soil are black, brown and red covering 42.5%, 32.3% and 25.2% of the total area of the woreda, respectively. Soil type is Euritic fluvisol lying on the low plain on valley floor enclosed by low but steep side hills and drains to rift valley river basin. The soils are deep to very deep, mostly alluvial origin, moderately well to imperfectly drain. Plane, mountainous and rugged topography share about 40.9%, 32.5% and 20.6%, respectively. The vast part of the plane land is located in the eastern part of the woreda. This part is low land with relatively wormer climate.

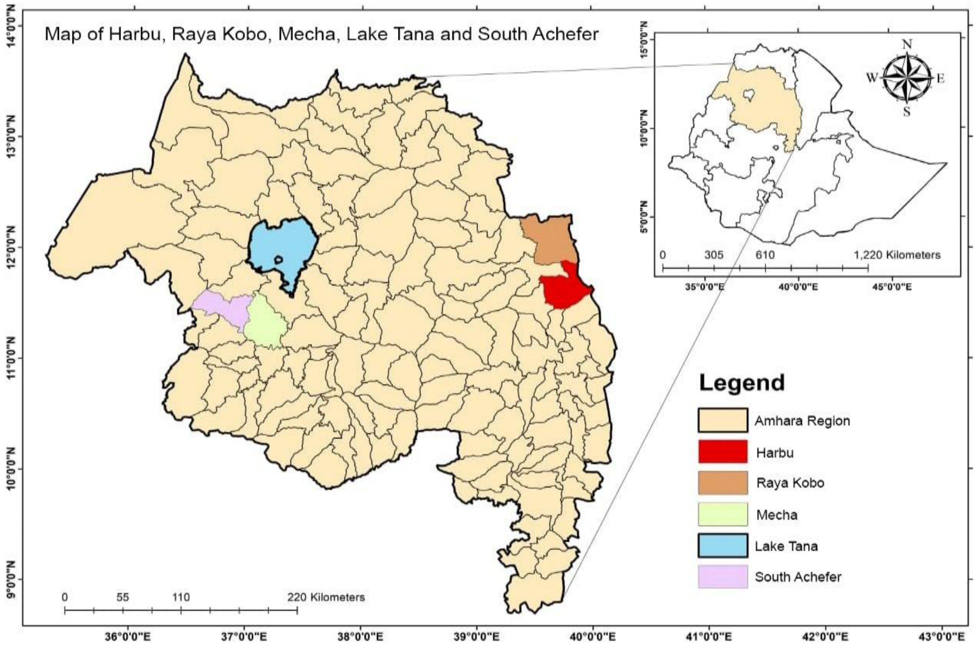
The livelihood of the population is dependent on mixed farming (crop and livestock) with about 85% of its population engaged in agriculture. Due to the various constraints, the woredas are among food insecure woredas of the ANRS (WoA, 2018). The area is characterized by crop dominated mixed farming system. The major crops grown in the area are sorghum, teff, and maize, finger millet, barley and wheat in order of importance. Other major crops are pulses including chickpeas, beans and peas, and oil seeds like sesame under rain fed conditions, whereas teff, maize, onion, mung bean, chickpea, tomato, potato, sugar cane and different fruit trees are grown under irrigated conditions. The most commonly and largely cultivated fruits are guava, orange, banana, papaya, mango, lemon, avocado and Tirengo (Citron medica). A significant portion of the area is unsuitable for annual crop cultivation due to the rugged topography, moisture stress and high soil degradation (ANRS, 2018). The total cultivated land of the woredas is 76155 ha out of which irrigated land is 9285.18 ha which is about 12.2% of the woreda cultivated land moreover 37% of the households are estimated to be oxen-less. (WOA, 2019).

3.1.2 North Mecha and South Achefer Woredas

The other study areas are North Mecha and South Achefer woredas of West Gojjam zone where the irrigation schemes in Koga irrigation development program is found. The woredas are located about 40-60 km from the regional city Bahir Dar in the direction of west. Based on WoA (2019), the total population of the woredas is about 539,015 of whom 271,150 are male and 267,865 females. With an area of 3663.92 square kilometers, the woredas have a population density of 147.11 per square kilometer, which is less than the Zone average of 158.25 persons per square kilometer. The woredas have a crop-livestock mixed farming system. They are located in the highlands at an altitude of 1,900 to 3,200 m.a.s.l. The mean annual rainfall recorded in the area is 1480-1522 mm with mean monthly temperature of 23.8-25.8°c. The total cultivated land is 71719.5 ha out of which irrigated land is 37551.92 ha.

The agro-climatic feature of the woreda is inclined to be inter-tropical convergence with 34.9%, 62.1% and 13% of it is Dega, Woina Dega and Kolla, respectively. Red soil is the dominant soil type in the area which accounts 98% while black soil accounts only 2% (Anteneh and Birhanu, 2012). The soil type is Nitosol enclosed by plain lowlands and some steep side hills and drains to Blue Nile River Basin. The major crops grown in the area are maize, finger millet, barley, wheat and teff under rain fed conditions, whereas wheat, maize, barley, onion, potato, garlic, cabbage, tomato, pepper and different fruit trees are grown under irrigated conditions. The livelihood of the population is dependent on mixed farming (crop and livestock) with about 85% of its population engaged in agriculture. The two woredas of West Gojjam are the food secured woredas of the ANRS (WoA, 2019).

Figure 2: Map of the study areas



Source: Ethiopian GIS Unit 2020

3.2 Selection of Respondents

Multi-stage random sampling technique is adopted for this study. First, two zones of the Amhara region are selected purposively based on the availability of irrigation schemes and their representativeness of the western high rain fall and eastern low rain fall areas of the region. The selected zones are North Wollo from eastern part and West Gojjam from western part of the region. In the second stage, two woredas (districts) from each zone are selected randomly. Habru and Raya Kobo are selected from North Wollo zone whereas; North Mecha and South Achefer are selected from West Gojjam zone of the region. In the third stage, representative kebeles (irrigation schemes) are randomly selected from each woreda. Finally 544 respondent households are selected based on the proportionate probability sampling techniques. Therefore, results are based on a survey of 544 households and all plots operated by the households, and 32 communities (schemes) in the selected four woredas in 2018/19 annual crop based farming systems of the region, thought to represent the major annual crop production systems in the region in terms of agricultural and market infrastructure characteristics, and irrigation accessibility.

To determine the sample size, the formula given by (Kothari, 2004) was used as follows:

$$n = \frac{Z^2PqN}{e^2(N-1)+Z^2Pq} = \frac{(1.96)^2(0.5)(0.5)*17990}{(0.04)^2*17990+(1.96)^2(0.5)(0.5)} = 580$$

Where, n is the sample size; Z is the standard cumulative distribution that corresponds to the level of confidence with the value of 1.96; the value for Z is found in statistical tables which contain the area under the normal curve. e is desired level of precision; p is the estimated proportion of an attribute present in the population with the value of 0.5 as suggested by Israel (1992) to get the desired minimum sample size of households at 95% confidence level and ± 4% precision; q=1-p; p for member of irrigation users, 1-p for non-members and N is the size of the total population from which the sample is drawn.

Table 2: Distribution of the sample in districts, scheme and households

Sample woredas	**Scheme users**		**Sample Kebeles / Scheme**	**Kebele sample households**		
	Total	**Sample**		**Total**	**Sample**	**Male (Female)**
Habru	8650	136	Shafi_Welawele	205	30	20 (10)
			Anto_Kokono	350	44	39 (5)
			Gotu_Waymel	359	38	36 (2)
			Burka_Debdekla	157	24	21 (3)
Raya-Kobo	13105	206	Waja_Golesha_uplow	2715	67	55 (12)
			Hormat_Golina_upper	3344	90	84 (6)
			Hormat_Golina_middle	1022	25	22 (3)
			Hormat_Golina_lower	1002	24	17 (7)
North Mecha	8526	133	Kudimi_Chihona	3420	59	49 (10)
			Adibera_Enguti	1520	26	20 (6)
			Telta_Tekledib	2753	48	41 (7)
South Achefer	4388	69	Kilti_Branti	380	30	26 (4)
			Ashar_Dingrsi	418	24	18 (6)
			Lalibela_Dinbelal	345	15	12 (3)
Total	34669	544		17990	544	460 (84)

Source: North Wollo and West Gojjam Zones Office of Agriculture, 2019.

3.3 Methods of Data Collection

The study is conducted based on data obtained from primary and secondary sources. Face-to-face personal interviews using semi-structured questionnaire is employed to collect primary data. Both open and close-ended types of questions are included in the questionnaire to collect information pertinent to the purpose of the study.

3.4 Model specification and Estimation

3.4.1 Extent of agricultural commercialization

Following von Braun and Kennedy (1994), it is possible to compute household crop output market participation in annual crops as the proportion of the value of crop sales to total value of crop production, which we refer to in this paper as crop-output market participation (COMP) index, computed as depicted in equation 1:

$$COMP_i = \frac{\sum \bar{P}_k S_{ik}}{\sum \bar{P}_k Q_{ik}} \qquad \textbf{(1)}$$

Where: Sikis quantity of output k sold by household i evaluated at an average district (community) level price ($\bar{P}_k$), Q ik is total quantity of output k produced by household i.

Unlike a number of previous studies, our dependent variable is constructed on the basis of the aggregate values of all the ten crops considered in our study. Moreover, crops are categorized as cereal, horticulture and pulse for easiness of analysis. According to(Heltberg and Tarp, 2002), such an approach maximizes the use of available information. Moreover, it facilitates substitution among crops due to some exogenous variables that may increase participation in the sale of an individual crop at the expense of another.

3.4.2 Determinants of commercialization

Fractional outcome regression models (fractional response models and beta regression) are applicable if the dependent variable is explained in the form of fractions, proportions, rates, probabilities, and indices (Baum, 2008). Fractional response models and the beta regression model capture nonlinear relationships between the fractional outcome variable and exogenous variables. Additionally, the models are used to avoid model misspecification and dubious statistical validity. For instance, fractional response models are appropriate when the outcome variable includes zero, values between zero and one, and one itself unlike the beta regression model, i.e., $0<y<1$ (Baum, 2008).

For household participation in crop output market as seller, and the household participation in crop input markets as buyer, to identify determinants of participation, fractional probit must be used since the non-participant are small in number and two-limit Tobit model for intensity of participation, since these variables are lower censored at zero and upper censored at one. To address the objective of factors that affect the level of participation in the market. Preferably, the OLS model is applicable when all households participate in the market but in reality not all households participate. Some households may not prefer to participate in a particular market in favor of another, while others may be excluded by market conditions. If the OLS regression is estimated excluding the non-participants from the analysis, a sample selectivity bias is introduced into a model. Such a problem is managed by following a two-stage procedure as suggested by (Heckman, 1979) or Tobit procedures. These procedures have been discussed broadly in (Tobin, 1958), (Greene, 1997)

The general specification defining Tobit model is specified in matrix notation as follows (eq. 2):

$$y_i = \beta' x_i + \varepsilon_i \qquad \textbf{(2)}$$

Where: y_i* = is a latent variable, which is unobserved for values less than 0 and greater than 1 that representing subsistence or fully commercial index;
x_i= is vector of independent variables, which includes factors affecting market participation and level of commercialization;
β = is vector of unknown parameters to be estimated;
ε_i= is a disturbance term assumed to be normally distributed with zero mean and constant variance σ2; and i = 1, 2, 3... n (n = the number of observation).

Given the observed dependent variable commercialization index (y_i), Tobit model is specified in Equation 3 as:

$$y_i = \begin{cases} y^* \; if \;\; 0 < y^* < 1 \\ \;\; 0 \;\; if \;\; {y_i}^* \leq 0 \end{cases} \qquad \textbf{(3)}$$

The advantage of the Tobit model as in Equation (3) is that it captures the decision to participate as well as the resulting outcome extent of commercialization, whereas a fractional probit model provide information on the decision to participate only.

The Tobit model is estimated using maximum likelihood estimations. The log likelihood (LL) of the model is specified in Equation 4 as:

$$ln\ L = ln\left(\coprod_{y_i>0} f(y_i) \coprod_{y_i=0} F(0)\right) = \left(\sum_{y_i>0} ln\ f(y_i) \sum_{y_i=0} ln\ F(0)\right) \quad \textbf{(4)}$$

Since y* is assumed to be normally distributed as error terms are assumed to be normally distributed, f(.), F(.) and hence the log likelihood functions can be written in the form of density function and cumulative density function of the standard normal distribution as: Ø(.) and Φ(.) and the log likelihood function is rewritten as follows (eq.5):

$$ln\ L = \sum_{y_i>0}\left(\left(-ln\ \sigma + ln\ \emptyset\left(\frac{y_i - x_i\beta}{\sigma}\right)\right) + \sum_{y_i} ln\ \left(1 - \emptyset\left(\frac{x_i\beta}{\sigma}\right)\right)\right) \quad \textbf{(5)}$$

However, the Tobit coefficients cannot be interpreted directly as estimates of the magnitude of marginal effects of changes in the explanatory variables on the expected value of the dependent variable, because there are three main conditional expectations of interest in the Tobit model. These are the conditional expectation of the underlying latent variable (y^*); the conditional expectation of the observed dependent variable (y); and the conditional expectations of the uncensored observed dependent variable ($y/y > 0$). Following (McDonald and Moffitt, 1980; Greene, 1997;(Johnston & Dinardo, 1997) the marginal effects of these conditional expectations, respectively are given as:

$$\frac{\partial E(\frac{y^*}{x})}{\partial x} = \beta \quad \textbf{(6)}$$

$$\frac{\partial E(\frac{y}{x})}{\partial x} = \beta\emptyset\left(\frac{x\beta}{\sigma}\right) \quad \textbf{(7)}$$

$$\frac{\partial\ Pr(y > \frac{0}{x})}{\partial x} = \emptyset\left(\frac{x\beta}{\sigma}\right)\frac{\beta}{\sigma} \quad \textbf{(8)}$$

The interpretations of these marginal effects depend on the point of interest based on the focus of the study (Greene, 2003).

4. Result and Discussion

4.1. Descriptive Statistics

4.1.1 Household demographic and socioeconomic characteristics

The summary of the statistics for the variables considered in the study are given in Tables 1 and 2 below. About 15.44% of households in the sample are female headed. About 55% of household heads are literate. The average household size is about 5.54 persons, with an average family labor supply of 3.3 persons per household. The mean age and education level of the sample households are about 43.25 years and grade 2.89 respectively. The average livestock owned is about 4.87 TLU. Most of the sample households (92.65%) have access to extension services while about 31.3% of them have access to credit service in 2018/19 cropping season. On average, the sample households walk about 76.62 min (nearly about 7 km distance) to reach the market of input and output in the study area.

The results have also revealed that about 97% of the sample's households have participated in food crop sales. However, on average 65% of the annual crop produced is marketed as measured by the crop market participation index, indicating high (sufficient) market participation on average. The average value of annual crop produced and sold per household are ETB 97148 and 63562 respectively. On average, a household cultivates about 1.55 ha of land being the minimum 0.1375 ha and maximum 4.775 ha.

4.1.2 Commercialization index

Appendix Table 1 displays the summary statistics of crop commercialization by district. The result has shown that the average value of the overall sample household output commercialization index of crop producers is 0.6483 (64.83%) with the highest and lowest in north Mecha (0.7501) and Habru (0.5643) districts, respectively. This level of market participation is higher than the national average reported to have been 52% (ATA, 2016).

Since vegetables are relatively less prevalent in the food basket consumed and primarily produced to be used as a source of cash for the households to meet extra cash needs for expenses such as children's school fee, medical expenses, and other household social obligations. Moreover, cereal and pulse crops produced in irrigation season are target for the market as a source of cash. The survey result has shown that the farm households' crop output commercialization index fall in commercial level. The result has also indicated that 3.31% of the overall sample households have commercialization index of zero value indicating that they are fully subsistence in terms of crop production and marketing. However, there is a great variation in the proportion of subsistence farmers in terms of specific crop among districts with the highest and lowest in Habru (34.56%) and north Mecha (2.26%), respectively (see Appendix Table 1).

The result has also revealed that most of the commercialization index (74.45%) falls above 50% commercialization index while the least (6.8%) falls below 25%.The majority (77.8%) of farmers are categorized as commercial (highly commercialized) farmers, whereas transitory (moderately commercialized) and subsistence (non-commercialized) farmers constituted 15.4% and 6.8% of the total farm households respectively, implying that in general farm households sell more than 50 percent of their output.

Table 3: Descriptive statistics of some dummy variables used in the regression analysis

Variables	Response	WUA Member	WUA Non-member	Pooled	χ2-value
Output_Market_participation	Yes	247 (99.19%)	279 (94.58%)	526 (96.69%)	9.01***
	No	2 (0.81%)	16 (5.42%)	18 (3.31%)	
Educ_status	Illiterate	101 (40.56%)	146 (49.49%)	247 (45.4%)	4.343***
	Literate	148 (59.44%)	149 (50.51%)	297 (54.6%)	
Sex_hh	Female	28 (11.24%)	56 (18.98%)	84 (15.44%)	6.192**
	Male	221 (88.76%)	239(81.02%)	460 (84.56%)	
Admin_member	No	135 (54.22%)	195 (66.10%)	330 (60.66%)	7.99***
	Yes	114 (45.78%)	100 (33.90%)	214 (39.34%)	
Multipurp_coop_member	No	69 (27.71%)	103 (34.91%)	172 (31.62%)	3.24*
	Yes	180 (72.29%)	192 (65.09%)	372 (68.38%)	
Animal_scotch_cart	No	78 (40.42%)	221 (71.21%)	299 (54.96%)	103.65***
	Yes	171 (59.58%)	74 (28.79%)	245 (45.04%)	
Pack_animals_ ownership	No	161 (64.66%)	242 (82.03%)	403 (74.08%)	21.23***
	Yes	88 (35.34%)	53 (17.97%)	141 (25.92%)	
Observation (N)		287	257	544	

***, **, and * indicates significant at the probability level of 1%, 5% and 10% respectively.
Source: Author's computation from sample survey data (2019).

Table 4: Descriptive statistics of continuous variables used in the Tobit regression analysis

Variables	Description	WUA Member		WUA Non-member		Pooled		t-value
		Mean	SD	Mean	SD	Mean	SD	
Commercialization index	Extent of market participation in percent ranging from 0 to 100	67.77	20.48	62.34	23.92	64.83	22.56	-2.81***
Value of crop produced	Total value of crop produced measured ETB# per household	104138.5	72114.4	91245	71194	97146.74	71838.76	-2.09**
Value of crop sold	Total value of crop sold measured ETB per household	69628.77	51992.3	58441	56707	63561.81	54834.46	-2.38**
Age_hh	Age of the household head in years	43.22	10.26	43.26	11.39	43.25	10.88	0.04
Educ_level_formal	Formal education level of the household head	3.26	3.39	2.56	3.16	2.882	3.287	-2.51**
Dist_main_market	Distance to the nearest market in min.	93.68	51.8	73.51	55.41	82.75	54.67	-4.36***
Dist_town	Distance to the nearest town in min.	79.87	51.94	73.87	55.31	76.62	53.83	-1.29
Crop_income_AE	Total crop income per AE in ETB	16509.16	10836.14	14817.77	10341.08	15591.95	10594.37	-1.86*
Total_income_AE	Total income in ETB per AE	22059.48	13023.02	20146.79	13445.04	21022.27	13257.7	-1.68*
TLU	Total livestock owned	5.29	2.22	4.51	2.805	4.869	2.583	-3.01***
Family_size_number	Family size in number	5.795	1.99	5.332	1.795	5.54	1.9	-2.85***
Share_offfarm_income	Share of off-farm income to total income	6.044	11.76	8.662	13.645	7.464	12.872	2.373**
Observation (N)		287		257		544		

***, **, and * indicates significant at the probability level of 1%, 5% and 10% respectively. ETB# is roughly equivalent to 0.033 USD in March 2019.

Source: Author's computation from sample survey data (2019).

4.2 Econometric Analysis

Before the interpretation of model coefficients, better to test some the assumption of CLR model should hold true. Hence, multicollinearity, hetroscedasticity and model specification error test (test for omitted variables) are performed using appropriate statistical tests. VIF was employed to test the existence of mulitikcollineratity among explanatory variables and the result showed that the mean VIF was 1.86 which indicates no problem of multicollinarity among explanatory variables in the model. Breusch Pagan/Cook-Weisberg test for heteroscedasticity is used and the result indicated that heteroscedasticity is a problem. Furthermore, regression specification error test, test of omitted variables result showed that there exist omitted variables in the model. Hence, fractional probit model has been employed to analyze market participation decision and tobit model to identify determinants of intensity of crop market participation (see Appendix Table 2).

4.2.1 Determinants of crop output market participation and commercialization

Fractional probit model has been employed to estimate the likelihood of crop output market participation and factors affecting market participation of smallholder farm households in the study area. Table 4 column 2 reports the results of our econometric analysis. The results of the fractional probit model depicts that the factors that affect the likelihood of farm households' output market participation is positively influenced by distance to nearest town, share of crop income, total livestock number, agricultural cooperative membership and proportion of irrigated land. It is also negatively influenced by age of the head, distance to the nearest market, irrigation farming experience and location.

Econometric analysis of factors affecting the extent of crop market participation is specified and modeled using two-limit Tobit model and the results from this estimation are depicted in Table 5 column 3. Ten variables among nineteen tested variables are found to affect commercialization are age of the household head, distance to the nearest main market in minutes of walk, distance to the nearest town in minutes of walk, experience in irrigation farming, agricultural marketing cooperative membership, member of water users association, share of crop income, total tropical livestock units, proportion of irrigated area and location. The marginal effect result is depicted in Table 5.

Age of head affect both the probability and extent of crop output market participation negatively and significantly at less than 5 percent significance level. The marginal effect result show that as age increase by one year, both the probability and extent of output market participation decrease by 0.22%. Aged households are less likely to participate in the crop output market because younger household heads tend to have better ability to obtain, process and use market information compared to older ones. The negative and significant relationship between the two variables indicates that older households tend to have more dependents causing more consumption, hence lowering both probability of crop output market participation and extent of participation. The finding implies that older farmers might be more concerned about being food secured than engage in the markets. The result is in agreement with the findings of (Taye et al. 2018; Edosa, 2018; Abafita et al. 2016; Demeke and Jema, 2014) who found out that younger people participate more than older people do in marketing.

Distance to the nearest main market in minutes of walk is found to be significantly and negatively affecting both the likelihood and extent of market participation at 1 percent significance level. The marginal effect result has revealed that as the distance to the market in minutes of walk increases by one more minute, both the likelihood to sell their output to the market and the extent of participation decreased by 0.06%. The closer the smallholder farmers are to the output market, the higher the crop commercialization level due to better information access on the dynamics of market forces and reduced transportation costs. The findings by Barrett (2007); Gebre et al. (2015); Yalew (2016); Alelign et al. (2017); and Tadele et al. (2017) indicated that market distance had a negative and significant effect on commercialization, consistent with the result of the study.

Distance to the nearest town in minutes of walk is also found to be significantly and positively affecting both the likelihood and the extent of market participation at 10 percent significance level. The marginal effect has revealed that as the distance to the town in minutes of walk increases by one more minute, both the probability and extent of crop output market participation increase by 0.03%. The possible explanation for this unexpected result is that those near to town have multiple options for nonfarm activities to earn income and reduce their interest to supply more to the market. This result is in line with the finding by Taye et al. (2018) while contradicting with Pender and Dawit (2007); (John et al, 2009); Solomon et al. (2010).

Experience in irrigation farming is found to be statistically significant and negatively affect both the probability and extent of market participation at 10 percent significance level. The marginal effect has depicted that as the experience in irrigation farming increases by one year, the probability and extent of market participation decreases by 0.25% and 0.26% respectively. The probable reason for the negative relationship is due to the fact that older farmers (more experienced household heads) might be more concerned about being food secured and would not want to take the risk of demanding their crop banks. On the contrary, younger household heads would engage in the markets and probably they are more dynamic to adopt new technologies that enhance productivity. This result is in congruent line with the finding reported by Alelign et al. (2017) and in contrary to previous studies by Yalew (2016) and Aman et al. (2014).

Membership in water users association has influenced both the probability and extent of crop output market participation positively at 10 percent significance level. The marginal effect result has revealed that for households being member of WUA, both the probability and extent of market participation increases by 3.22%. The result suggests that WUA membership has contributed to the practice of more productive technologies, trainings related to irrigation water management and choice of profitable crop. This result is similar to the findings of (Rehima et al. 2013; Stephen et al. 2017; Assefa et al. 2019).

Share of crop income is another important variable that affect both the likelihood and extent of crop output market participation positively and significantly at 1 percent significance level. The marginal effect result shows that an increase in share of crop income by one percent, the probability and extent of crop output market participation increases by 0.25% and 0.26% respectively. The result is in line with the findings reported by Kumilachew (2016).

Livestock ownership measured in TLU has significantly and positively affect both market participation and commercialization at 5 percent significance level. The marginal effect result shows that an increase in livestock owned by one TLU, the probability and extent of crop output market participation increases by 0.84% and 0.89% respectively. This is due to the fact that livestock and crop production is usually considered as complementary enterprises in that livestock can positively contribute to crop production by providing natural fertilizer, oxen used for traction power and source of cash to finance purchased inputs such as seed, fertilizer and agrochemicals. Therefore, livestock ownership has a positive effect on crop production explicitly and on commercialization implicitly. The study result is in conformity with the findings of Habtamu (2013); Degye (2013); Aman et al. (2014); Tadele et al. (2017) and Taye et al. (2018).

Agricultural marketing cooperative membership has influenced both the probability and extent of crop output market participation positively at less than 5 percent significance level. The marginal effect result has revealed that for households who are members of the marketing cooperative, the likelihood to sell their output to the market and the extent of market participation increased by 5.44% and 5.49% respectively. The result suggests that marketing cooperative membership has contributed to the practice of crop output market participation via its advantage of obtaining better information access and credit services. The finding is consistent with that of (Rehima et al. 2013; Stephen et al. 2017; Assefa et al. 2019).

Proportion of irrigated area: As the size of irrigated land holding increases, both the probability and extent of household participation in crop output market as a seller increases significantly at less than 1 percent significance level. The marginal effect has revealed that as proportion of irrigated land increases by a unit, the probability and extent of market participation increases by 0.19% and 0.18% respectively. This may reflect the fact that farm households with sufficiently large irrigated land holdings give priority to market oriented crop production that could produce more marketable surplus. This result is in agreement with the finding reported by Samuel and Sharp (2007); Mebrahatom (2014); and Taye et al. (2018) which show that proportion of land allocated for specific crop production positively affected marketable surplus of outputs.

Location affects both the likelihood and extent of market participation negatively and significantly at less than 1% significance level. The household being in the eastern part of Amhara, the probability and extent of market participation decreases by 18.74% and 20.51% respectively. The explanation for this relationship could be due to the fact that households residing in eastern part of the region have relatively smaller land holding size than that of the western part of the region. Moreover, there is low level of production compared to western part and this is may be due to the difference in topography, soil fertility, and access to markets, access to infrastructures and difference in socio-economic characteristics of the study areas. Hence, much of their production could be allocated for their own consumption. The result is in line with the findings of Gebreselassie and Sharp (2008); Tadele et al. (2017); Taye et al. (2018) and (Hellen et al, 2020) have shown that difference in location and agroecology led to difference in level of market participation.

Table 5: Parameter estimates of determinants of crop output commercialization regression results

Crop market participation/ Commercialization	Fractional probit		Tobit			
	Coef. (S.E)	dy/dx	Coef. (S.E)	$\partial E(y*/ \partial($	$\partial E(y/y_i > / \partial(x_i)$	$\partial P(y > 0/ \partial(x_i)$
Sex_ head	0.0507 (0.0635)	0.0188 (0.0237)	0.0198 (0.0238)	0.0198 (0.0238)	0.0197 (0.0236)	0.0002 (0.0003)
Age_ head	-0.0055** (0.0025)	-0.002** (0.0009)	-0.002** (0.0009)	-0.002** (0.0009)	-0.0019** (0.0009)	-0.00002* (0.00001)
Literacy_ status	-0.0439 (0.0513)	-0.0161 (0.0188)	-0.0159 (0.0191)	-0.0159 (0.0191)	-0.0158 (0.019)	-0.0002 (0.00022)
Family_ size_ AE	-0.0116 (0.0154)	-0.0043 (0.0057)	-0.0038 (0.0056)	-0.0038 (0.0056)	-0.0037 (0.0056)	-0.00004 (0.00007)
Dist. nearest main market in min.	-0.0017*** (0.0005)	-0.0006*** (0.0002)	-0.0006*** (0.0002)	-0.0006*** (0.0002)	-0.0006*** (0.0002)	-0.00007* (0.00004)
Distance to nearest town in min.	0.001* (0.0005)	0.0003* (0.0002)	0.0003* (0.0002)	0.00033* (0.00019)	0.00033* (0.0002)	0.00004 (0.00003)
Distance to ECX in km	0.0007 (0.0008)	0.0002 (0.0003)	0.0003 (0.0003)	0.0003 (0.0003)	0.0003 (0.0003)	0.000034 (0.00004)
Irrigation experience	-0.0069* (0.0038)	-0.0026* (0.0014)	-0.0026* (0.0015)	-0.0026* (0.0015)	-0.0026* (0.0015)	-0.00003 (0.00002)
Land_ fragmentation_ index	-0.0998 (0.1859)	-0.0368 (0.0685)	-0.0333 (0.0661)	-0.0333 (0.0661)	-0.0331 (0.0656)	-0.0004 (0.0007)
Share_ crop	0.0069*** (0.0016)	0.0025*** (0.0006)	0.0026*** (0.0006)	0.0026*** (0.0006)	0.0025*** (0.0006)	0.00003* (0.00002)
Share_ off-farm	0.0018 (0.0024)	0.0006 (0.0009)	0.0006 (0.0009)	0.0006 (0.0009)	0.0006 (0.0009)	0.000006 (0.00001)
Total_ TLU	0.0228** (0.0106)	0.0084** (0.0039)	0.0089** (0.0039)	0.0089** (0.0039)	0.0089** (0.0039)	0.00009 (0.00006)
WUA_ member	-0.0046 (0.0509)	-0.0017 (0.0187)	-0.0019 (0.0185)	-0.0019 (0.0185)	-0.032* (0.0182)	-0.0003 (0.00026)
Agri_ marketing_ coop_ member	0.1517** (0.0757)	0.0544** (0.0263)	0.0529** (0.0255)	0.0529** (0.0255)	0.0526** (0.0254)	0.0004* (0.0002)
Extension_ advisory_ services	0.1093 (0.1009)	0.0409 (0.0384)	0.0457 (0.0407)	0.0457 (0.0407)	0.0453 (0.0401)	0.0007 (0.0009)
Log_ off-farm_ income	-0.0049 (0.0043)	-0.0018 (0.0016)	-0.0018 (0.0017)	-0.0018 (0.0017)	-0.0018 (0.0017)	-0.00002 (0.00002)
Rentsharein_ land	-0.0026 (0.0119)	-0.0009 (0.0044)	-0.0009 (0.0045)	-0.0009 (0.0045)	-0.0009 (0.0044)	-0.00001 (0.00005)
Prop_irrigated_land	0.0057*** (0.001)	0.0019*** (0.0004)	0.0018*** (0.0004)	0.0019*** (0.0004)	0.0019*** (0.0004)	0.00002** (0.00001)
Location_eastern	-0.5562*** (0.1362)	-0.1874*** (0.0453)	-0.2065*** (0.0506)	-0.2065*** (0.0506)	-0.2051*** (0.0501)	-0.0022* (0.0013)
_cons	0.0389 (0.2369)	-	0.5026*** (0.0900)	-	-	-
/sigma	-	-	0.2004*** (0.0078)	-	-	-

Note: ***=p<0.01; ** =p<0.05; *=p<0.1; Pseudo R2 = 9.55%

Source: Model result from sample survey data (2019).

5. Conclusion and Recommendations

5.1 Conclusion

The results from the descriptive analysis have revealed that 64.83% of the crop produce is sold. The majority of farmers 77.76% are categorized as commercialized farmers whereas 15.44% and 6.8% are semi-commercialized and subsistence farmers, respectively. Besides, the average commercialization index of each category of crops in the study areas is estimated. The result has indicated that the average commercialization index of horticultural, cereal and pulse crops are 0.95, 0.43 and 0.59 of the total production respectively. The result has indicated that all crops produced in the study areas during irrigation season could contribute to household commercialization.

In the study areas internal and external factors contribute to the likelihood of output market participation and commercialization. Hence, among the factors age of household head, distance from the market place, distance from the nearest town, experience in irrigation farming, share of crop income, livestock ownership measured in TLU, membership in water users association, membership in marketing cooperative, proportion of irrigated land, and location are significantly influencing crop output market participation and commercialization among smallholder crop producers.

Irrigation is expected to lead to changes in crop mix (cash crop orientation) and crop-switching involves substituting low yielding and low profitable crops with new high-yielding and more profitable crops. Implicitly this implies switching from the subsistence production to the market-oriented production. Therefore, the findings of the study indicate that an attempt to increase smallholder farmers' participation in the output market should give special attention to significant explanatory variables.

5.2 Recommendations

Based on the findings, the following recommendations and policy implications are forwarded.

Membership in WUA and marketing cooperative increase crop output market participation and commercialization via its advantage of obtaining better information access and credit services. Consequently, an effort has to be done to organize farmers in the stated institutions so as to get the advantage accordingly. Moreover, distance from the nearest market negatively affects smallholder farmers' crop output commercialization. Hence, crop output commercialization should be improved by investing on necessary facilities like market access, market infrastructure, road, and transportation service.

Land size allocated to irrigated crop production has a positive effect on crop output market commercialization. As a result, land productivity-enhancing technologies should be designed and implemented. Since land resources are limited in the study area, output-output production based education, training, and extension service should be executed to increase land productivity to rise smallholder farmers' participation in the output market.

Hence, to enable smallholder's participation and commercialization in crop output marketing government interventions is needed in strengthening institutional service, skill and experience and infrastructure facilities. Thus, policies to address these factors are called for.

Finally there are unobservable site specific effects that influence market participation and commercialization decisions. Identification of the most important village level effects requires further inquiry. Moreover, it is essential to have further study on the extent and nature of market oriented production under irrigated systems in contrast to rain-fed systems.

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Consumer Preferences on Imported and Domestic Wooden Furniture in Addis Ababa, Ethiopia

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Abstract

In recent decades, wooden furniture production and marketing is increasing rapidly in Ethiopia. However, with changing consumer tastes and preferences coupled with market globalization, domestic enterprises are facing increasing competition from imports. While wooden furniture production technology is improving in Ethiopia, more needs to be done to address the evolving dynamics in public preference and taste while overcoming the pressure from the import market. However, the wooden furniture sector in Ethiopia is scarcely researched and documented to support the production and marketing system. Therefore, this study investigates consumer preferences on imported and domestic wooden furniture in Addis Ababa, Ethiopia. Multi-stage sampling was used to select the sample size of 385 consumers who purchased wooden furniture. Data were collected using a household survey with a structured questionnaire and analyzed through descriptive statistics, Kendall's test, and Multivariate Probit (MVP) model by using STATA software. The findings showed that imported wooden furniture are higher in terms of finishing, outlook, color, compatibility with other objects, and design; whereas, domestic wooden furniture are superior in terms of durability, environmental friendliness, maintainability, and affordability. MVP results also showed that preference of domestic wooden furniture found a substitution for imported plus domestic wooden furniture products. The findings also show that consumer preferences for wooden furniture products were influenced by age, number of years in marriage, family size, number of years living in the city, occupation, and advertisement. The study, therefore, recommended that domestic furniture companies need to improve the finishing, design, outlook, color, styles, and other desirable attributes of their products to attract and satisfy domestic

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demand and preferences for substituting importation by focusing on the improvements of multiple attributes. In addition, furniture companies should consider different socio-economic characteristics of consumers during the production of their furniture products to satisfy diversified needs.

Keywords: Consumer**,** furniture, multivariate probit, preference, product attribute, wooden furniture

1. Background of the study

Globalization has opened up forest products business to worldwide trade, a nd it now plays an important part in the global economy (Nguyen, 2016). Nowadays, among forest products, trade in the production and consumption of wood products around the world is growing rapidly (Sasikumar, 2019). This is due to increasing furniture demand, population growth, evolution of new furniture models, and individual taste and preferences (Adu-Sarpong, 2017). Population coupled with a boom in modern housing, an increase of household income, and an emergence of cottage industry has brought a continuing demand of households for quality furniture (Kumburu & Kessy, 2018**)**. In a market environment that is constantly changing, understanding customer purchasing behavior is crucial for companies to operate successfully and efficiently (Pirc Barčić et al., 2021). Understanding consumer behavior is considered the cornerstone for successful marketing, reliable production management, and the successful research and development activities (Khojasteh-Khosro *et al*., 2020; Pirc Barčić *et al*., 2021).

Compared to the past, consumers of the present time have a better and wide variety of product choices from around the world due to the decreasing trade barriers, and the digitization of the world economy (Amanfo *et al*., 2014; Sasikumar, 2019). The shift of consumer demand, preference, and retention are global issues that affect all organizations, be it large or small, global or local (Shah, 2007). As a result of high demand and competition, furniture industrialists worldwide are operating under firm competition in the attempt to own the largest share in the market to serve the high demand (Jošt *et al*., 2020). Hence, currently, the situation in the international market forces countries to focus on developing and facilitating the growth of the local market since the domestic market is seen as a root for economic growth (Chanjarika, 2013; Jošt *et al*., 2020). In developed parts of the world, the majority of furniture producing firms have begun to emphasize innovative consumer-oriented furniture product designs as a strategy of maintaining a reasonably big percentage of satisfied consumers (Nirmal *et al*., 2018).

In African countries, the production and consumption of furniture products have grown over the years. However, they have not been with the good trend of the global production growth and have been facing a severe struggle for survival in a less dynamic domestic consumer market (Adu-Sarpong, 2017). Consumers have been exposed to foreign alternatives for domestic-made products and foreign products due to the increase in imported products and highly competitive consumers' markets in Africa (Robert & Patrick, 2009). Chinese and Malaysian furniture are of much quantity in the domestic market of most African countries and other developing world more than domestically produced furniture (Kumburu & Kessy, 2018). Like other African countries, East African countries imported furniture products from outside of Africa (ITTO, 2016). Ethiopia with a trade value of USD 43 million has emerged as the largest importer among East African countries (ITTO, 2016).

The demand for wooden furniture products from Ethiopia is met by both local manufacturers and imported products from abroad (Birhan, 2014). The country imported large amounts of a variety of furniture products from other countries and its import-export trade balance indicated that the import is greater than its export (Birhan, 2014; Alem, 2016). To increase production and fill the growing furniture demand, the government of Ethiopia has recognized small and microenterprises as remedy (SMEs). These enterprises are one of the Growth and Transformation Plan (GTP, 2016) strategies to enhance wealth creation, expansion of employment opportunities and import substitution (Drbie & Kassahun, 2013; Gutu & Yali, 2020).

However, currently, where the competition is far beyond what the market requires, most furniture manufacturing SMEs are not showing improvement in their performance (Cherkos *et al*., 2018). Competition between imported and domestically manufactured furniture is high and this puts a strong pressure on many of the actors in the sector. Furniture manufacturers should understand what determines consumers' preferences and tastes of their wooden furniture if they need to be successful in their business. For example, Kotler and Armstrong (2010) clearly stated that consumer preference is affected by product-specific and non-product-specific factors. Such factors, therefore, need to be identified to get better insight into consumers' needs and wants (Jošt *et al*., 2020). However, many existing studies generally conducted in Ethiopia related to furniture focused on the growth, contribution, and challenges of SMEs engaged in furniture (Drbie & Kassahun, 2013; Birhan, 2014; Tarfasa *et al*., 2016; Cherkos *et al*., 2018).

Therefore, a study on consumers' preferences for imported and domestic wooden furniture is vital to generate information that is helpful to advice policymakers and stakeholders. And also, important to inform the targeting of domestic manufacturers and traders in the process of making them competent in the domestic market as well as international trade by improving their product. Hence, to fill this gap, this study was conducted to evaluate consumers' preferences on imported and domestic wooden furniture and factors affecting their preference.

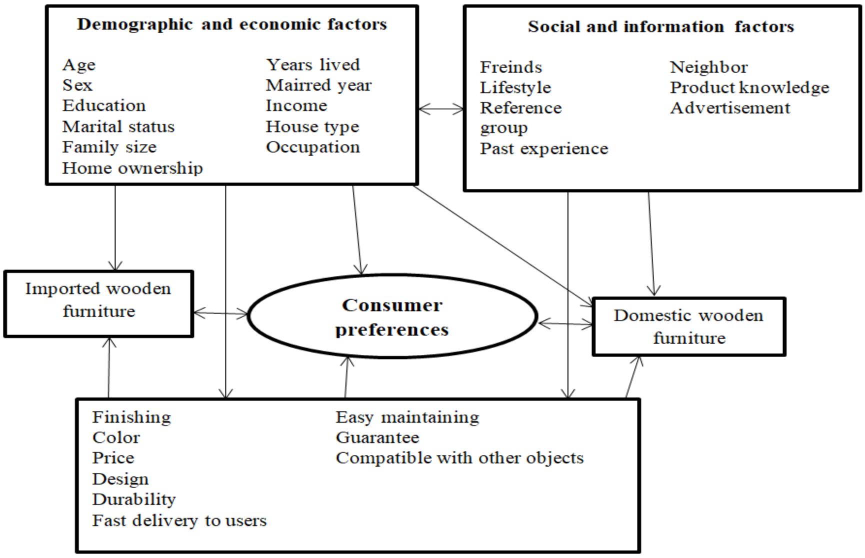
2. Literature Review

2.1 Theoretical Review

The concept of preferences comes from economic theory, which is defined as the individual tastes, as measured by the utility of various bundles of goods. According to Rajpurohit (2011), preferences indicate choices among neutral or more valued options available. Consumer as an important factor in the marketplace has a preference when making a decision. The theory of consumer choice is the branch of microeconomics that relates preferences to consumption expenditures and consumer demand curves. It analyzes how consumers maximize the desirability of their consumption as measured by their choices subject to limitations on their expenditures, by maximizing utility subject to a consumer budget constraint.

Based on the type of utility function, the utility theory assumes that preferences are completely reflexive and transitive (Belton & Stewart, 2002). The preferences are complete if, for any pair of choices A and B, one and only one of the following conditions are fulfilled: A is preferred to B, B is preferred to A or A and B are equally preferred. Board (2009) noted that preferences are said to be reflexive if for any pair of choice, A and B that are identical, then, B is also equally preferred to A. The preferences are said to be transitive if for any three choices A, B, and C; A is preferred over B and B is preferred over C, then, it is concluded that A is preferred over C. The hypothesis on reflexivity and transitivity implies that the furniture consumer is a rational decision-maker. Furniture consumers are assumed to act rationally because they will choose between imported and locally made furniture to maximize total utility. Hence, consumers have to make choices based on preferences. The implication is that the consumer will maximize utility, through preferring either imported or domestic furniture subject to the factors that constrain them.

Figure 1: Conceptual framework of the study



Source: Adapted from (Kumburu & Kessy, 2018)

2.4 Conceptual Framework

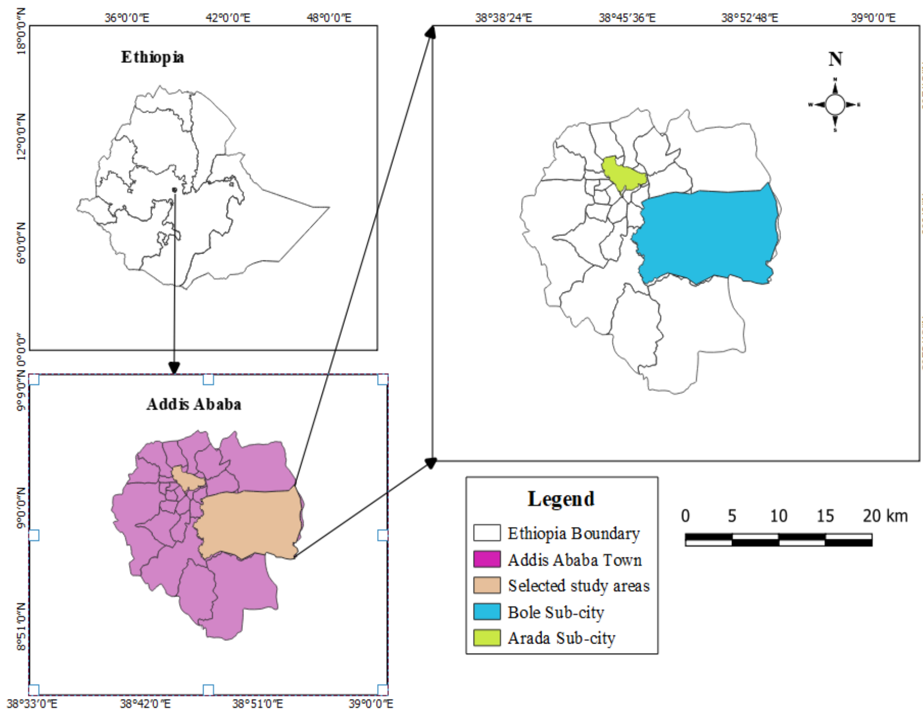
Identifying factors that affect consumer behavior have numerable considerations in previous research. The theory of the expected behavior model is selected as a basic conceptual framework that includes variables based on survey data where perceived behavior controls consumers' purpose to purchase furniture (Xu et al., 2020). This study adopted the theory of consumer behavior with the assumption that consumer choices for products and their attributes are driven by utility derived from consumption subject to budget constraints (Varian, 2010). Hence, consumers prioritize products and their attributes that yield maximum utility. In this study, consumers were presented with imported and domestic-made wooden furniture products and their attributes as shown in Fig1. Consumer preference is affected by different factors (product and non-product attributes). Some scholars noted that consumers assign different values to imported and domestic furniture products based on the tangible differentiating attributes that influence their utility for the products (Kumburu & Kessy, 2018). Therefore, this conceptual framework tries to describe the proposed relationship between the variables (product attributes, socio-demographic factors, social factors) and the variable which is the preference of consumers on imported or domestically-made furniture.

3. Materials and Methods

3.1 Description of Study Area

This study was conducted in Addis Ababa, which serves as a social, economic, and political center for the country. It is found with a rough center located at 8°55'N-9°05'N latitude and 38°35'E-38° 05'E longitude (Sherefa, 2012). The city is situated at a height ranging from 2015 to 3125 meters above sea level (m.a.s.l) with an average mean yearly temperature of 17°C. The total population as of August 2019 is estimated to be 4,592,000 with an annual growth rate of 4.4 % (CSA, 2019). This constitutes approximately 20% of Ethiopia's urban population.

Figure 2: Map of the study area



3.2 Sampling Technique and Sample Size Determination

In this study, a multi-stage sampling technique was employed to achieve the objectives of the study. At the first stage, Addis Ababa city was selected among the major cities in the country. As indicated (in which section?), Addis Ababa city was purposively selected because it is the largest city among the cities of Ethiopia and it is the major destination of imported furniture. Furthermore, the city has a higher level of business activities including furniture, and a large number of furniture manufacturing firms are located in it than in any other city or town in the country (CSA, 2014). According to CSA (2014) data, the city accounts for about 30% of the furniture industries in the entire country, which makes it a good candidate city for the study.

In the second stage, Bole and Arada sub-cities were selected for this study out of ten sub-cities in Addis Ababa. Based on this, Arada sub-city was selected purposively based on representativeness of the center of the city and availability of many domestic wooden furniture products and consumers; whereas, Bole sub-city was selected mainly based on the availability of many imported wooden furniture products exchange, consumers, and expansion of new houses especially the existence of many condominium houses to enhance the representativeness of the consumer. In the third stage, sample consumer households were selected using systematic random sampling. The target population or sample unit of the study comprises imported and domestic household wooden furniture consumers. The targeted consumers were selected purposively targeting consumers who had purchased domestically produced or imported furniture at least in the last 5 years taking into consideration of inflation and the dynamics of consumer behavior (Kizito, 2009).

However, this target population was very large. Thus, the sample size determination method was applied to select representative samples from the total population size. To determine the sample size out of the total population of wooden furniture consumers in the sample Woredas, the researchers followed Cochran's formula. The sample size was determined by using Cochran's formula of calculation from the large population (Chochran, 1977) as follows:

$$n = \frac{Z^2 * (P) * q}{e^2} \qquad \textbf{(1)}$$

$$n = \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2} = \frac{3.8416 * 0.5 * 0.5}{0.0025} = 384.16 = 385$$

Thus, the sample size = 385 consumer households

Where, n is the sample size, Z is the selecting criteria value of desired confidence level (1.96), p is the estimated proportion of an attribute that is present in the population (0.5), q = 0.5(1-p), and e is the desired level of precision (0.05).

Based on the above sample size, proportion sampling was used to determine the sample size from two Woredas.

3.3 Data Sources and Data Collection Methods

Data were collected from both primary and secondary sources. The main primary data sources were imported and domestic wooden household furniture consumers. The primary data included socio-economic variables, wooden furniture attributes, perception of consumers on furniture attributes, and types of wooden household furniture purchased from imported and domestically produced furniture shops. The secondary data were collected from academic journals, books, articles, and reports which were related to consumer preferences.

The major instrument employed for primary data collection was the questionnaire. Data from both imported and domestic wooden household furniture consumers were collected using structured questionnaires, through face-to-face interviews, and key informant interviews. Based on Fisher's view of a structured questionnaire, close-ended questions were employed. If the researcher wants to quantify the research material, then, it is best to use a structured approach (Fisher, 2008). Key informant interview was conducted to identify relevant furniture attributes from different concerned bodies (producers, consumers, traders, and SMEs office); whereas, a structured questionnaire was employed for collecting final consumer household data. Before the actual data collection, a pilot test was conducted and finally, primary data collection was carried out using the final questionnaire.

3.5 Method of Data Analysis and Presentation

Both descriptive statistics and econometric analysis were used to meet the specific objectives of this study. In descriptive statistics, mean, standard deviations, frequency and percentage were used to describe the hypothesized variables. Parametric statistical tests such as the Chi-square test and one-way ANOVA were also used to understand and confirm the relationship between wooden furniture preferences and other associated factors. In addition to parametric statistics, a non-parametric test (Kendall's coefficient of concordance test) was used to rank an individual's level of preference and satisfaction on imported and domestic wooden furniture attributes. At the same time as for econometric analysis, multivariate probit model (MVP) model was used through STATA 16 software.

To analyze the major factors influencing the preference of imported and domestic wooden furniture products by consumers, a multivariate probit model (MVP) was used. The MVP model is one of the Random utilities (RUM) that is used to analyze the consumers' furniture products and their attributes choices. It is appropriate for modeling discrete choice decisions such as the choice of furniture attributes and the product itself. It is an indirect utility function where an individual with specific characteristics associates an average utility level with the origin of the product choice set (Lancaster, 1966). Multinomial models are appropriate when individuals can choose only one outcome from the set of mutually exclusive, collectively exhaustive alternatives. However, in this study, consumers' product and attribute choices are not mutually exclusive; considering the possibility of simultaneous choices of products and their attributes and the potential correlations among these products and attributes choice decisions. Therefore, the multinomial logit model was not appropriate to estimate non-mutual exclusive and non-homogenous alternatives.

In this study, the Multivariate Probit model (MVP) was applied for consumer variation in the choice of products and to estimate several correlated binary outcomes jointly. The multivariate Probit (MVP) approach simultaneously models the influence of the set of explanatory variables on choices of products and their attributes, while allowing for the potential correlations between unobserved disturbances, as well as the relationships between the choices of different choices (Capellari & Jenkins, 2003).

It is assumed that a given consumer i in decision making considering a not exclusive alternative that constituted the preference set K^{th} of furniture products, the choice sets may differ according to the decision-maker for maximizing his/her utility. Let U_O represent the benefits to the consumer who chooses domestic wooden furniture, and let U_k represents the benefits of the consumer to choose the K^{th} furniture products: where K denotes preference of imported furniture (Y_1), domestic furniture (Y_2), and both imported and domestic (Y_3). The consumer decides to choose the k^{th} furniture product if $Y^*_{ik} = U_k - U_0 > 0$. The net benefit Y^*_{ik} that the consumer derives from choosing furniture is a latent variable determined by observed explanatory variable (X_i) and the error term (εi):

$$\text{Yik}^* = X_i\beta_{ki} + \varepsilon_\text{i} = (Y_1, Y_2, Y_3); \qquad \textbf{(2)}$$

Using the indicator function, the unobserved preferences in the above equation translate into the observed binary outcome equation for each choice as follows:

$$= \{1\ if Yik^* > 0 \,|(k = (Y1, Y2, Y3))\} \atop 0\ otherwise \qquad \textbf{(3)}$$

Yi* is an unobservable latent variable denoting the probability of choosing j type of furniture, for i = 1 (imported furniture), i = 2 (domestic furniture), i = 3 (both imported and domestic furniture)

In the multivariate model, where the choice of several furniture product is possible, the error terms jointly follow a multivariate normal distribution (MVN) with zero conditional mean and variance normalized to unity (for identification of the parameters) where (μ_{x1}, μ_{x2}, μ_{x3}) MVN~(0,Ω) and the symmetric covariance matrix Ω is given by:

$$\begin{bmatrix} 1 & \rho X1X2 & \rho X1X3 \\ \rho X2X1 & 1 & \rho X2X3 \\ \rho X3X1 & \rho X3X2 & 1 \end{bmatrix} \qquad \textbf{(4)}$$

Of particular interest are the off-diagonal elements in the covariance matrix, which represent the unobserved correlation between the stochastic components of the different types of furniture products. This assumption means that Eq. (4) generates a MVP model that jointly represents decision to choose a particular furniture product. This specification with non-zero off-diagonal elements allow for correlation across error terms of several latent equations, which represents unobserved characteristics that affect the choice of alternative products.

Following the formula used by Cappellari and Jenkins (2003), the log-likelihood function associated with a sample outcome is then given by:

$$LnL = \textstyle\sum_{i=1}^{n} \omega i ln\varphi(\mu i, \Omega) \qquad \textbf{(5)}$$

Where ω is an optional weight for observation i and Φi is the multivariate standard normal distribution with arguments μi and Ω, where μi can be denoted as:

$$\mu\text{i} = (ki1_i\beta_I Xi1, ki2\beta 2Xi2, ki3\beta 3Xi3) while\ \Omega\text{ik} = 1 \text{for j} = \text{k}\ and$$
$$\Omega\text{jk} = \Omega\text{kj} = kijkik\rho\text{jk for j} \neq \text{k; k} = 1;\ 2;\ 3 \text{ with kik} = 2\text{yik} - 1$$

4. Results and Discussion

4.1 Socio-economic characteristics of consumers and their furniture preference

To make the analysis robust, each characterization of wooden furniture consumers was made by grouping individuals under the furniture origin they preferred and comparisons using chi-square and F-test were made (Table 1). The findings revealed that 52.7% of the consumer households were females and 47.2% of them were males. Among them, 26.0% of females and 19.2% of males preferred to purchase imported wooden furniture as well as 19.7% of males, and 19.5% of females preferred domestic wooden furniture. The remaining 8.8% of males and 6.8% of females preferred both domestic and imported wooden furniture. About 65.2% of consumer households were married, while 34.8% of them were single. Among them, 16.4% of the single and 28.8% of married households prefer imported furniture, 12.7% of the single and 26.5% of married respondents prefer domestic furniture, and 5.7% of the single and 9.9% of married respondents prefer domestic plus imported furniture.

Table 1: Proportion of consumer socio-economic characteristics by furniture preferences

Variables	Category	Preferences of wooden furniture origin (%)				χ^2 -value
		Imported	Domestic	Both	Total	
Sex	Male	19.2	19.7	8.8	47.8	4.22
	Female	26.0	19.5	6.8	52.2	
Marital status	Single	16.4	12.7	5.7	34.8	0.61
	Married	28.8	26.5	9.9	65.2	
Education status	Not attend formal education	2.6	2.6	0.3	5.5	10.77
	Primary	6.8	8.1	2.9	17.7	
	Secondary	9.6	7.0	4.2	20.8	
	Higher education	26.2	21.6	8.3	56	
Occupation	Salaried employee	24.1	26.5	6.8	57.4	15.04***
	Self-employed	21.0	12.7	8.8	42.6	
Home ownership	Own home	20.8	22.9	8.1	51.7	4.899*
	Rented home	24.4	16.4	7.5	48.3	
House type	Single family house	22.3	19.7	5.2	47.3	8.147*
	Condominium	22.8	19.5	10.4	52.7	

Note: '***' & '*' represent 1% and 10% significance level; I=imported and D= domestic
Source: Own survey data (2020)

The Educational status shows that about 5.5%, 17.7%, 20.8%, and 56% have not attended formal education, attended primary education, secondary education, and higher education, respectively. About 2.6% of the respondents did not attend formal education; whereas, about 6.8%, 9.6%, and 26.2% of the respondents had primary education, secondary school, and higher education that preferred imported wooden furniture, respectively; while 2.6%, 8.1%, 7.0%, and 21.6% of them preferred domestic wooden furniture, respectively. The other 0.3%, 2.9%, 4.2%, and 8.3% of the respondents preferred both domestic plus imported wooden furniture.

Occupational engagements showed that the majority of the respondents were salaried employees (57.4%) and self-employed (42.6%) (Table 1). Regarding product preference of origin, about 24.1% and 21.0% of consumers were salaried employees and self-employed who preferred imported wooden furniture respectively, while 26.5% and 12.7% of consumers preferred domestic wooden furniture, respectively. Small proportion of consumers who are self-employed (8.8%) and salaried (6.8%) prefer both imported plus domestic wooden furniture. Homeownership of respondents showed that about 51.7% of them had their own home, while 48.3% of them lived in a rented house (Table 1). The result showed that 24.4% and 16.4% of the respondents who were living in rented house preferred imported and domestic wooden furniture, respectively, while only 7.5% of them preferred imported plus domestic wooden furniture.

Regarding house type, about 47.3% and 52.7% of the respondents live in single-family houses and condominium houses, respectively. From the total respondents, about 22.3% and 22.8% of respondents preferred imported wooden furniture, whereas, 19.7% and 19.5% of them preferred domestic who live in a single-family house and condominium house, respectively. The other 5.2% and 10.4% of them preferred both imported plus domestic wooden furniture who live in a single-family house and condominium house, respectively. The chi-square test result showed that there was a significant difference at a 10% significance level in terms of house types.

The mean socio-economic characteristics of the consumer by furniture origin are presented in Table 2 below. The mean age of consumers who preferred imported, domestic, and both imported plus domestic wooden furniture was 33.07, 37.24, and 35.64 years, respectively. The age of the consumer was statistically significant at a 1% significance level.

In terms of family size, consumers had on average 3.92, 4.63, and 5.12 family members in the household for imported, domestic, and both imported and domestic furniture buyers, respectively. The finding indicates that the family size of the consumer statistically influences the choice of wooden furniture at a 1% level of significance. Regarding income, both imported and domestic wooden furniture buyers had the highest mean monthly income of ETB, imported wooden furniture consumers (9131.01 ETB), domestic wooden furniture consumers (7917.23 ETB), and both imported plus domestic wooden furniture consumers (8595.58 ETB). Year of residence in the city showed that imported wooden furniture buyers live the highest mean years of 11.05 years, followed by both imported plus domestic furniture buyers with mean years of 10.25 and domestic wooden furniture buyers with the mean years of 11.12. The F test showed that there was no statistical influence on the choice of furniture. The result also showed that the length of the year lived by the consumers after married was about 9.0, 5.2, and 5.9 on average for domestic, imported, and imported plus domestic wooden furniture buyers, respectively. The chi-square test showed a statistically significant difference at a 1% level of significance.

Table 2: Mean consumers' socio-economic characteristics by furniture preferences

Variables	Preference for wooden furniture						
	Imported		Domestic		Imported + Domestic		ANOVA
	Mean	SD	Mean	SD	Mean	SD	F-value
AGE	33.07	9.17	37.07	11.17	35.64	10.57	6.42***
FAMS	3.92	1.99	4.63	1.85	5.12	2.19	11.03***
YEARSLVD	11.05	11.0	10.25	9.64	11.12	11.4	0.77
MARDYR	5.2	7.9	9.0	11.3	5.9	8.2	6.51***
INCOM	9131.01	7405.12	7917.23	5407.25	8595.58	5988.26	0.27

Note: '***' represents a 1% level of significance;
Source: Survey data (2020)

4.2 Consumer preferences between imported and domestic wooden furniture

The result showed that 45.2% of respondents preferred to buy imported furniture, whereas, 39.2% of respondents preferred domestically produced wooden furniture. Only 15.6% of respondents preferred to buy both imported and domestic furniture (Table 3). This result implies that imported furniture was more purchased than domestic furniture.

Furthermore, the chi-square test result showed that there was a statistically significant difference in furniture preferences among imported, domestic and domestic plus imported furniture at 1% significance level (χ= 56.64) in terms of origin. This might be associated to the reason that imported furniture products could have much more influence on the minds of consumers compared to domestic furniture regarding finishing, design, color, and availability of multiple choices. This finding is supported by the findings of the study by Khattak & Shah (2011) who found that consumers who live in big cities considered imported products as those of high value, and they feel pride when consuming those products.

Table 3: Wooden furniture preference variation

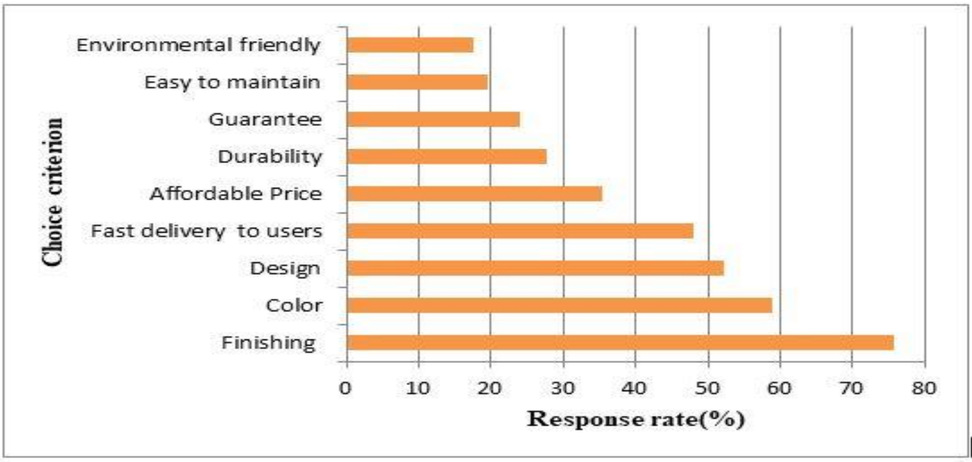
Type of wooden furniture	Frequency	Percent	χ^2
Imported	174	45.2	
Domestic	151	39.2	56.64^{***}
Imported + domestic	60	15.6	

Note: '***' presents a 1% level of significance; Source: Survey data (2020)

4.3 Reasons of consumer preference for imported and domestic wooden furniture

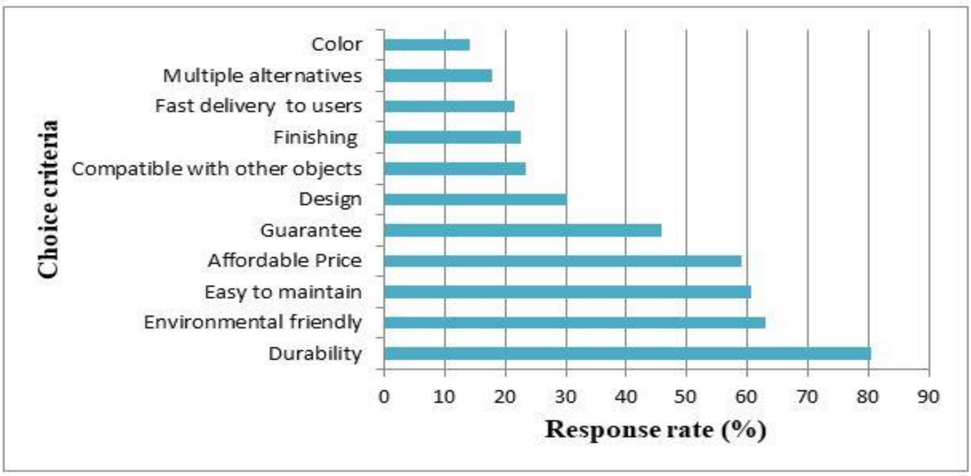
The consumers were required to give reasons for their preferred imported wooden furniture which is displayed in Figure 3 below. According to the results, about 75.6% of respondents gave finishing as the main reason for preferring imported wooden furniture followed by outlook (60.2%), color (59%), multiple alternatives (55.9%), compatibility with other objects (52.7%), design (52.1%), fast delivery to users (47.9%) comfort (42.7%), affordability price (35.5%), durability (27.8%), guarantee (24.1%), easy to maintain (19.5%) and environmental friendly (17.5%). Among all attributes stated for preferring imported wooden furniture, the proportion of finishing ranked first.

Figure 3: Consumers' choice criteria for imported wooden furniture



In domestic wooden furniture, about 80.4% of respondents stated that durability was the main reason for preferring domestic wooden furniture, followed by environmentally friendly (63.1%), easy to maintain (60.6%), affordability price (58.9%), guarantee (45.8%), design (30.2%) and comfort (29.9%) (Figure 4). Additionally, compatibility with other objects (23.5%), finishing (22.6%), fast delivery to users (21.5%), outlook (21.2%), multiple alternatives (17.9%), and color (14.2%) of attributes were stated fewer preference criteria of domestic wooden furniture by respondents.

Figure 4: Consumers' choice criteria for domestic wooden furniture



The findings of the study indicate that finishing, color, outlook, multiple alternatives, compatibility with other objects and design are the most preferred product attributes for imported wooden furniture while domestic wooden furniture; durability, environmental friendliness, easy maintenance, affordability price, and guarantee are the most preferred product attributes. This finding is consistent with the study by Chanjarika (2013) who noted that domestic furniture was more durable and had fewer varieties compared to imported one, while consumers preferred more imported furniture due to its availability of many varieties and enough design.

4.4 Consumers' Wooden Furniture Attributes Importance Ranking

The factors that the consumers consider when purchasing household furniture were scaled from not very important to very important on a five-scale preference basis (Table 4). The result revealed that the ranking of furniture attributes by consumer preference for bedroom furniture, the durability was the most important attribute with a mean rank of (7.16); followed by finishing, with the mean rank of (6.32); design, with a mean rank of (5.7); color, with a mean rank of (5.12); affordability with a mean rank of (4.58); user- friendliness, with a mean rank of (4.28); compatibility with other objects, with a mean rank of (4.06); fashion; with a mean rank of (4.4) and multipurpose with a mean rank of (3.74).

Table 4: Mean ranking and preference of consumers for wooden furniture attributes

Attributes	Living room furniture	Bedroom furniture
	Mean Rank	Mean Rank
Durability	6.41	7.16
Color	5.08	5.12
Multipurpose	3.85	3.74
User-friendly	5.71	4.28
Affordability	4.53	4.58
Fashion	3.7	4.04
Design	5.73	5.7
Finish	5.94	6.32
Compatible with other objects	4.05	4.06
Kendall's (W)	0.205	0.24
χ^2	632.57	740.39
P-value	0.000***	0.000***

Note: '***' represents a 1% level of significance

Source: Survey data (2020)

The findings showed that durability and versatility were the highest and the least influencing factors, respectively among bedroom furniture attributes on consumers' preference. The value of W (0.24) was significant at a 1% significance level (χ=740.395, P=0.000), and implies there was a level of agreement among the respondents in ranking the bedroom furniture attributes. W indicated a significant difference in the factors that determine the preference for wooden bedroom furniture. Hence, it is concluded that there is a significant difference in the preference of consumers towards wooden bedroom furniture attributes. Kendall's W results are similar to that of Oztop *et al. (*2008) who found that durability was the highest-ranked attribute preferred by consumers.

The finding of consumer preference regarding living room furniture features showed that the most preferred attribute was durability with a mean rank of (6.41); followed by finishing, with a mean rank of (5.94); design, with a mean rank of (5.73); user-friendliness with a mean rank of (5.71); color with a mean rank of (5.08); affordability with a mean rank of (4.53) and compatibility with other objects with a mean rank of (4.05). The result further shows that multipurpose and Fashion attributes have less preference score with the mean rank of 3.85 and 3.7, respectively. The finding is in line with Oztop *et al*. (2008) who found that durability was ranked as first by consumers. Mohamed and Yi (2008) also found that durability, design, and price were important influencing attributes of wooden household living room furniture those matter to all consumers. A related study by Arowosoge & Tee (2010) and Wiafe *et al*. (2014) revealed that durability, design, finishing, and color attributes were important in influencing consumers' ultimate choice of wooden dining furniture. Other findings by Ismail (2010) indicated that price, durability, comfort, style, and color were more important evaluative choice criteria of household furniture by consumers. Furthermore, the finding of the study was supported by Oztop *et al.* (2008) who found that the average score of durability attribute was higher on bedroom, dining room, and living room furniture products by consumers.

4.5 Socio-Demographic and Reference Group Factors of Furniture Preference

As indicated in Table 5 below, consumers are susceptible to different socio-demographic influences in purchasing decisions. The result revealed that the preferences of consumers between imported and domestic wooden furniture statistically associated and affected by experience (χ^2=10.168, P=0.001), children's interest (χ^2=7.217, P=0.007) Husband's/wife's interest (χ^2=2.894, P=0.089) whole family's interest (χ^2 =3.272, P=0.070), product knowledge (χ^2=6.154, P=0.013) and lifestyle (χ^2 =6.49, P=0.011).

Table 5: Proportion of socio-demographic and reference group factors for preference

Influencing factors	Imported	Domestic	χ^2 = value	P-value
	Percent	Percent		
Past experience	57.3	42.7	10.168	0.001***
Advertisement	44.7	55.3	0.175	0.676
Children interest	58.1	41.9	7.217	0.007***
Husband/wife interest	54.2	45.8	2.894	0.089*
Neighbor	50.0	50.0	2.116	0.146
Whole family interest	56.7	43.3	3.272	0.070*
Economy status	49.4	50.6	1.210	0.271
Product knowledge	59.7	40.3	6.154	0.013**
Lifestyle	61.8	38.2	6.49	0.011**
Friends	46.9	53.1	0.175	0.676

Note: ***, ** and * present 1%, 5% & 10% level of significance. Source: Survey data (2020)

The preference of consumers to imported wooden furniture is mainly influenced by lifestyle with a proportion of 61.8%, followed by product knowledge (59.7%), children's interest (58.1%), experience (57.3%), whole family's interest (56.7%), and husband's/wife's interest (54.2%). On the other hand, the decision of consumers on domestic wooden furniture preference is affected by husband's/wife's interest with a proportion of 45.8%, followed by whole family's interest (43.3%), experience (42.7%), children's interest (41.9%), product knowledge (40.3%) and lifestyle (38.2%). Hence, there is an association between socio-demographic and reference groups with the preference of consumers towards imported and domestic wooden furniture. The finding of this study is supported by Eshetu (2017) and Eshetu (2018).

4.6 Determinants of Consumer Preference on Imported and Domestic Wooden Furniture Products

The multivariate Probit model was used to identify factors affecting the wooden furniture preference of consumers. Wald test **(**χ^2 (42) = 93.09, p=0.000) is significant at 1% probability level. Thus, the MVP model fits the data reasonably well. Likewise, the model is significant because the null hypothesis that preference of the three furniture choices is independent was rejected at a 1% significance level. The result of the likelihood ratio test in the model (LR χ^2 (3) = 65.3082**,** Prob > χ^2 = 0.000) indicates the null hypothesis that the independence between wooden furniture preference decision (rho21 = rho31 = rho32 = 0) is rejected at 1% significance level and there are significant joint correlations for two estimated coefficients across the equations in the models. The correlation between the probability of choosing domestic or domestic plus imported (ρ32= -0.761) was significant at a 1% level of significance (Table 6). The finding of the estimated correlation implies that coefficients are statistically significantly different from zero in one pair of 3 pairs. This implies that the unobservable factors that increase the probability that a consumer chooses to purchase their furniture from domestic sources reduces the probability of purchasing the same from both imported plus domestic sources. The preference for domestic wooden furniture is found to be a substitution to domestic plus imported.

Age: The result revealed that the coefficient of age had a negative and positive effect on the preference of imported and imported plus domestic wooden furniture at a 10% significance level, respectively. This means that old consumers had a probability of choosing imported wooden furniture by less than 2.1%. This might be due to globalization; young individuals have a greater knowledge of the attributes present on furniture products and today's market is dominated by consumers who have the power to demand quality attributes for the new house types.

Family size: The result showed that family size was positively and statistically significant in imported and imported plus domestic wooden furniture preferences at a 1% significance level. This indicates that the more the number of people in a household, the more they are likely to prefer imported and both imported plus domestic wooden furniture by 13.9% and 13%. This might be due to the reason that as the size of the family increases, the variety and the needs of family members' preference increases regarding wooden furniture origin. This result is supported by the finding of Kumburu & Kessy (2018).

Years lived after married: Consumers who live for a long period after marriage had a higher probability of choosing domestic wooden furniture and lower for import plus domestic furniture at 5% and 10% significance level, respectively. This implies that the probability of choosing domestic furniture is lower by 2.6% and imported plus domestic is higher by 2.7% when the consumer stays a long year after marriage.

Table 6: MVP estimations for determinants of wooden furniture preference

Variables	Import (1)		Domestic (2)		Domestic+ imported (3)	
	Coef. (Std. Err.)	Dy/dx	Coef. (Std. Err.)	Dy/dx	Coef. (Std. Err.)	Dy/dx
SEX	-0.193		-0.208		0.076	
	(0.157)	-0.194	(0.153)	-0.203	(0.157)	0.083
AGE	-0.021*		-0.005		0.022*	
	(0.012)	-0.021	(0.011)	-0.002	(0.012)	0.017
EDUC	0.007		-0.005		0.011	
	(0.015)	0.007	(0.014)	-0.009	(0.015)	0.012
MARTS	-0.021		-0.220		-0.058	
	(0.172)	-0.023	(0.168)	-0.208	(0.186)	-0.014
MARDYR	0.003		0.026**		-0.027*	
	(0.013)	0.003	(0.013)	0.024	(0.014)	-0.018
FAMS	0.138***		0.029		0.107***	
	(0.043)	0.139	(0.040)	0.035	(0.040)	0.130
YEARSLVD	-0.002		-0.014*		0.004	
	(0.007)	-0.002	(0.008)	-0.016	(0.007)	-0.001
OCCUP	0.218**		-0.254***		0.153*	
	(0.086)	0.219	(0.082)	-0.267	(0.092)	0.144
INCMlog	-0.111		0.009		0.023	
	(0.099)	-0.113	(0.093)	0.028	(0.100)	0.039
HOUSTY	-0.154		-0.012		-0.167	
	(0.161)	-0.157	(0.159)	-0.015	(0.168)	-0.194
HOMRSHIP	0.159		0.235		-0.106	
	(0.154)	0.157	(0.152)	0.233	(0.164)	-0.172
RESDDIST	-0.007		-0.012		-0.009	
	(0.012)	-0.007	(0.012)	-0.010	(0.014)	-0.010
ADVRTACS	0.796***		0.476**		-0.507**	
S	(0.231)	0.793	(0.187)	0.478	(0.229)	-0.550
CONST	1.829		0.964		-3.038	
	((0.955)		(0.901)		(0.956)	
	/atrho21	0.042(0.087)	rho21		0.041(.086)	
	/atrho31	-0.054(0.090)	rho31		-0.054(0.090)	
	/atrho32	-0.999(0.171)	rho32		-0.761***(0.072)	
Likelihood ratio test of rho21 = rho31 = rho32 = 0: χ^2 (3) = 65.3082 Prob > χ^2 = 0.0000;						
Obs. = 385, Log likelihood = -598.49269 Prob > χ^2 = 0.0000, Wald χ^2 (39) = 93.09						

Note: ***, **& * represents 1%, 5% and 10% level of significance, respectively
Source: Survey data result (2020)

Years lived in the city: The results indicated that the length of the year consumers living in the city is negative and statistically significant in domestic wooden furniture preference at a 10% level of significance. This finding revealed that consumers who resided longer years in the city are less likely to choose domestic wooden furniture by 1.6%. This might be due to the reason that the consumer who lived long years in the city especially, in a large city, there is a probability of gradual shifting to new coming products from abroad than the usual product.

Occupation: The result revealed that occupation is positively and significantly associated with imported and both imported and domestic furniture preference at 5% and 10% level of significance. On the other hand, it is associated negatively and significantly with domestic furniture at 1% level of significance. The marginal effect shows that as consumers engaged in self-employing work, more likely choose imported and both imported and domestic furniture by 21.9% and 14.4%, while less likely choose domestic furniture by 23%. This might be the reason that occupation creates a different economic class which leads to different purchasing power within the consumer. This is in line with the findings of the study conducted by Kumburu & Kessy (2018) and Troian (2011) who stated that occupation showed the social status of the consumer and was linked to explaining the consumer preferences on furniture.

Residence distance: The finding showed that the coefficient of residential distance is positive and statistically significant in the probability of choosing imported plus domestic wooden furniture at a 5% significance level. This implies the probability of choosing imported plus domestic wooden furniture is positively influenced by access to furniture products nearest to consumers' residents. This result is consistent with the findings of Kumburu & Kessy (2018) who found that residence location significantly influences furniture preference.

Advertisement: It influenced the preference of imported and domestic furniture positively and significantly at 1% and 5% significance levels, respectively but negatively affected the preference of imported plus domestic wooden furniture at a 5% significance level. The marginal effect shows that consumers who have access to advertisements are more likely to prefer imported and domestic furniture products by a factor of 0.79 and 0.48, respectively.

6. Conclusions and Policy Implications

Understanding consumer preferences for products and relevant attributes is a key to production and marketing success. Manufacturers and enterprises engaged in product differentiation of higher value-added furniture products must not only constantly seek attributes that are most attractive to consumers, but also carefully evaluate whether any of those favorable products and attributes are competing with the existing attributes.

This study analyzed consumers' preferences for imported and domestic wooden furniture products and their attributes. From the finding of the study, significant differences were observed on the level of consumers' preference between imported and domestic wooden furniture products and their attributes. The results of the study indicate that imported wooden furniture were mostly preferred by consumers. The findings show that imported wooden furniture are higher in terms of finishing, outlook, color, compatibility with other objects, and design; whereas, domestic wooden furniture are superior in terms of durability, environmental friendliness, maintainability, and affordability. In the case of imported, domestic, and imported plus domestic wooden furniture preference, the preference of domestic wooden furniture was found to be a substitution for imported plus domestic wooden furniture preference and statistically significant. Consumer preference on furniture products was affected by age, the number of years in marriage, family size, number of years the consumer lived in the city, occupation, and advertisement.

Among five domestic furniture attributes, finishing, Design, and durability attributes were complementary while the price was found to be a substitution for the preference of color attributes in domestic wooden furniture products.

Based on the finding of the research, the following recommendations were forwarded.

- Domestic wooden furniture manufacturers should take into account the preferences of the consumers regarding finishing, design, color, and compatibility of furniture products to increase the competitiveness of domestic furniture with imported ones for satisfying domestic demand and preference.
- Furniture manufacturers also should be focused on the production of multiple products with multiple attributes to meet the needs of different consumer groups by considering different demographic, economic, social, and different house types.

- Furniture producers should identify complementary and substitutable furniture products and their attributes that consumers choose jointly
- There is a need for advertisement and awareness to consumers to favor domestic wooden furniture to give more value than imported furniture
- Government should invest in domestic furniture production by issuing loans to domestic furniture manufacturers
- Future research should focus on the quantification of volume and clustering of wooden furniture products which are imported and made in the country.

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Willingness to Pay for Improved Options of Choke Mountain Forest Ecosystem Services: A Choice Experiment Study

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Abstract

Globally the demand for forest ecosystem services has been increasing. Forests produce a wide array of goods and services for human beings. Although there is an inadequacy of scientific data on values of forest ecosystems at a larger scale for alpine areas, the demand for forest ecosystem services has been increasing in many countries. Thus, the study is held at Choke Mountain population. The area is situated in the north-western part of Ethiopia. It aims to identify the main attributes of the existing natural forests what the community has preferred and estimate their willingness to pay for that forest ecosystem services using choice experiment. To that effect, two districts and four villages are chosen, and a cross-sectional data are collected from 384 randomly selected respondents. Multinomial logit and conditional logit are used to see the results of the data following the analysis procedures. After doing two consecutive focus group discussions, eight attributes have been identified. Thereafter, 16 choice sets have been generated using fractional factorial orthogonal design with three strategic options (option A, option B and option C including the later as status quo). Among the identified attributes, attributes of grass availability and forest products have been significant at increasing level, which shows to increase the probability of choosing one of the improved alternative scenarios. But the attributes of enabling to create job opportunities for the youth and increase biodiversity levels are insignificant parameters, keeping other things constant. The basic multinomial logit model results revealed Br. 496 has been the maximum amount that a respondent is willing to pay (WTP) per year for increased grass availability attribute among the forest ecosystem services. The finding suggests that the government and the surrounding population should give more emphasis to increase awareness and practices on Choke Mountain forest ecosystem services.

Keywords: Choke Mountain, choice experiment, ecosystem services, forest resources, WTP

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1. Introduction

1.1 Background

Forests may mean different things to different people in different places and are also defined in various ways. Forests may be valued as ecological, political, economic, and cultural entities. Existing international definitions of forest differ from one another in many ways (Karimeh, 2011; Chao, 2012; FAO, 2020). Forests provide livelihood and ecological benefits, and incomes for countries in Sub-Saharan Africa (SSA). Economists determine the optimal use of forest resources by maximizing the stream of benefits as the value of its ecosystem services (Boadu, 2016). Africa's forests are fast diminishing to the detriment of climate, biodiversity, and millions of people dependent on forest resources for their well-being (Karimeh, 2011). But Africa lost about 34 million hectares of its forests between 2000 and 2010 (Eric, 2018). The decline of forests here is interpreted as deforestation, forest degradation, or a combination of both and is a complex socio-economic, cultural, and political event (Hyunshik and Tamirat, 2018).

Ethiopia is rich in natural resources, including a vast species of trees and wildlife, and categorized as one of the 20's like-minded and mega-diverse countries (Abeje et al., 2018). Ethiopia's forest resources including high forests, riverine forests, ericaceous vegetation, woodlands, and trees on farms provide goods and services that have economic, ecological, and social value (AFF, 2011). Historically, about 35-40% of Ethiopia's land area was covered with high forests at the turn of the 19th century. However, today the country has lost more than 60% of its forests since 1900 due to continuous deforestation (Abate, 2018). Therefore, preventing deforestation and forest degradation is necessary from both a climate stabilization and sustainable development point of view (World Bank, 2015).

The Government of Ethiopia has now a days interested in strengthening the contribution of the forest sector to achieve economic growth and to ensure the social and environmental sustainability of the country. According to the strategic plan of MEFCC (2017), Ethiopia has 17.4 million hectares of forests covering 15.7% of the country's land, and the presence of a large area of degraded lands become suitable for forest restoration. Choke mountain forests are one of the natural forest patches of the country which is threatened by its unwise utilization. This area has a large block of highlands found in East Gojjam Zone of the Amhara Regional State in the north-western part of Ethiopia. However, in the long-term unsustainable use of these natural resources including Choke mountain forests, increases not only the environmental degradation but also the decreases economic growth and livelihood opportunities.

Ethiopia owns diverse vegetation resources covering from tropical rain forests up to its desert scrubs (Demel et al., 2010). But the existing natural forests are shrinking from time to time due to increased human population and livestock production. In line with this, human population pressure is common in the afro-alpine areas of Ethiopia (Belay et al., 2012). Recent studies have revealed that Choke Mountain area is an afro-alpine area surrounded by large population of people who found in 9 surrounding woredas and holds 24 mammals, 52 bird and 4 amphibian species including one chameleon species (Abeje et al., 2018). Even if, it has tremendous benefit to the community and for the environment its way of conservation is quite traditional and unsustainable.

A large portion of the afro-alpine part of the Choke Mountain is converted into agricultural lands. At present fragmented forest patches are dominantly observed in the mountain ranges, where open access grazing and expansion of agriculture are common practices due to the rise of both livestock and human population in the area (Aramdie and Demelash, 2013). Hence, knowing the relevance of the forest in terms of the goods and services, what it renders to the community is incumbent. In this regard, the studies that have been undertaken on the economic values of Choke mountain forest ecosystem services (CMFES) were short-handed. In line with this, identifying the major forest attributes in the context of the local community and estimating their willingness to pay for improved forest goods and services is crucial. It helps to implement properly planned action towards its conservation and sustainable forest management system.

1.2 Objectives of the study

It is obvious that forests have paramount importance to the wellbeing of people. The challenge is the way that the resource is conserved and utilized or managed. As discussed in the introductory part, Choke mountain forests are natural forests existing in various patch forms in that area and the local community abuse it illegally. They have used the forest and related resources in various ways including as source of fire wood and livestock feed by freely grazing the grasses to animals. Choke Mountain is one of the hot spot areas of biodiversity and it is an important forest ecosystem in the country. It is also commonly called 'the water tower' of the upper Blue Nile basin and its watersheds. According to

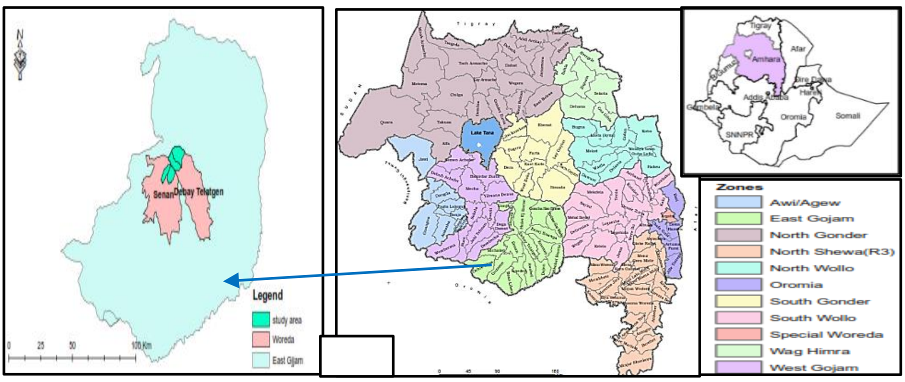
Teferi *et al.* (2010) and the report of Ethiopian Wildlife and Natural History Society (EWNHS, 2018) several tributaries of the Blue Nile River such as more than 59 rivers and 273 small springs, mainly originated from this mountain. It also holds many springs that are used for domestic consumption like drinking water for both humans and animals (Belay *et al.*, 2012). It also has the potential for being one of the tourist destination areas of the country. Thus, identifying the main attributes of CMFES becomes a vital concern. Therefore, it is necessary to identify the different attributes in valuing the Choke Mountain forest ecosystem services and to estimate respondents' willingness to pay for the ecosystem services. The study is, therefore, intended to identify the main attributes of the Choke Mountain forest ecosystem services and estimate the amount that the local community are willing to pay for the services.

2. Methodology

2.1 Description of the Study Area

The study was held in the Choke mountains area. Choke Mountains are a large block of highlands of East Gojjam Zone of the Amhara Regional State situated in the north-western part of Ethiopia. The whole mountain area extends over 10°41' to 10°44'N and 37°50' to 37°53'E. Its topography is sloppy and mountainous. The mean monthly temperature was 17°C and the average annual rainfall was 1378 mm. The highest peak of Choke Mountain rises to 4100 meters above sea level (Belay et al., 2013). The study was held specifically in two districts (locally called woredas), namely Sinan and Debaytilatgen woredas. Sinan woreda has 11 rivers and 486 springs while Debaytilatgen woreda consists of 9 rivers and 150 springs (Teferi et al., 2010; WPCO, 2019).

Figure 1: Administrative map of the study area



2.2 Sampling Technique and Sample Size Determination

For the study two stage sampling was employed. In the first stage, two woredas were selected purposively in terms of area coverage that the largest forest patches are found here. Then in second stage four kebeles two from each woreda (Dangulie and Abazazh-woybeyign from Sinan woreda, and Enekoy and Shimie from Debaytilatgen woreda) have been selected using systematic random sampling based on the total area coverage of natural forests in the kebeles. That is to say, it is important to identify and list all the kebeles having some natural forest sizes and select randomly from them. The population size of Abazazh-woybeyign and Dangulie kebele accounts for 1290 and 1158 household heads with a total population of 8231 and 8123 people respectively. While, the population of Enekoy and Shimie kebele has 566 and 407 household heads; and totally consists of 8562 and 6757 people, respectively (WPCO, 2019). Finally, 384 rural household heads or respondents (176 from Sinan and 208 Debaytilatgen) have been randomly selected using Cochran's formula (Cochran, 1977)

$$n = \frac{\mathbf{z^2(1-p)p}}{\mathbf{e^2}} = \frac{\mathbf{(1.96)^2(1-0.5)0.5}}{\mathbf{(0.05)^2}} = 384.16 \qquad \textbf{(1)}$$

Where: n implies sample size, *p* estimated population proportion, *z* the z-value, *e* size of the error willing to commit in estimating *p*.

2.3 Sources and Types of Data

Primary data (which are quantitative and qualitative in nature) have been collected from the selected respondents. Qualitative type of data has been collected using two round FGDs and the quantitative data gathered using structured questionnaire though it has been managed as an interview schedule since most of the respondents have been illiterate (unable to fill the questionnaire by themselves alone). The secondary data have been also collected from various documents of East Gojjam Zone, woredas and kebele offices of administration, agriculture, and environment & land administration.

The questionnaire covers four sections: demographic characteristics of respondents, perception of respondents for the forest resources choice set questions for the choice experiment study, and livelihood questions. The questionnaires were translated in to local language (i.e., Amharic) for easy understanding of respondents during the data collection process.

2.4 Models and Methods of Data Analysis

Ultimately the appropriate model employed for this type of study is MNL model (described in Equation 6 below following the procedures from Equation 2 to 7) to prefer one's alternative among given choices or alternative like choosing *j* over the other *k* items as described by McFadden (1974) and Louviere et al. (2000). But it can be seen with other related models to see the best values of preferences among the respondents using conditional logit or mixed logit models. In our case, the dependent variable is the choice made by an individual respondent among the given choice sets and alternative strategies and the independent variables are the items given as an attributes in each option or choice sets.

In the usual *multinomial logit* model, the expected utilities are modeled in terms of characteristics of the individuals. The regression coefficients (βi) may be interpreted as reflecting the effects of the covariates on the odds of making a given choice or on the underlying utilities of the various choices. In another way, there is a model which is called the *conditional logit* model, and turns out to be equivalent to a log-linear model where the main effect of the response is represented in terms of the covariates. In this regard, McFadden (1973) proposed modeling the expected utilities in terms of characteristics of the alternatives rather than attributes of the individuals.

To clarify the idea, choice experiment (CE) was applied to estimate respondent's willingness to pay for the Choke mountain forest ecosystem services. CE method has been widely used and considered as more preferable method than contingent valuation (CV) approaches. Gatto et al. (2014) described that CV targets the study of WTP for a specific event like a policy change but CE considers complex goods and services, such as environmental resources, that can be made up of several lists of attributes. The person interviewed can compare and choose one of the policy alternatives within a choice set, usually composed of different scenarios, plus the status-quo or the existing situation. Hence, instead of having to answer a complex bidding question as in CV, the respondent has to select one out of a certain number of choice sets corresponding to the preferred policy alternative (Louviere, 2006; Gatto et al., 2014).

Moreover, the other advantage of CE over CV is that the former reduces potential sources of biases from respondents and provides more extensive data

(Hanley *et al.*, 2001; Birol *et al.,* 2005). Hence, the application of choice experiments in the valuation of multiple functions and products of public goods and services has been increasing from time to time. For instance, Gatto *et al.* (2014) has undertaken the study on exploring WTP for forest ecosystem services by residents of the Vento Region of Italy in 2011 using CE, and select six attributes (with four levels for each attribute) including cost items with its too wide range of levels (nine levels) and presenting three alternative strategies including the status quo option. These scholars have identified attributes such as view of forest structure, capacity of carbon sequestration in percent, change in number of important species for biodiversity conservation, extent of landscape change, forest recreation service, and the cost item as annual tax paid by each household to support the application of regional forest policy. Lastly, the analysis has made by using MNL and Latent Class models and the results revealed that WTP is significant for attributes of recreation (19.7 - 88 €) and carbon sequestration (11.2 - 42.2 € per household).

Based on the random utility theory (RUT) explained by Train (2003), the utility U_{ijt} of a good or service is composed of two main components, which a given individual *i* gets from alternative *j* in the choice situation *t*. The first component is the deterministic component or the observable (systematic) part V_{ijt}, consists of attributes; and the second component is the random error component or the unobservable part (stochastic term) ε_{ijt} (Boxall and Macnab, 2000). The deterministic component of the utility function (V_{ijt}) is specified as linear and can be written as a product of β*'s* and X_{ijt}, which has expressed by using a vector of attributes or explanatory variables (X_{ijt}) linked to the individual *i* and their coefficients or vector of the betas (β*'s*) as follows:

$$V_{ijt} = \beta' X_{ijt} \tag{2}$$

In other words, for simplicity Equation 2 can describe the relationship of each component in an individual's utility

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} = \beta' X_{ijt} + \varepsilon_{ijt} \tag{3}$$

where U_{ijt} is the utility of an individual *i* obtained from choosing alternative *j* within the choice situation t,

V_{ijt} represents the deterministic/observable component of the utility function, representing the attributes of *j* alternatives or socio-economic characteristics of the individual; and
ε_{ijt} represents the stochastic or random error component of the utility function.

As expressed in Equation 3, an individual *i* derives utility U_{ijt} from the *j* alternatives in a given situation *t* with the complete set of choices C. Hence, the utility is represented as a function of the attributes of the preferred or relevant forest ecosystem goods or services Z_{jt} of each alternative and the individual's socio-economic characteristics S_{it} together with the random error components ε_{ijt} which may affect the behavior of each respondent (Rolfe et al., 2000). These can be given as:

$$U_{ijt} = V_{ijt}(Z_{jt}, S_{it}) + \mathcal{E}_{ijt} \qquad \textbf{(4)}$$

The respondent in a CE choice set will maximize his/her utility by choosing the scenario (or alternative) *j* among the other *k* within the choice set if the scenario *j* has higher utility than the others. Hence, Equation (4) again can be written as the probability of a consumer *i* choosing the option or alternative *j* over the other *k* as McFadden (1974) and Louviere et al. (2000) described in terms of systematic and error components as:

$$P(j/C) = Prob\,(U_{ijt} > U_{ikt}) = Prob\,[(V_{ijt} - V_{ikt}) > (\mathcal{E}_{ikt} - \mathcal{E}_{ijt})]; \qquad j,k \in C;\ j \neq k \qquad \textbf{(5)}$$

where C represents the complete set of choices.

To estimate Equation (5) the error distribution must be assumed usually Gumbel distributed and Independently and Identically Distributed (IID), hence the probability of choosing *j* is given by:

$$P_{ijt} = \frac{exp^{(\mu V_{ijt})}}{\sum exp^{(\mu V_{ikt})}} = \frac{e^{(\mu \beta' X_{ijt})}}{\sum e^{(\mu \beta' X_{ikt})}} \qquad \text{for all } k \in C \qquad \textbf{(6)}$$

where μ represents a scale parameter (usually set at 1 to keep constant error variance), and inversely proportional to the variance of the error term.

This leads to the expression for the probability P, of choosing alternative *j* from given options. Assuming the error terms of the resulting utility function are independently and identically distributed, a multinomial logit (MNL) model can be developed. This error assumption is derived from the property of independence of irrelevant alternatives (IIA) assumption, which states that the probability of choosing one alternative over the other depends entirely on the utility of the respective alternatives (McFadden et al., 1977). In other words, due to the inherent stochastic or random error component of the utility, U_i, function; choices made between alternatives are expressed as a function of the probability that respondent, *i*, will choose an alternative, *j*, in preference to other alternatives. In this regard, the MNL model generally takes the following form:

$$P_{ijt} = \frac{\exp^{(\mu V_{ijt})}}{\sum \exp^{(\mu V_{ikt})}} = \frac{e^{(\mu\beta' X_{ijt})}}{\sum e^{(\mu\beta' X_{ikt})}} \text{ for all } k \in C \text{ involved in the choice set, C} \quad (7)$$

where μ represents a scale parameter (usually set at 1 to keep constant error variance), and inversely proportional to the variance of the error term.

2.5 Identification and Selection of Attributes and Levels for CMFES

2.5.1 Identifying attributes and setting levels

In identifying Choke Mountain forest ecosystem goods and services and in selecting the most important attributes and their levels, critical review of literature has been primarily undertaken and then the focus group discussions with woreda and kebele experts have been held. Attributes and their levels have been used to portray scenarios to respondents and three main selection criteria were suggested in some literature, such as demand-relevance; policy relevance; and measure-ability (Bennett and Blamey, 2001; Blamey et al., 2002). Here, the demand-relevance aspect has taken more consideration due to the presence of high attention to be given on the already existing forest by the community members. This is true because, most of them need to conserve it, though some others try to damage. In terms of attribute levels, Bennett and Blamey (2001) suggested that CE design should take into account the types of measurement in levels to be either qualitative or quantitative. However, it is common in CE studies to use qualitative levels to inform respondents about the choice of attributes and their levels included in choice cards.

The most common sources of measurement of attribute levels have been derived from the literature review (Oh et al., 2007) and focus group meetings (Hanley et al., 2001), and a combination of both (Christie et al., 2007). Both the literature review and focus group discussions (FGD) have been used to identify Choke mountain forest attributes and set their levels. As a pretest, two round group meetings have been conducted with the community members having nearby forest patch. Participants in focus group discussions (FGD) have first asked some general questions about their perceptions towards CMFES. Then, FGDs were held with 40 randomly selected household heads (hh) from the neighboring but non-sampled kebeles, and 4 experts of the woreda and kebele level and kebele administrators. Then all the participants of the FGD have tried to identify the list of potential attributes of CMFES.

Finally, they determined the most preferred list of attributes and set their levels to be used in the CE. The list of attributes of that ecosystem services presented during the discussion time were:

- fuel-wood and other forest products;
- shade service to livestock and human;
- helps to regulate the local weather condition,
- to attract tourists for personal satisfaction;
- forming soil through decomposition;
- hiking, jogging, and observing views;
- used for research and education activities
- prevent flood risk and landslide;
- gene-pool for diverse plant & animal species
- Improve biodiversity of flora and fauna;
- food source to people;
- equestrian show & hunting wild animals;
- source of grass for livestock;
- supply sustainable water;
- create job opportunity for youths; and
- source of construction material

The respondents have asked what major types of products and/or services they obtained from the forest ecosystem. The FGD participants or both households and experts lastly identified eight mostly preferred attributes of

CMFES, although eight is generally seen as the maximum number of attributes in a choice set study (WHO, 2012). Then they set two levels for the seven attributes and three levels for the other single attribute or for the payment attribute. Therefore, the more prioritized and identified attributes and levels of Choke Mountain forest ecosystem services (CMFES) were listed in details in Table 1.

Table 1: Identified and selected attributes and levels of CMFES

Attributes	Levels	Number of levels
Grass availability	Decrease, Increase	2
Fuel-wood and other forest products	Decrease, Increase	2
Water availability	Low, High	2
Create job opportunity for youths	No, Yes	2
Shade for livestock	No, Yes	2
Biodiversity	Low, High	2
Reduce soil erosion and flood risks	No, Yes	2
Respondent's contribution (payment)	100 Birr, 200 Birr, 300 Birr	3

Own computation

2.5.2 Constructing the experimental design and creating choice sets

The FGD participants have been informed to get into the choice options and hence two hypothetical new options or alternative strategies have been set which are named as option A and option B. Besides to these, option C or the status-quo option showing the current situation of the forest ES have also included as the third alternative for the respondents. These three strategic options (option A, option B, option C) have set in each choice set as a generic form (Hensher et al., 2005).

In constructing the experimental design, the identified attributes and levels have been combined using an orthogonal fractional factorial design by SPSS software. This design has been used to reduce the number of choice sets that each respondent is required to select. Using SPSS this design generated 16 combinations called choice sets for the first option (option A) in its main effect combinations of attributes and levels. The second option or option B in each of the 16 choice sets has been created from the first option using a shifted design (Diafas, 2014). Then, the created choice sets have been assigned into four blocks (Block 1, 2, 3, 4) and each block contains four choice sets (Choice set 1, 2, 3, 4) to minimize respondent's cognitive burden. Finally, each respondent has been randomly assigned to one of the four blocks as shown in Table 2. This is a representative or one choice set ("Choice set 1") among the four choice sets presented to a single respondent.

Table 2: Example of the designed choice set to a randomly selected respondent

Block 2			
Choice set 1			
Attributes	**Option A**	**Option B**	**Option C (Status-quo)**
Grass availability	Increase	Decrease	As it is today,
Fuel-wood and other forest products	Increase	Decrease	”
Water availability	Low	High	”
Create job opportunity to youths	Yes	No	”
Shade for livestock	No	Yes	”
Biodiversity	High	Low	”
Reduce flood and soil erosion risks	Yes	No	”
Your payment contribution	100 Br	200 Br	”
Which option do you prefer?	Option A ☐	Option B ☐	Option C ☐

Own computation

Each household head's contribution in each alternative strategy has depicted the amount of money that has been assumed to pay per year for about three years in the form of cash to support the people working for improvement of CMFES. Option A and Option B would have a cost to them but no payment would be required for option C. Therefore, the respondents have to know the descriptions via the enumerator and choose the box that corresponds to their preferred option. However, if the existing situation (option C) is held as it is the forest and its ecosystem services would continue to deteriorate.

2.5.3 Formulating the questionnaire, Compilation, Coding, and Data Analysis

In developing the questionnaires to undertake the survey and to ensure that the survey would realistically elicit data of interest from respondents, a pre-test has been carried out. Some modifications to the questionnaire has been made after pretesting it. The prepared structured questionnaire focuses on the preferences for different levels of the services that Choke Forest ecosystem render to the direct users or the nearby community. The government or policy makers are advised to find out what people here in the area really think about what has to be done for the forest ecosystem. Hence, in the given choice sets within the designed structured questionnaire, Hypothetical options have been given whereby showing different improvement situations for the forest ecosystem and tell the respondents which situation they like best as shown in Table 2.

Next to data collection, reviewing the whole process of data collection has been made. Then the data sets have been arranged by giving codes based on observation id, block number, number of choice sets, levels of the attributes and chosen options or preferred alternatives. Before the analysis, data cleaning from available errors has been the primary activity that has been taken into account. Then the analysis comes using descriptive methods and econometric tools. SPSS version 20 and STATA 14 software packages were used for data analysis.

3. Results and Discussion

The overall response rate of the collected primary data has been 96%, which shows the good and wonderful manner of respondents during the data collection process. The result of the study holds four types of data collected from randomly sampled respondents, who are being household heads living in the target populations. The first data set consists of socio-economic and demographic characteristics of the respondents. The second data set focused on the identification and selection of attributes and levels. The third data set consists of the respondents’ choice for the different hypothetical improvement scenarios or options. The fourth type of data set holds the estimated amount of respondents' willingness to pay (WTP) towards the improved forest situation of ecosystem services in Choke Mountain area.

3.1 Socio-economic and Demographic Characteristics of the Respondents

The results for continuous variables have been depicted in Table 3, and for the categorical variables in Table 4. The mean age of the respondents has been 42 years. The majority of them (69%) have been adults who are being in the range of 35-54 years old. The average family size of the respondents in the study area has been 5 but the values varied between a minimum of 2 and a maximum of 11 family members for a household head. Among the respondents, 94% have been male and 6% were female. More than 94% of the respondents have been married and 55% illiterate.

Table 3: Mean values of continuous variables (N=384)

Variable	Mean	Std. Dev.	Min.	Max.
Age of household head (hh) in No. of years	41.9349	9.46139	21	80
Family size of hh in No.	5.0182	1.5421	2	11
Land size of hh in ha.	0.7139	0.3792	0.25	3
Distance of hh's home in minute from forest edge	37.5135	18.8992	4.8	120
Distance of market from hh's home in minutes	71.3802	27.7493	10	120
Annual income of hh in Birr (ETB)	14990.91	13326.12	1800	56000
No. of DA contact days in a month	2.7161	1.8635	0	6

Survey result, 2020

According to the survey result, all of the respondents have been generating their income from mixed farming, that means crop cultivation and livestock rearing. Farming is the major source of income for the farmers in the area having a minimum of 1800 Birr and a maximum of 56000 Birr per annum. The average annual farm income has been shown as 14991 Birr. Most of the respondents (46%) own the smallest land size in the range of 0.5 - 1 ha, and even the next majority of them (41%) owned between 0.25 - 0.5 ha of land. However, the average land size becomes 0.71 ha.

3.2 Econometric Results of the Respondent's Choice

For the econometric analysis of the different hypothetical alternatives (options), the MNL, conditional logit (clogit) and random parameter logit (RPL) models have been used. There are three dependent variables in line with the three options including the new improvement strategies (option A and option B) with alternative specific constant one (ASC1) for option A; and ASC2 for option B. Two types of equations have been developed such as basic model equations including ASC and extended model equations which includes the interactions of socio-economic and demographic variables of respondents with the basic model. If ASC1 and ASC2 excluded for the basic MNL model, it assumes that the status-quo scenario (option C) is preferred to exist.

Table 4: Statistical values of categorical variables (N=384)

No.	Variables	Value	Freq.	Percent	Average
1	Sex	Female	23	6	
		Male	361	94	
2	Marital status	Single	0	0	
		Married	364	94.8	
		Widowed	11	2.9	
		Divorced	9	2.3	
3	Educ. Status	Illiterate	211	55	
		Literate	173	45	
4	Age	21-34	79	20.6	41.9349
		35-44	156	40.6	
		45-54	110	28.6	
		55-64	28	7.3	
		>65	11	2.9	
5	Land size in ha	no land 0-0.24	3	0.8	0.71309
		0.25-0.5	158	41.1	
		0.51-1.0	176	45.8	
		1.01-1.5	38	9.9	
		1.51-2.0	7	1.8	
		2.01-2.5	1	0.3	
		2.51-3.0	1	0.3	

6	Annual income in Br.	<2000	259	67.4	14990.9
		2000-5000	19	4.9	
		5001-10000	11	2.9	
		10001-20000	20	5.2	
		20001-30000	11	2.9	
		30001-40000	30	7.8	
		40001-50000	17	4.4	
		>50000	17	4.4	

Survey result, 2020

3.2.1 MNL Model Results

In computing the results, two types of formulation have been used by saying as basic MNL model results and extended MNL model results. The basic MNL model has been estimated based on the assumption of preference homogeneity utility for the status quo, and incorporating the identified attributes (the main effects) of Choke forest ecosystem goods and services concerning the two options (option A and option B only without interacting with ASC). Similarly, with the equations of the basic model, both the dummy and continuous variables have been included. Hence, six socio-economic variables of the sampled respondents such as sex, education status, marital status, age, family size, land size, total annual income, forest distance, and market distance from home of the household variables were incorporated. But in the extended model, a new combination of variables was the presence of interactions of the attributes with the ASC. This enables to capture the influences of the variables on the probability of the respondent to choose either of the given options (option A, option B; and option C).

Four choice sets have been provided for each of the respondents with three alternatives including the status-quo. The levels are given dummy form (except the payment attribute) such as either increase or decrease levels; high or low levels and ‘yes’ or ‘no’ levels. For the attributes of payment, the levels consist of no payment for the status-quo option and three levels such as 100, 200 and 300 ETB for the other two options which was determined at the time the group discussion among some selected participants farmers. All these dummy items have been coded as 1 for 'increase', 'high', and 'yes' levels and 0 otherwise. Stata14 has been used to estimate model results and presented in Table 5.

The result of the estimated basic MNL model has revealed attributes such as increase in grass availability, high level of water availability, access to more forest products, reduction the occurrences of flood and soil erosion risks, provision of shade service to livestock, the payment attribute, ASC and model constant term (const) have been statistically significant from 1% to 10% levels.

Table 5: Regression results of the MNL, clogit and RPL models

Attributes (Choice variables)	basic MNL	extended MNL	clogit	RPL
	Coefficients	Coefficients	Coefficients	Robust. Coef.
Alternative specific constant (ASC)	-.1667**	-2.0947**	-0.0519	0.0759**
Respondent's payment amount	-.0062***	-.0064***	-.0047***	-.0015***
Increase in grass availability	3.0894***	3.0414***	2.2482***	0.6328***
Decrease in grass availability	3.1888***	3.1430***	2.3062***	0.6430***
Increase in forest products	0.1619**	0.1608 **	0.0911	0.0384**
High amount of available water	-.2263**	-.22689**	-.1314**	-.0527***
Create job opp. to youths	0.0170	0.0158	0.0101	0.0046
Provide shade service to animal	-.1622**	-.1637**	-.0952*	-.0384**
Presence of high biodiversity	-.0883	-0.0900	-0.0529	-0.0215
Reduce flood & soil erosion risk	0.1302*	0.1312*	0.0761	0.0293*
Constant	-2.0512***	-	-	0.1139***
Interaction of Alternative specific constant (ASC) with age		0.000193		
Interaction of ASC with sex		0.0077647		
Interaction of ASC with family size		-0.0002554		
Interaction of ASC with land size		-0.0039771		
Interaction of ASC with forest distance		-0.0000325		
Interaction of ASC with market distance		-0.0000237		
Interaction of ASC with income		1.65E-09		
Interaction of ASC with marital status		0.0056089		
Interaction of ASC with education		0.001198		
Number of respond.				
Number of obs.				
Pseudo R^2				
Log likelihood				
Prob > chi^2				
LR chi^2 or Wald chi^2				

*** significant at 1% level ** significant at 5% level * Significant at 10% level

The alternative specific constant (ASC) has a negative sign except in RPL result, and it is significant which implies that there is a week reaction of the respondents to welfare improvement as we move away from the status quo. The coefficient of the payment attribute (payt) represented by $ß_1$, which holds levels of continuous values have indicated how much the utility is increased or decreased by having one extra Birr, while the other coefficients measure the change in the utility from the reference category. Thus, the respondents have preferred an alternative from the given options that decreases the utility of paying fewer amounts such as from 0.0064 Br. in extended model to 0.015 Br. In RPL model conserve the forest ecosystem.

In case of $ß_2$, an opportunity of increasing grass availability (*incga*) rather than living in the current situation increases the utility of the alternative by 3.09. Similarly, $ß_4$ *has* showed that if the given choice set with options contained an opportunity to increase in forest products (*incfp*), the utility of choosing that option will be increased by 0.16 utility level. While in the case of $ß_6$ and $ß_{10}$ the utility of a high amount of water availability (*hiwa*) and provision of shade services (*yeshl*) will be declined by 0.23 and 0.16 utility levels, respectively.

They have also preferred an option in a choice set that helps to reduce the occurrence of flood and soil erosion risks, as denoted by $ß_{14}$, measure the change in the utility from the reference category or the status-quo option to either of the two options by 0.13 utility level. However, the coefficients for the creation of job opportunities for youths ($ß_8$) and the attribute of high amount of biodiversity conservation level ($ß_{12}$) have been insignificant (Table 5). But $ß_3$, $ß_5$, $ß_7$, $ß_9$, $ß_{11}$, $ß_{13}$ have been empty values of *ß*'s or labels for the attributes after analyzing model results.

The regression results of the extended model have also been estimated to show the presences of observed heterogeneity. The interactions of respondents' socio-economic and demographic characteristics with the alternative specific constant (ASC), which represents the hidden characteristics that the respondent that does not see in the choice task (Gatto et al., 2014). The coefficients for the forest attributes such as payt, increase in forest products (incfp), high water availability (hiwa), and provision of shade services to livestock (yeshl) in the extended model are similar to the coefficients of the basic model in both of its signs and significance levels, but only having small variations or improvements in decimal figures of the magnitudes. Even if the sign of some coefficients for interactions of ASC with the socio-economic co-variants appeared have been negative signs as expected, all of them become insignificant (Table 5). This shows that the respondents have not been willing to prefer any improvement plans. But they have preferred the status-quo situation regardless of any influences of the socio-economic factors.

The coefficients of the interaction of ASC with age, sex, education, income, and marital status of the respondents have been positive but not significant. This is because the willingness to pay and ability to pay for improved plans may have a positive or direct relationship to affect the lives of the people though they have much preferred the status-quo situation than the designed alternatives or options as improved plans. On one hand, a significant and negative ASC means they want to change the status quo by the given improvement options. On the other, the interaction of the coefficients of ASC with family size, land size, the distance of the respondent's home from the forest edge and nearby market center has negative signs. But the coefficients of both factors have been insignificant which implies that they perceive those factors which are not important.

According to Birol et al. (2005), the overall explanatory power of the model could be assessed using McFadden's Pseudo R^2. When the value for Pseudo R^2 is less than 0.4, the model is said to be a good fit (Birol et al., 2005; Bennett and Blamey, 2001). Hence, the estimated values of R^2 for the above basic and extended MNL models have been 0.13 which is similar and adequate but with a slight difference in their log-likelihood values -2553.801 and -2553.7908 for the basic and extended multinomial logit models, respectively (Table 5).

3.3.2 Conditional Logit (clogit) and RPL models

According to Alpizar et al. (2001), the standard multinomial logit model has two basic limitations. The first one is its assumption of the independence of irrelevant alternatives (IIA) which is derived from the result of IID assumptions that states the ratio of choice probabilities between two alternatives in a choice set is unaffected by other alternative changes in that choice set. That means if new alternative plans are added or removed over the existing one, it will not affect the choice probability of the first alternatives.

The second limitation of MNL rises with the incorporation of observed heterogeneity into the model by having the interaction of the socio-economic characteristics with the attributes or the alternative specific constants. But the MNL model does not take into account the taste variation or unobserved heterogeneity among each respondent. Due to these two main shortcomings of MNL, the fixed-effect or conditional logit and mixed-effect or random parameter logit models have been used to incorporate the unobserved heterogeneity and to relax the IID assumptions.

The estimated results of the clogit and RPL model revealed that the sign and significance level of the coefficients is similar to the results of the MNL models. But there is a slight change in the magnitudes of the coefficients for all attributes, except the constant term (ASC) which shows the change in both its magnitude and signs (from the negative sign in the MNL results to the positive sign in RPL) being significant at 1% level. The attributes of grass availability and respondent's payment are significant at 1% while the attributes of forest products, water availability, and shade services are significant at 5% level and the attribute of flood and soil erosion risk significant at 10% level. However, the improvement in the model fit of the RPL is less likely preferred as compared with the basic and extended MNL model results. Nevertheless, the magnitude of the attributes becomes less from the service users.

3.3 Estimation of Willingness to Pay

Within the context of indicating the improvement strategy to conserve, the forest ecosystem includes a price proxy such as the contribution of local people (respondents) in three-year period. This can be realized through land tax as a payment mechanism to estimate the value of payment attributes to know how much money the respondent would be willing to give up for the improvement of the forest status. This can be estimated as the ratio of the value of the coefficient of each attribute’s beta parameters to the negative of the payment attribute (Train, 2003).

$$\text{WTP} = -\frac{\beta a}{\beta c} \qquad \textbf{(8)}$$

As the model results shown in Table 6, the maximum value of respondents for the given improvement options for the attributes of forest ecosystem services have to pay Br. 496 per hh annually for increasing in grass availability and a minimum of Br. Two for creating job opportunity for youths of the nearby community using basic MNL and conditional logit model results, respectively (Table 6).

Table 6: Results of respondents' willingness to pay for CFES in different models

Variables	Values of respondents WTP in			
	basic MNL	extended MNL	clogit	RPL
Alternative specific constant	-329.6089	-326.9580	-11.0422	75.6673
Increase in grass availability	496.4473	474.7353	478.3752	411.9129
Increase in forest products	26.0166	25.1063	19.3927	25.5107
High amount of available water	-36.3636	-35.4082	-27.9601	-35.0232
Create job opp. to youths	2.7331	2.4736	2.1443	3.0267
Provide shade service to animal	-26.0643	-25.5516	-20.2676	-25.5107
Presence of high biodiversity	-14.1856	-14.0498	-11.2704	-14.2687
Reduce flood & soil erosion risk	20.9165	20.4769	16.1874	19.4573

In addition, the value of creating job opportunity to youths is sound in RPL model result more than the others. However, a negative sign for WTP value for most of the attributes implies diminishing marginal utility for the attribute having higher levels. There has been no big difference in the results of the different models but respondents want to give more emphasis to grass availability to their livestock (Br 496) and increase in forest products (Br. 26). Moreover, reducing flood and soil erosion risks with a maximum annual contribution of Br 20.9 in basic MNL and a minimum of Br 16.2 in clogit and create job opportunity to youths (max. Br 3.03 and a min. of Br 2.1) having positive coefficient values. Therefore, the results in the above table have revealed that conserving the natural forest is the vital concern of the local community in sustaining grass to their livestock.

4. Conclusion and Recommendations

Natural resource conservation is basic for human wellbeing in general. In the study site the existence of the natural forest highly threatened with prioritizing the current interest of unsustainable utilization. That is the use of the forest for fuel wood as well as land grabbing for crop production and making as an open grazing field to animals. Hence, the intended purpose of the study has been to understand how the local community perceive to conserve this natural resource and to estimate the average willingness to pay for the ecosystem services they have been aided. Henceforth, alternative scenarios have been created hypothetically. The alternatives contained several combinations of choice sets with various attribute levels and individual characteristics that influence the stated choice sets of the forest ES users, as well as the trade-offs between features of attribute levels. Consecutive FGDs have been held and totally eight attributes have been identified and their levels determined. Finally, the number of respondents' WTP to implement the changes associated with the given options of the forest ES have been computed as a maximum of 496 ETB per year. Hence, the findings of this study help forest managers in the preparation of resource management plans and for awareness creation to any of interested stakeholders in sustaining a healthy environment and keeping the natural forest ecosystem services.

Overall, the study can be considered as an informative part of scientific work to reconsider the current situations of the natural forest and its vulnerability to losses. But the local community can be reoriented to sustain and utilize it through participating them in any conservation plans. As a recommendation, the government or policy makers are to find out what people here in the area really think about what has to be done for the forest ecosystem. Specifically, some of the local people have a desire to undertake forest conservation activities. The majority of them prioritize to satisfy the immediate needs like collection of firewood from the forest and over grazing of animals.

Therefore, the concerned government institutions like environmental protection, rural land administration and wild life conservation offices, culture and tourism office, agriculture and natural resource management office with the various chains of administrative offices should give much and attention towards the sustainable management and conservation of the natural forest with its diverse species of inhabitants. Moreover, this natural resource can be a source of income for women, youth and all the local communities through integrated efforts stakeholders like Ethiopia Electric Utility by fulfilling the fuel wood need of the people.

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