

**Ethiopian Economics Association (EEA)**

**and**

**Ethiopian Strategy Support Program  
(ESSP) of IFPRI**



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**PROCEEDINGS OF THE  
SEVENTEENTH INTERNATIONAL  
CONFERENCE ON THE ETHIOPIAN  
ECONOMY**

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**Edited by**

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- ❁ Partners of all activities of EEA are Friedrich Ebert Stiftung of Germany (FES), Think Tank Initiative of the International Development Research Center (IDRC) of Canada, and Civil Society Support Program (CSSP)
- ❁ The 17<sup>th</sup> International Conference was co-organized by the Ethiopian Strategy Support Program (ESSP) – the collaborative program of the International food Policy Research Institute (IFPRI) and the Ethiopian Development Research Institute (EDRI).
- ❁ The 17<sup>th</sup> International Conference was co-sponsored by IFPRI/ESSP, Initiative Africa, Friedrich Ebert Stiftung of Germany, UNECA, the World Bank, International Growth Center (IGC), APRA/IDS, CEPHEUS/Growth Capital Partners, and *Frontieri*.

## ***FOREWORD***

The Ethiopian Economics Association (EEA) is happy to issue the proceedings of the 17<sup>th</sup> International Conference (the 28<sup>th</sup> Annual Conference) on the Ethiopian Economy that was held from July 18 to 20, 2019 at EEA Multi-purpose Building 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 had 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 not only resident Ethiopian researchers, but also Ethiopian researchers based abroad as well as non-Ethiopian researchers throughout the world conducting research on Ethiopia, or more widely, present and discuss research findings.

This year's conference, as was last eight years, has been co-organized by the Ethiopian Strategy Support Program (ESSP) – the collaborative program of the International food Policy Research Institute (IFPRI) and the Ethiopian Development Research Institute (EDRI). It was also co-sponsored by IFPRI/ESSP, Initiative Africa, Friedrich Ebert Stiftung of Germany, UNECA, the World Bank, International Growth Center (IGC), APRA/IDS, CEPHEUS/Growth Capital Partners, Frontieri, etc. The Association well recognized the support of sponsors and partners institutions during the opening and closing time of the conference and by displaying the support at the conference program, which has been distributed to all participants and medias; and banners at different corners of the venue.

At the conference about 50 presentations were made in four plenary, three parallel sessions and two panel discussions with the attendance of about 950 persons in three days. In addition, one key note speech was also organized. Out of the total 50 presentations, about 26 were presented by partner institutions like IFPRI-ESSP, International Growth Centre (IGC), United Nation Economic Commission for Africa (UNECA), the World Bank, etc. The rest 24 papers were presented by individual researchers.

The 17th International Conference on the Ethiopian Economy was opened by H.E. Dr. Eyob Tekalgn Tolina, State Minister of the Ministry of Finance of the Federal Democratic Republic of Ethiopia at the presence of higher dignitaries and invited guests. The presence of H.E. Dr. Eyob Tekalgn, who greatly honored us by opening officially the conference and explaining the Government direction of the Economic Reform Program demonstrate the value of the conference to the economic policy making process of the country. H.E. Dr. Eyob Tekalgn not only graced the conference by officially opened the conference, but also by attending all events of the conference up to coffee break that include Presidential Address by Dr. Abebe Aemro Selassie, African Director of IMF, delivering Honoring Certificates to key partner institutions and attending the Launching of Oxford Handbook of the Ethiopian Economy.

The participants of the conferences were drawn from different international organizations, Federal and Regional Government Offices, Universities and Colleges across the country, Civil Society Organizations, local and international Research institutes and scholars from universities across Europe and Africa.

The editorial committee reviewed papers that were presented for the publication of the proceedings of the conference and communicated its comments and suggestions including editorial comments to authors. After passing all these process and language editing, the editorial committed selected 15 papers to be included in the proceedings.

At this juncture, on behalf of the Ethiopian Economics Association, I would like to thank the Ethiopian Strategic Support Program (ESSP) of the International Food Policy Research Institute (IFPRI), for being a regular co-organizer of the EEA's International conferences since 2010. My appreciation also goes to the authors of the papers and the conference participants whose active participations made the conference meaningful and dynamic. The many professionals who dedicated their time to the conference and served as chairpersons deserve due thanks for their special contributions. The staffs of the EEA 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.

I also want to extend my personal gratitude to the members of the Executive Committee of the Ethiopian Economics Association for the dedicated services and the leadership they provided to the Association.

Our special thanks go to our partners who have shared our vision and provided us with generous financial support to operationalize the activities of EEA. These include, Think Tank Initiative of the International Development Research Center (IDRC) of Canada and the Friedrich Ebert Stiftung of Germany.

I would like also to extend my sincere gratitude to H.E. Dr. Eyob Tekalgn Tolina, and Dr. Abebe Aemro Selassie for their insightful address; and other senior government officials who spared their busy schedule and participated in the conference.

Finally, I would like to convey the message that our Association is willing to strengthen its capacity and seek new ways of addressing the economic problems and to be of better service and to meet the expectations of its members and the public at large.

A handwritten signature in blue ink, appearing to read 'Tadele Ferede', with a stylized flourish at the end.

Tadele Ferede (PhD)  
President  
Ethiopian Economics Association

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# **The Inter-linkage between Institutional Quality and Economic Development in some Selected African Countries: Panel Data Approach**

**Wondatir Atinafu<sup>1</sup>**

## *Abstract*

*This paper examines the inter-linkage between economic development and institutional quality of some selected countries in Africa. Data for 27 African countries between 1996 and 2016 are used in a dynamic panel model of System GMM estimation. The results show that institutional quality significantly and positively affects development (real GDP per capita) indicating that better governance can enhance economic progress and vice versa. The causal link between governance and development is found to be bi-directional running both from governance to development and from development to governance. Except voice and accountability, all institutional quality indicators significantly affect economic development in Africa. The results further suggest that good governance has positive and significant impact on economic development in all the countries under consideration regardless of their level of growth, but is most desirable for lower income economies. However, there is no significant relationship between institutional quality and HDI. Furthermore, regression results demonstrate that the colonial background of countries was one of the factors for cross country variation of institutional quality in Africa. Policies formulated to improve governance and development should not be treated as different strategies; they have to be treated as integral components of the same strategy.*

**Key words:** Africa, Economic development, Institutional Quality, Panel data, GMM

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## **Acronyms**

ADI = Africa Development Indicators

DIFF-GMM = Difference Generalized Method of Moments

FD = Financial Development

RGDPPCGR = Real Gross Domestic Product Per capita Growth rate

GE = Government Effectiveness

GMM = Generalized Method of Moment

HDI = Human Development Index

IQ = Institutional Quality

IV = Instrumental Variable

LDCs = Less Developed Countries

MENA = Middle East and North Africa

NIE = New Institutional Economics

OLS = Ordinary Least Square

PS = Political Stability and Absence of Violence

RL = Rule of Law

RP = Rural Population

RQ = Regulatory Quality

SSA = Sub-Saharan Africa

SYS-GMM = System Generalized Method of Moments

TO = Trade Openness

UNDP = United Nation Development Program

VA = Voice and Accountability

WDI = World Development Indicator

WGI = World Governance Indicator

## **1. Introduction**

North defined institutions as "tools that are formulated and practiced by human beings to control their political, economic and social interaction" (North 1990, p.3), while Acemoglu et al. (2005), described the importance of economic institutions as "one that determine the incentives of and the constraints on economic actors, and shape economic outcomes". In a nutshell, North (1990) argues that if the "rules of the game" are such that agents can secure the returns of investing in physical capital, human capital and new ideas then these

investments will take place and economic progress will follow. Otherwise, people would invest in rent seeking, political competition and violence; and economic stagnation or decline would be the consequence.

Growth theories, especially, endogenous growth theory, have shown that economic development depends on accumulation of human and physical capital as well as access to modern technologies. Accumulation of these factors is likely to be influenced by institutional characteristics: the distribution of political and civil rights, government effectiveness, the quality of the legal system and regulatory policies, better control of corruption and so on. However, identifying the underlying effect of institutions on economic development, measuring its size, and understanding the mechanism of transmission of institutional quality to growth, are difficult issues.

Why are some countries rich and others poor? Since Solow (1956), the tentative answer has been differences in capital accumulation and technical change, but this is unsatisfactory as the theory fails to explain what accounts for these differences. Endogenous growth theories (Aghion and Howit, 1992; Romer, 1990) emerged to answer the question and argue that differences in research and development and human capital led to differential growth in technical change and accumulation. Still, why do some countries invest more in education and innovation? North (1990), Acemoglu and Robinson (2003) and other New Institutional Economists contended differences in institutions could explain the differences in economic performance across time and space. Some authors (Khan, 2010; Chang, 2011; and Reinert, 2007) argued that it wasn't institutions that caused growth; rather, it was a country's economic structure that was the fundamental cause of economic performance, emphasizing that it was worth investigating the relationship between institutions and development in the African context.

The question of why Africa is one of the poorest continents in the world continues to be a fascinating one. The region's slow pace of development and its lack of convergence with its developed counterparts in terms of income and productivity have been academically stimulating. What is readily observable is that despite the large number of studies on this question, there has been no consensus among researchers on the underlying factors of this sluggish economic performance. The literature provides various explanatory theories and postulations: institutional and policy (Kilish et al., 2013), geographic (Sachs, 2015)), cultural and historical (Acemoglu et al., 2000) or trade (Baltagi et al.,

2009). All have emerged in recent years to try to explain growth differences across African countries.

Interestingly, there is also a growing body of literature that places a lot of emphasis on the role of institutions in explaining growth differences across countries. In effect, this literature has shifted the question from “getting prices right” to “getting institutions right”. It is also worthy of note, despite the large number of studies on the effect of institutions on economic growth, that the effect of economic development on institutional quality and the question of which comes first, remains a void in the literature. This remains a wide gap in the New International Economics (NIE) literature and this needs to be explored. The question that is left unanswered in the region is whether institutional quality is the cause or consequence of economic development. Thus, the thrust of this paper is the attempt to analyze the causal relationship between institutional quality and economic development in the African context.

Several empirical studies have been undertaken by different scholars on the unidirectional flow from institutions to economic progress including: Basu and Das (2010), Lennart (2016), Hadhek et al. (2012), Kilish et al. (2013), Constantinos et al. (2014), and Ifere et al. (2015). However, the existing theoretical and uni-directional empirical results are inconclusive, making it difficult to draw unambiguous conclusion about the nexus between economic development and institutions in LDCs in general and Africa in particular. Hence, the purpose of this study is to fill this gap by attempting to see the bi-directional causation between institutions and economic progress in the African context using a dynamic panel regression model.

Among the prior studies in this area, Ifere et al. (2015), and Lennart (2016) employed the Ordinary Least Squares (OLS) method of estimation. Using an OLS estimator for the estimation of dynamic panel model is, however, both biased and inconsistent and thus, this paper has used the a GMM estimation method which produces more efficient parameter estimates than many other techniques, including OLS and Random and Fixed Effects, particularly in instances of endogeneity and multicollinearity. It might also eliminate any bias rigorously related to unobserved individual heterogeneity and provide a better picture of the estimation results. The study also investigated the institutional quality of selected countries based on their colonial experience, an approach that we believe has not been used in the literature.

The overall objective of this study then is to investigate the interlinkage between institutional quality and economic development in the context of selected African countries. More specifically, it aims to investigate the direction of causation between institutional quality and economic development, to identify which of the governance indicator(s) matter most in Africa, and to analyze whether there is any difference in institutional quality between the selected countries based on their past colonial experience.

The remainder of the paper is organized in four sections. Section 2 includes a review of the relevant literature; Section 3 provides data and descriptive statistics; and Section 4 offers the findings and discussion of results. Section 5 provides the conclusion.

## **2. Brief Review of the Literature**

The debate regarding the direction of causation between economic progress and institutional quality has been ongoing during the last few decades. On one hand, the new institutional economists such as North (1990), Acemoglu, Johnson and Robinson (2005), Murphy et al (1993) and Iqbal and Daly (2014), argue that better institutional quality leads to better economic progress. On the other, ((Khan (2010); Chang (2011); Reinert (2007); and Glaeser et al. (2004)) contend that economic growth is the cause of better institutional quality, maintaining improved economic progress is vital to construct well-developed institutions. It is true that economic development changes institutions in number of ways. Increased wealth from growth may create demands for higher-quality institutions and greater wealth makes better institutions more affordable. Institutions are costly to establish and run, and the higher their quality the more 'expensive' they become. In addition, economic development also creates new agents of change which demand new institutions. (Chang 2011). North, however, stresses that institutions affect investment in physical and human capital, as well as the organization of production (North, 1990). In order to reach a high level of output per worker, social infrastructure should provide an environment that supports productive activities, encourages capital accumulation, skill acquisition, invention and technology transfer (Hall and Jones 1999).

Earlier studies have provided a number of insights regarding the impact of institutions on economic growth by focusing on the uni-directional perspective, that is from institution to development. Among these, Basu and Das (2010) used

the Li-Racine generalized Kernel estimation methodology (Li and Racine, 2004) to study the relationship between institutions and development, based on data for 102 countries between 1980 and 2004. Their results indicated institutions had a positive impact on the level of development. Lennart (2016), assessed the nexus between institutions and economic growth in Africa for the period between 1999-2014 using OLS estimation technique and the results revealed that institutions positively and significantly affected economic growth in Africa. Hadhek et al. (2012) also studied the effect of institutional factors on investment and economic growth for a set of 11 countries in the MENA region during the period 2000-2009, using a model of dynamic panel data. Their paper found a significant relationship between institutional variables and economic growth.

Kilish et al. (2013) conducted a study on the role of institutions on economic performance in SSA using Arellano and Bond first difference and Blundell-Bond System Generalized Method of Moment estimators to estimate specified models. The result emphasized that institutions really matter for SSA's economic progress. Ifere et al. (2015) studied the relationship between institutional quality, macroeconomic policy and economic development in Nigeria using OLS estimation technique for the period of 1995 up to 2013, finding that institutions had only an insignificant impact on Nigeria's economic development. Constantinos et al. (2014) studied the relationship between institutional quality and economic growth for the Sudanese economy between 1972 and 2008. By using an ARDL bounds-testing approach to co-integration as proposed by Pesaran et al. (2001), the empirical results obtained suggested that, for the Sudanese economy, the quality of the institutions was one of the most important defining factors of economic prosperity.

Despite such support for the positive impact of good governance on economic growth, there are some studies that show contrary results. One important challenge to the significance of good governance for the economic growth of African countries came from an empirical analysis by Sachs et al., (2004) which shows differences in performance among African countries cannot be explained by differences in the quality of their governance.

Overall, there is no agreement on the causal linkage between institutional quality and economic development. Most of the empirical studies that have been carried out have focused on the direction of causality from institutions to economic progress; the reverse direction certainly needs further empirical investigation.

### **3. Methodology of the Study**

#### **3.1 Data Type, Source and Method of Analysis**

The study considered the annual data of 27 selected African countries for the years from 1996 to 2016. The data sources were the WDI (2010, 2012 and 2017); UNDP reports and the WGI database. In this study, both descriptive and econometric data analysis methods are employed.

#### **3.2 Model Specification**

The basic model for dynamic panel with additional explanatory variable can be written as:

$$Y_{it} = \alpha Y_{it-j} + \sum \beta X_{it} + \delta Z_{it} + \varepsilon_{it}, \text{ where } \varepsilon_{it} = \mu_i + \lambda_t + v_{it} \quad (3.1)$$

Where, Y and X are economic development or institutional quality, alternatively. Z represents control variables used as a mediator between governance and development such as Trade openness, human and physical capital.  $i = 1, \dots, N$  is cross-section/country while  $t = 1, \dots, T$  is time period. The denotations  $\mu_i$ ,  $\lambda_t$ , and  $v_{it}$  are individual effects, time effects, and disturbance terms respectively.

Specific to our objectives of examining the relationship between institutional quality and economic development using dynamic panel data, our paper rests on the following basic model:

$$Y_{it} = \alpha Y_{i, t-j} + X_{it} + \delta Z_{it} + \varepsilon_{it} \quad (3.2)$$
$$\varepsilon_{it} = \mu_i + \lambda_t + v_{it}$$

In fact, the study contains three basic models to capture the nexus between institutional quality and economic development. Colonial dummies were also incorporated in the last model to analyze whether there was any difference in institutional quality between the selected countries on the basis of their past colonial experience.

The equation 3.3 specifies the effect of governance on development. That is,

$Y_{it} = \gamma + \sum_{j=1}^m \alpha_j Y_{i, t-j} + \sum_{r=0}^n \beta_r X_{i, t-r} + \sum_{k=0}^q \delta_k Z_{i, t(L)} + \mu_i + \nu_{it}$  To put it in another form, the model is defined using the variables of interest as:

$$\text{LnGDPPC}_{it} = \gamma + \sum_{j=1}^m \alpha_j \text{LnGDPPC}_{i, t-j} + \sum_{r=0}^n \beta_r \text{IQ}_{i, t-r} + \text{koTO}_{it(L)} + \text{k1GER}_{it(L)} + \text{k2GIR}_{it(L)} + \mu_i + \nu_{it} \quad (3.3)$$

Where LnGDPPC = Natural logarithm of Gross Domestic per capita (proxy for economic development); IQ = Institutional Quality; TO = Trade Openness; GER = Gross Enrollment Ratio (proxy for human capital) and GIR = Gross Investment Ratio (proxy for physical capital).

The equation (3.4) is similar to equation (3.3), but this uses HDI (proxy for economic development) as a dependent variable. To put it in another form, the model is defined as:

$$\text{HDI}_{it} = \gamma + \sum_{j=1}^m \alpha_j \text{HDI}_{i, t-j} + \sum_{r=0}^n \beta_r \text{IQ}_{i, t-r} + \text{koTO}_{it(L)} + \text{k1GER}_{it(L)} + \text{k2GIR}_{it(L)} + \mu_i + \nu_{it} \quad (3.4)$$

The following equation is also similar to equation (3.2) with the exception of interchanged denotations between Y and X and inclusion of colonial dummy:

$$\text{IQ}_{it} = \gamma + \sum_{j=1}^m \alpha_j \text{IQ}_{i, t-j} + \sum_{r=0}^n \beta_r \text{LnGDPPC}_{i, t-r} + \text{koTO}_{it(L)} + \text{k1GER}_{it(L)} + \text{k2GIR}_{it(L)} + \sum Dc + \mu_i + \nu_{it} \quad (3.5)$$

Lastly, equation 3.6 allows us to see the effect of economic development on governance quality by taking HDI as a proxy for economic development.

$$\text{IQ}_{it} = \gamma + \sum_{j=1}^m \alpha_j \text{IQ}_{i, t-j} + \sum_{r=0}^n \beta_r \text{HDI}_{i, t-r} + \text{koTO}_{it(L)} + \text{k3GER}_{it(L)} + \text{k4GIR}_{it(L)} + \sum Dc + \mu_i + \nu_{it} \dots \quad (3.6)$$

### 3.3 Estimation Method

The empirical model was estimated using the system Generalized Method of Moment (GMM) developed by Arellano and Bover (1995). The key intuition behind the GMM method is that the panel structure of the data provides

a large number of instrumental variables in the form of lagged endogenous as well as exogenous variables. The use of many instruments can improve the efficiency of various IV and GMM estimators (Blundell and Bond, 1998).

It is important to note that the use of lagged values (and first differences of lags) of the endogenous variables as an instrument would be invalid in the presence of serial correlation. We therefore conducted tests for serial correlation to judge the reliability of our estimates. Arellano and Bond (1991) provide a test for autocorrelation, AR (1) & AR (2), appropriate for linear GMM regression. If the test shows a first order autocorrelation but no second order autocorrelation, it indicates the instruments are valid.

In order to identify the causality between economic development and institutional quality, the study adopted the Engle-Granger causality test of panel data (Wald test).

## **4. Data Presentation, Discussion and Interpretation**

### **4.1 Data Presentation and Description**

The World Bank governance indicators, consisting of six indexes, are used as measures of institutions in this paper. They are: regulatory quality, voice and accountability, government effectiveness, political stability and absence of violence, rule of law, and control of corruption. Together, these indicators give the picture of governance performance of a country. Since data for the indicators are available for all countries of the world, it is easy to compare governance across countries. The value of each indicator ranges from 0 to 1. The closer the value is to zero, the weaker the quality of governance and the closer to 1 the better the quality of institutions.

### **4.2 Econometric Result and Interpretation: System GMM Econometric Analysis**

#### **I. The Effect of Institutional Quality on Economic Development**

##### **A. Taking GDP per capita as a proxy for economic development**

In model (1A), log of GDP per capita (proxy for economic development) is the dependent variable while aggregated institutional quality (IQ) is among the independent variables. Trade Openness (TO), Gross Investment Ratio (GIR) and Gross Enrollment Ratio (GER) are additional explanatory variables in the models.

The regression result shows that GDP per capita is significantly affected by its lag, governance quality and all other control variables. Institutional quality is found to be significant (at five per cent significance level) indicating the existence of strong positive relationship between governance quality and level of economic development. The positive coefficient shows that improved governance implies better economic progress and vice versa. The result is consistent with the theoretical and empirical justifications given by Acemoglu (2003), Hall and Jones (1999), Iqbal and Daly (2014), Campos and Nugent (1999) and Chauvet et al. (2004)

**Model 1A: Two-step GMM regression result of economic development-institutional quality**

Regressors	Coefficient	Std. Error	Z-statistics
LnGDPPC t-1	0.91 ***	0.03	30.32
IQ	0.157**	0.071	2.22
TO	-0.0033***	0.0012	-2.74
GIR	0.0163***	0.0025	6.52
GER	0.002***	0.0005	4.02
Const.	0.424**	0.017	24.93
Specification Test Statistics			
AR (1) P-value = 0.45			
Wald Stat, P-value = 0.000 Chi2 (5) = 8655.6 Ho: LnGDPPCt =LnGDPPCt-1 = 0			
Sargan Test Chi2 = 9 (0.688)		Hansen test Chi2 =9 (0.68)	
Number of Observation = 81			
Number of Group = 27			

Unexpectedly, “Trade openness” statistically significant at one per cent, has a negative regression coefficient of (-0.0033) meaning that it has a negative effect on economic development of the countries under consideration. This result can be justified by the fact that most of these countries suffer from unfair trade with developed countries. Also, by liberalizing trade these countries open up opportunities for developed countries to dump manufactured commodities, indirectly killing infant domestic industries, resulting in an unfavorable internal economic situation.

Following the finding that institutional quality is an important determinant of economic development in Africa, we investigated whether the impact of governance quality differed according to conditional distribution of income. To capture this, three independent regressions were conducted by classifying the sampled countries into different groups depending upon their levels of income. Using the World Bank (2016) classification of countries based on GNI per capita, the countries were categorized as low-income economies (12 countries), lower middle-income economies (10 countries) and upper middle-income countries (5 countries). Prior to examining the effect of governance on economic development of countries at different level of income, we also checked whether governance quality differed across different income levels, analyzing this using a dummy variable. The dummy was created by subdividing countries as middle- and lower-income countries. The result obtained from the regression showed there was a statistically significant difference in the institutional quality of the two income groups (see Appendix 1). It appears middle-income countries have relatively better governance quality than lower-income economies.

The result of the below table indicates that institutional quality has a positive and significant<sup>2</sup> impact at all levels of growth, except low-income countries, and has a larger positive impact on the lower income economies. The result indicates that good governance is desirable at all levels of growth, but it is more important for lower income categories than for the middle-income economies.

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<sup>2</sup> The result obtained by subdividing the countries in terms of their level of income may not be strong enough because of insufficient number of countries (observations) under consideration.

**Model 1B: Two-step GMM regression outcome of governance quality effect on economic development of different income group**

Variables	Low-income economies	lower middle-income economies	Upper middle-income economies
	Model (I) Coeff.	Model (II) Coeff.	Model (III) Coeff.
LnGDPPCt-1	0.92 *** (0.32)	0.87 *** (0.03)	0.85 *** (0.025)
IQ	0.321 *** (0.116)	0.26 ** (0.11)	0.11 ** (0.051)
TO	-0.054 *** (0.0046)	-0.0012** (0.0005)	-0.03 ** (0.013)
GIR	0.023 ** (0.011)	0.02 ** (0.009)	0.018*** (0.0015)
GER	0.0071 * (0.004)	0.0062 ** (0.003)	0.008*** (0.0021)
Const.	0.294 ** (0.114)	0.215* (0.101)	0.205 ** (0.095)
Hansen- Sargan Test P-value	0.28	0.55	0.20
AR (1) P-value	0.31	0.36	0.23
Wald test	0.000 (8596.7)	0.000 (7,025)	0.000 (4,852)
No. of obs.	36	30	15
No. of groups	12	10	5

*B. The separate effect of institutional indicators on economic development (GDP per capita)*

The separate impact of the six governance indicators on economic development was analyzed using a regression shown in Model (1C). The analysis helped to identify the indicator with the most powerful impact and lay foundation to identify the area of attention (among the governance indicators) in accelerating economic development.

Model (a) represents a development model where governance quality is represented by control of corruption (CC). Model (b) is the same model with political stability and absence of violence (PS) denoting governance quality. Similarly, models (c), (d), (e) and (f) are development models where government effectiveness (GE), regulatory quality (RQ), rule of law (RL) and voice and accountability (VA) respectively are the variables of interest.

The result from Model (1C) shows that control of corruption (CC)<sup>3</sup> affects economic development significantly at five percent significance level with the coefficient of 0.211. It is found that an economy with lower corruption can

<sup>3</sup> The value of each indicator ranges from 0 to 1. The closer the value is to zero, the weaker the quality of governance and the closer it is to 1 the better the quality of the indicator.

realize better development and vice versa. This implies that the country that can control the extent to which public power is exercised for private gain, including petty and grand forms of corruption, can enjoy faster economic progress. This finding is consistent with the argument of Murphy et al., (1993).

Political stability and the absence of violence (PS) were found to be positively and statistically significant at ten percent level of significance, implying that political institutions seem to be correlated with the economic progress of sampled countries, and suggesting good political institutions generate economic institutions that are less fragile and able to influence economic activity. Indeed, when property rights and contractual rights are poorly protected and the legal structure is weak or unhealthy, it is impossible to stimulate economic activity, or realize good economic performance. An economy with no violence and characterized by political stability has better prospects of economic development and vice versa. This implies that in a situation where the likelihood of the government to become destabilized or overthrown by unconstitutional and violent means is high, it is hardly possible to achieve accelerated economic development.

As indicated in (Model 1C), the regulatory quality (RQ) of the government has positive and statistically significant impact on the economic development of African countries. This result suggests that the ability of the government to formulate and implement sound policies could contribute to the increment in RGDP per capita. Moreover, rule of law (RL) that measures the enforceability of contracts as well as the effectiveness and predictability of the judiciary affects economic development positively and significantly (at ten percent significance level). In cases where the rule of law is weak, economic progress slows down while a strong rule of law catalyzes economic expansion. This finding supports the empirical investigation of Kilishi et al. (2013).

Government effectiveness (GE) which covers the quality of public services, the quality of civil services, the degree of their independence from political pressure, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies is found to have positive and significant impact on economic development. However, voice and accountability (VA) was found to be insignificant in affecting economic progress. Contrarily, all control variables came out with significant and positive coefficients, conforming to a priori expectation, with the exception of trade openness which contributed negatively.

**Model 1C: Two-step GMM regression outcome of economic development-institutional quality model by considering six governance indicators as regressors.**

Variables	Model (a) Coeff.	Model (b) Coeff.	Model (c) Coeff.	Model (d) Coeff.	Model (e) Coeff.	Model (f) Coeff.
LnGDPPCt-1	0.834*** (0.53)	0.883*** (0.033)	0.921*** (0.031)	0.863*** (0.044)	0.877*** (0.038)	0.891*** (0.04)
TO	-0.0024* (0.0013)	-0.00024** (0.0011)	-0.0057*** (0.002)	-0.0001 (0.002)	-0.0034** (0.0015)	-0.0033*** (0.0012)
GIR	0.0186*** (0.0033)	0.02*** (0.003)	0.02*** (0.0027)	0.018*** (0.0033)	0.041*** (0.003)	0.023*** (0.0028)
GER	0.0035*** (0.0007)	0.0023*** (0.00073)	0.0024*** (0.00045)	0.00132*** (0.00034)	0.0024*** (0.0005)	0.0036*** (0.0005)
CC	0.211** (0.09)					
PS		0.158* (0.094)				
GE			0.235** (0.1)			
RQ				0.3** (0.138)		
RL					0.233* (0.12)	
VA						0.106 (0.11)
Const.	0.773** (0.324)	0.385** (0.191)	0.353* (0.205)	0.49** (0.242)	0.515*** (0.154)	0.345*** (0.21)
Hansen-Sargan Test P-value	0.695	0.475	0.66	0.628	0.442	0.532
AR (1) P-value	0.52	0.43	0.19	0.72	0.68	0.24
Wald test	0.000 (1794)	0.000 (5745)	0.000 (1867.1)	0.000 (922.95)	0.000 (1525.84)	0.000 (5677.9)
No. of obs.	81	81	81	81	81	81

Generally, the regression outcome indicated that control of corruption, political stability and absence of violence, government effectiveness, regulatory

quality and the rule of law all independently demonstrated very strong significance, implying that these variables can provide more explanation of economic development (GDP per capita) than any others.

*C. Taking Human Development Index as a proxy for economic development*

Unlike GDP per capita, when HDI is taken as a proxy for economic development, there is no significant relationship between governance and economic progress. This implies that among the three components of HDI, governance quality is more highly correlated with income than with education and health in the countries under consideration. This can be explained by the fact that almost all countries in Africa were building economic progress by exporting natural resources, the root cause for corruption and political instability which in turn reduced governance quality.

**Model 2A: Two-step GMM regression result of economic development-institutional quality model (taking HDI as a proxy for economic development)**

<b>Regressors</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>Z-statistics</b>
HDI t-1	0.871***	0.063	13.54
IQ	0.0022	0.024	0.09
TO	-0.001***	0.0003	-3.33
GIR	0.00043***	0.00012	3.56
GER	0.00045**	0.0002	2.24
Constant	0.036**	0.0162	2.23
<b>Specification Test Statistics</b>			
AR (1) P-value = (0.26)			
Wald Stat, P-value = 0.000 (1754.21)		Ho: HDIt = HDIt-1 = 0	
Sargan Test Chi2 = 9 (0.902)			
Number of Observation	81		

This shows governance quality in Africa is closely associated with income rather than health and education, a result in line with the findings of Islam et.al (2005), Congdon Fors and Olsson (2005).

*D. The separate effect of institutional indicators on economic development (HDI)*

The individual impact of the six institutional quality indicators on economic progress was analyzed using a separate regression shown in Model (2B).

The result revealed that political stability and absence of violence (PS) affects the human development index (HDI) positively and significantly at ten percent significance level (with the coefficient of 0.024). An economy associated with better political stability can realize better economic development and vice versa, because an absence of political turmoil enables the expansion of qualified health and education centers which in-turn raises the HDI of the country. Two major components of HDI, education and health, are often provided by foreign civil societies and NGOs in Africa. These organizations usually demand political stability and an absence of violence before establishing centers. As a result, the existence of political stability is a defining factor for better economic progress.

Voice and accountability, however, have negative impact on institutional quality in Africa, although the indicator comes out statistically significant at five per cent level of significance. Control of corruption, government effectiveness, regulatory quality and rule of law were found to be statistically insignificant, implying that the fight against corruption, government implementation capacity and the likelihood of crime and violence do not seem to be correlated with the HDI of the sampled countries.

The result from Model (2A) also shows that HDI is significantly affected by its lag, trade openness, gross investment ratio and gross enrollment ratio. Institutional quality is found statistically insignificant in affecting economic development, indicating the absence relationship between governance quality and level of human development index. This is due to the tradeoff between the effect of each of the institutional quality indicators of HDI (see Table, Model 2A) with political stability having a positive effect and voice and accountability a negative effect. When we take the averaged institutional quality index, the negative effect of voice and accountability offsets the positive impact of political stability. The net impact of governance quality on HDI becomes insignificant. This result negates the argument of the institutions hypothesis that is some societies have good institutions that encourage investment in machinery, human capital, and better technology, and can as a result achieve economic prosperity (Acemoglu (2003).

**Model 2B: Two-step GMM regression outcome of economic development-institutional quality model by considering six governance indicators as regressors**

Variables	Model (a) Coeff.	Model (b) Coeff.	Model (c) Coeff.	Model (d) Coeff.	Model (e) Coeff.	Model (f) Coeff.
HDI <sub>t-1</sub>	0.767*** (0.067)	0.763*** (0.078)	0.827*** (0.043)	0.852*** (0.048)	0.821*** (0.05)	0.839*** (0.066)
TO	-0.0012*** (0.0003)	-0.0006** (0.00024)	-0.0007* (0.0004)	-0.001*** (0.00035)	-0.0014*** (0.0002)	-0.001** (0.0002)
GIR	0.0063*** (0.0011)	0.0045*** (0.0008)	0.0048*** (0.0008)	0.0055*** (0.0008)	0.006*** (0.0009)	0.004*** (0.0005)
GER	0.0007** (0.0003)	0.0005*** (0.00003)	0.0002* (0.00012)	0.0004*** (0.0001)	0.0005* (0.0003)	0.0007** (0.0003)
CC	-0.0114 (0.028)					
PS		0.024* (0.011)				
GE			-0.0344 (0.042)			
RQ				-0.01 (0.03)		
RL					-0.007 (0.021)	
VA						-0.026 ** (0.012)
Const.	0.0481** (0.023)	0.0514** (0.024)	0.063*** (0.021)	0.088*** (0.017)	0.095*** (0.025)	0.0514* (0.03)
Hansen-Sargan Test P-value	0.632	0.24	0.3	0.526	0.736	0.528
AR (1) P-value	0.32	0.49	0.61	0.73	0.55	0.47
Wald test	0.000(452.5)	0.000 (1298)	0.000(733.4)	0.000(524.1)	0.000(739.2)	0.000(1858)
No. of obs.	81	81	81	81	81	81

The final regressions, of the coefficients of physical capital (GIR) and human capital (GER), came out with significant and positive results, conforming to a priori expectation. These results confirm the relevance of the augmented Solow model in explaining Africa's economic progress. Investment in physical and human capital is important in promoting rapid growth in Africa.

## II. The effect of economic development on institutional quality

### A. Taking GDP per capita as a proxy for economic development and including colonial dummy

Looking at the effect of development on institutions, GDP per capita is found to be positively and significantly related to governance quality (at one percent level of significance), implying that economic progress is one of the most important determinants of institutional quality in Africa. The result strongly supports the argument of Chang (2011).

### Model 3A: Two-step GMM regression result of institutional quality - economic development

Regressors	Coefficient	Std. Error	Z-statistics
IQ t-1	1.026***	0.023	44.67
GDPPC	0.001***	0.0003	3.31
GIR	0.0007**	0.0003	2.33
TO	-0.001***	0.0002	-5.07
GER	0.0005***	0.00013	3.85
Colonial Dummy			
0	0		
BRITISH	0.021***	0.006	3.48
Constant	0.043***	0.01	4.3
Specification Test Statistics			
AR (1) P-value = (0.70)			
Wald Stat, P-value = 0.000		Ho IQ <sub>t</sub> = IQ <sub>t-1</sub> = 0	
Sargan Test Chi2 = 67(0.721)			
Number of Observation	76		
Number of Group	26		

In addition to looking at the effect of economic development on governance quality, colonial dummies are incorporated in this model to analyze whether there was any difference in institutional quality between selected countries on the basis of their past colonial experience.

Acemoglu, Johnson, and Robinson (2000), detail the way European powers set up “extractive states” in many colonies in Africa, Central America, and South Asia. Their institutions (broadly construed) did not introduce much protection for private property, nor did they provide checks and balances for governance. The explicit aim of the colonial powers was extraction of resources

in one form or another. This underlines the need to check the governance quality of countries based on their colonial history.

We created a dummy variable by classifying countries as British or non-British colonies as most had been British colonies, and it was difficult to create additional dummies for other colonizers because of the lack of sufficient 0's and 1's, a precondition for valid dummy variable regression. Britain, unlike other colonial powers, followed a process of indirect rule, expected to open the door for colonized countries to build their own governance structures.

The result in Table (Model 3A) above indicates that our dummy is significant at 1per cent level of significance suggesting a significant difference between the institutional quality of countries colonized by Britain and countries colonized by others (France, Portugal and Belgium). So, the difference in institutional quality of African countries arising from their colonial history is one important factor for cross-country variation of institutional quality in Africa. This result supports colonial heritage argument, that historical accident has a major role in explaining the current quality of institutions in the region. It is often argued that colonial institutions persist in some form or other and determine the quality of current institutions.

In general, the French administrative system was more centralized, bureaucratic, and interventionist than the British system of colonial rule. The other colonial powers, Portugal and Belgium, used varied administrative systems to facilitate control and economic exploitation. However, no matter the system, all were alien, authoritarian, and bureaucratic. They distorted African political and social organizations and undermined their moral authority and political legitimacy as governing structures.

*B. Taking HDI as a proxy for economic development and including colonial dummy*

HDI was found to be statistically insignificant in relation to governance quality of the countries in the study, implying that HDI is not one of the more important defining factors of institutional quality in Africa.

**Model 3B: Two-step GMM regression result of institutional quality-economic development**

Regressors	Coefficient	Std. Error	Z-statistics
IQ t-1	0.71***	0.078	9.1
HDI	0.012	0.08	0.15
TO	-0.002***	0.0003	-6.67
GIR	0.004***	0.0012	3.33
GER	0.00034***	0.0001	3.38
Colonial Dummy			
0		0	
British	0.06***	0.0145	4.14
Constant	0.094**	0.037	2.53
Specification Test Statistics			
AR (1) P-value = (0.32)			
Wald Stat, P-value = 0.112 (96.8)		Ho IQt = IQt-1 = 0	
Sargan Test Chi2 = 14 (0.206)			
Number of Observation	76		

The result here in regard to the colonial dummy is similar to the outcome of Model (3A), confirming the existence of an institutional quality difference between British and non-British colonies.

**4.2.3 Causality results**

To test whether economic development Granger-causes institutional quality, the coefficients of lags of economic progress (from models 1 and 2) were tested jointly employing a Wald test. The null hypothesis that economic development does not Granger-cause institutional quality was tested against the alternative that at least one of them is different from zero. The Wald test result from models 1 and 2 rejected our null hypothesis of no causality. This indicates that economic development Granger-causes institutional quality which in turn means that current and past information on economic progress helps to improve prediction of governance quality. Meaning that, better institutional quality is the result of better economic development in Africa.

Similarly, the null hypothesis that the coefficients of lagged values of institutional quality (in Model 3A) are jointly equal to zero was tested against the

alternative that at least one of them was different from zero. The Wald test, again, rejected the null hypothesis of no causality, showing that governance quality also Granger-causes economic development. In other words, current and past information on institutional quality does help to improve the prediction of economic prosperity. The causality test result implies that institutional quality and economic development (GDP per capita) have bi-directional causality running both from governance to development and from development to governance. However, in Model 3B (economic development proxied by HDI), the Wald test failed to reject the null hypothesis of no causality showing that institutional quality does not Granger-cause economic development (HDI).

#### **4.2.4 Arellano-Bover Estimation Diagnostic Tests**

In most instances one and/or two post-estimation procedure(s) is (are) undertaken to evaluate the Arellano and Bover (1995) and Blundell and Bond (1998) model. Two types of diagnostic test were used to determine the validity of the empirical models. These included the Hansen-Sargan test of identifying restrictions and an autocorrelation test. The tests are reported at the lower end of each table corresponding to each model.

##### ***1. Test of over identifying restrictions***

The Hansen-Sargan test of identifying restrictions under the null hypothesis of the validity of instruments (Roodman, 2006) examines the quality of specification of the model and the appropriateness of the instruments used. For all models, a high p-value of Hansen-Sargan test statistics was observed and hence the null hypothesis was not rejected. This showed that all specifications were well specified and that the instruments were appropriate.

##### ***2. Test for autocorrelation***

The test results of first-order autocorrelation (AR (1)) reported for each model showed that the null hypothesis of no autocorrelation was not rejected as the p-values exhibited insignificant coefficients. The observed high p-value results of AR (1) in all of our models revealed the instruments used in all models to be independent of the error term and hence appropriate for the estimation. It also indicated the consistency of our estimates and the validity of the System GMM estimator.

## **5. Conclusion and Implications**

### **5.1 Conclusion**

To capture the inter-linkage between economic development and institutional quality, the GDP per capita and human development index (HDI) were used as proxies for economic development while governance quality was proxied by an average institutional quality index aggregated from the six independent indicators. The parameters of the model were estimated using panel data by Arellano and Bover's dynamic panel data estimation technique. The estimation result of the first model shows that aggregated institutional quality positively and significantly affected real GDP per capita. More specifically, looking at the impact of each of the governance indicators on economic development, with the exception of voice and accountability, all showed a strong positive impact on economic progress. After disaggregating countries in terms of their levels of income, the results we obtained suggest good governance has positive and significant impact on economic development in all the countries under consideration regardless of their level of growth, though better institutions remain highly desirable for lower income economies.

The estimation result of the second model gave an unexpected outcome of no significant relationship between governance quality and economic development. In addition, when we analyzed the separate effect of governance indicators on HDI, only political stability and voice and accountability were found to be significant with positive and negative coefficients respectively. This implies the transmission mechanism of institutional quality to development is through income.

The last model which captured the causation showed that institutional quality was positively and significantly affected by economic development and vice versa. The estimation results showed the relationship between development and governance to be bi-directional, meaning governance has a statistically significant effect on economic development and economic development also has a significant effect on institutional quality. It is shown that institutional quality Granger-causes development, and development also Granger-causes governance quality. This indicates the growth of one will be retarded unless the other is carefully managed.

Furthermore, the regression result shows that there is a significant difference between the institutional quality of countries colonized by Britain and

countries colonized by France, Belgium and Portugal. The colonial background of the countries is certainly one of the factors for cross-country variation of institutional quality in Africa.

In sum, development and governance do have a significant relationship, with bi-directional causality running in both directions. Control of corruption, political stability and absence of violence, regulatory quality, rule of law, and government effectiveness, independently and significantly, affect economic development.

The salient conclusion to be drawn from this study is that good governance is important for the economic progress of African economies, especially those countries which are at the low end of income levels. In addition to improvement in quality of institutions, two other variables seem to matter for Africa's progress too, increase in investment in physical and human capital, but trade openness has negative effect on African economic development. Economic development (RGDP per capita) is the most important defining factor of governance quality in Africa.

## **5.2 Policy Recommendations**

The significance and bi-directional causality between economic development (GDP per capita) and institutions necessitates a need to formulate "development-inducing", "good governance" strategies. Since the causality runs from both directions, governments should place "development-inducing" and "good governance" simultaneously among their priorities. Due attention, also, must be given to improve the quality of governance while working towards accelerating economic development. Stakeholders should not treat these as different strategies; rather they should be seen as integral components of the same strategy.

To achieve sustainable economic development in Africa, both domestic and external policy makers have to place significant emphasis on the maintenance of political stability, government effectiveness, regulatory quality, rule of law, and control of corruption. More specifically Governments should formulate and implement sound policies and regulations that encourage private sector development and ensure effectiveness by enhancing the quality of public and civil services and of policy implementation. Countries should eliminate the likelihood of government destabilization and domestic unrest; combat the practice of using

public position for private gain and maintain the effectiveness and predictability of their judiciary organs.

As institutional quality responds positively to the improvement in economic performance, there is also the need to design appropriate policies to promote economic growth; and African states should concentrate on policies to promote development since development certainly enhances institutional quality.

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## Appendices

### Appendix 1: Two-step GMM regression result after disaggregating countries in terms of level of income

Regressors	Coefficient	Std. Error
IQ t-1	0.93***	0.0134
LnGDPPC	0.0072**	0.003
GIR	0.0032*	0.0017
TO	-0.0053***	0.0014
GER	0.0005***	0.00013
Colonial Dummy		
0	0	
Lower-income	-0.0036*	0.002
Constant	0.096**	0.04
Specification Test Statistics		
AR (1) P-value = (0.002)		
AR (2) P-value = (0.25)		
Wald Stat, P-value = 0.000	Ho IQ <sub>t</sub> = IQ <sub>t-1</sub> = 0	
Sargan Test Chi2 = (0.361)		
Number of Observation	81	
Number of Group	27	

### Appendix 2: Countries selected for Analysis

Algeria	Morocco	
Angola	Mozambique	
nin	Namibia	
Botswana	Nigeria	
Camer	Rwanda	
Chad	Senegal	
Congo, Rep.	Tanzania	
Cote d'Ivoire	South Africa	
Ethiopia	Uganda	
Egypt	Tunisia	Ghana
Gabon	Zambia	Zimbabwe
Kenya	Mali	Malawi

# Explaining Macroeconomic Fluctuations in Ethiopia: The Role of Monetary and Fiscal Policies<sup>1</sup>

Alemu Lambamo<sup>2</sup>

## *Abstract*

*The aim of this paper was to examine the role of monetary and fiscal policies in explaining macroeconomic fluctuations in Ethiopia using a structural VAR and Factor Model approach. In order to identify monetary policy shocks, a synthetic monetary policy indicator was estimated by factor analysis based on 13 variables reflecting monetary conditions in Ethiopia. Along with the fiscal policy shocks, these were identified using non-recursive frameworks. The main results are that an increase in government spending has an expansionary effect on output while an increase in tax revenue is contractionary, with spending multipliers larger than net tax revenue multipliers; that contractionary monetary policy is associated with falls in output; and that the contributions of fiscal policy shocks are larger than those of monetary policy shocks in explaining movements in output, with roughly equivalent contributions coming from shocks in fiscal policy components. In addition, the effect of fiscal and monetary policy shocks on output and inflation improved qualitatively and quantitatively when both policy variables were jointly considered rather than estimating them separately. This suggests the importance of a joint analysis of fiscal and monetary policy shocks.*

**Key Words:** Fiscal Policy. Monetary Policy. Multipliers. Fluctuations. SVAR

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## 1. Introduction

This paper examines the impact and the relative importance of monetary and fiscal policies in Ethiopia's macroeconomic fluctuations using a structural VAR model. Ethiopia is an interesting case study because its economic growth has attracted international attention in recent years. It has been among the fastest-growing economies in the world ([Zerihun et al., 2016](#); [Priewe, 2016](#); [World Bank Group, 2017](#)). At the same time, inflation has been high, persistently exceeding double figures, reaching unprecedented levels, and becoming a centre of policy debate from 2002/03. Indeed, high and persistent inflation has been one of the policy challenges in sustaining the country's significant economic growth. Different explanations for the high growth and inflation dynamics have been put forward at individual and institutional level, though there has been a lack of sufficient empirical evidence to identify the relative importance of monetary and fiscal policy in explaining the macroeconomic fluctuations. One argument has been that Ethiopia's growth has been driven by large and persistent public spending in pro-poor and growth-enhancing sectors.<sup>3</sup> These sectors include agriculture and food security, roads, water and sanitation, education and health ([Zerihun 2016](#)) Zerihun 2016 with high and persistent inflation in the country mainly caused by expansionary monetary policy ([Priewe, 2016](#); [Zerihun et al., 2016](#); [Minyahil et al., 2016](#)). Although the size of macroeconomic fluctuations arising from the use of these two policy frameworks vary from one country to another, depending on socio-economic and political settings, at least two key factors can be drawn from this paper. First, these policies provide the most effective policy option for sustaining current high economic growth in Ethiopia and hence influence the measures that policymakers might take. Second, this is a good opportunity to provide some empirical evidence of business cycle fluctuations in small open emerging market economies, where such evidence has been limited.

Empirical evidence on the impacts of monetary and fiscal policies has fuelled ongoing debate in the literature. Though more focus has been devoted to the study of monetary policy than fiscal policy, at least up until the 2008 financial crisis ([Perotti, 2002](#); [Ramey, 2011a](#); [da Silva and Vieira, 2017](#)), the results obtained so far are far from conclusive for either policy options ([Rafiq and](#)

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<sup>3</sup> These sectors include agriculture and food security, roads, water and sanitation, education and health ([Zerihun et al., 2016](#)).

Mallick, 2008; Coibion, 2012; Barakchian and Crowe, 2013; Cloyne and Hurtgen, 2016).<sup>4</sup> Regarding monetary policy, its contribution to output and price fluctuations is variously seen as insignificant (Fetai, 2013), very small (Bernanke et al., 1997; Christiano et al., 1999; Bernanke et al, 2005; Cloyne and Hurtgen, 2016), relatively unimportant (Leeper et al., 1996) or of medium (Coibion, 2012), or large and sizable influence (Romer and Romer, 2004; Forni and Gambetti, 2010). Despite considerable empirical evidence about its efficacy, there remains disagreement about the effect of monetary policy on the macroeconomy (Cloyne and Hurtgen, 2016). Empirical studies have also failed to find evidence supporting theoretical predictions on the positive response of output (real GDP) and inflation to contractionary monetary policy (Rafiq and Mallick, 2008; Castelnovo and Surico, 2010; Barakchian and Crowe, 2013; Cloyne and Hurtgen, 2016).

Like monetary policy, the evaluation of the effects and contribution of fiscal policy are also mixed in the current literature, especially the impact of shocks in net taxes. While different identification schemes yield very similar results for government spending shocks, these results are mixed for net tax shocks (Caldara and Kamps, 2008).<sup>5</sup> While some have found evidence of the negative and significant effect of shocks in net taxes on output and price dynamics (Blanchard and Perotti, 2002; Favero and Giavazzi, 2007; Mountford and Uhlig, 2009), others have identified a rise in output following positive shocks in net taxes (Dungey and Fry, 2009). Perotti (2002) also shows mixed evidence for a range of OECD countries and the U.S. The majority of these findings are obtained from estimating either monetary or fiscal policies separately, suggesting that any effort to use both monetary and fiscal policies simultaneously has been very limited (Dungey and Fry, 2009; Rossi and Zubairy, 2011; Fetai, 2013). This suggests failing to incorporate both monetary and fiscal policies simultaneously might give rise to wrong conclusions about the effects of monetary and fiscal policies in explaining macroeconomic fluctuations (Rossi and Zubairy, 2011; Fetai, 2013). This is confirmed by the empirical exercises carried out in this paper where the size of the response of the output improved significantly when both monetary and

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<sup>4</sup> Much of these findings in the literature has been for the United States (Cloyne and Hurtgen, 2016).

<sup>5</sup> While different identification schemes yield very similar results for government spending shocks, these results for shocks in net taxes are mixed (Caldara and Kamps, 2008).

fiscal variables were jointly analyzed in a single SVAR model.<sup>6</sup> The response of the output to net tax shocks has improved when monetary shocks is included into fiscal SVAR model. In particular, unlike in the case of joint fiscal and monetary shocks SVAR model, the response of output to net tax shocks is muted when only fiscal SVAR model is estimated. Similarly, the sizes of the responses of output to monetary shocks are improved both qualitatively and quantitatively when fiscal shocks is included into monetary SVAR.

There is also some empirical evidence that the effects of fiscal policy shocks do not control tax policy (see for example [Ilzetzki et al., 2013](#); [Kim, 2015](#)). Ignoring the net tax-government spending mix of fiscal policy and its response to both government spending and other macroeconomic shocks threatens to introduce a bias into empirical results.<sup>7</sup> It Estimating the baseline model by ignoring tax-spending mix in this paper also confirmed this result.

This is, therefore, crucial to model both fiscal and monetary policies simultaneously with a net tax-spending mix to show the impact and relative contributions of each shock to the fluctuations in output and inflation.

The key results from the structural VAR model are as follows: First, an increase in government spending has an expansionary effect on output, while an increase in net tax is contractionary, with spending multipliers larger than net tax multipliers. Second, contractionary monetary policy is associated with a fall in output; and third, the contributions of fiscal policy components are roughly equivalent in explaining output fluctuations. The contributions of fiscal policy shocks are larger than monetary policy shocks in explaining movements in output, and finally, the effects of monetary policy shocks on output improved both qualitatively and quantitatively when both policy variables were jointly examined rather than using separate models, underlining the value of a joint analysis of fiscal and monetary policy shocks.

The remainder of this paper is organized as follows. Section Two discusses the model used along with specification and identification of shocks. The Third Section presents empirical results based on impulse responses, fiscal

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<sup>6</sup> The response of the output to net tax shocks has improved when monetary shocks are included in a fiscal SVAR model. In particular, unlike in the case of a SVAR model of joint fiscal and monetary shocks, the response of output to net tax shocks is muted when only the fiscal SVAR model is estimated. Similarly, the size of the response of output to monetary shocks is improved both qualitatively and quantitatively when fiscal shocks are included in a monetary SVAR.

<sup>7</sup> Estimating a baseline model by ignoring the tax-spending mix covered in this paper provided confirmation of this result, though this is not presented here.

multipliers, and historical decomposition with Section Four devoted to some sensitivity analysis. The Fifth Section presents the main conclusions.

## **2. Data and Model**

The model used in this paper is a structural vector auto-regression (SVAR) model. This section describes the data and methodology employed to assess shocks from monetary policy, fiscal policy and other sources affecting the economy. It also describes the identification techniques used in this study.

### **2.1 Data**

The sample periods range from 1998:1-2017:4 on a quarterly basis. Interest Rate ( $r_t$ ), Consumer Price Index ( $\pi_t$ ), Real Output ( $y_t$ ), Net Taxes ( $t_t$ ), Government Spending ( $g_t$ ) and Exchange Rate ( $e_t$ ) were the variables included in the empirical VAR model. Additional information on net taxes and government spending were also used to estimate exogenous elasticities and to identify fiscal policy shocks. An additional 13 variables reflecting monetary conditions in Ethiopia were used to estimate the synthetic monetary policy indicator. All variables, except the interest rate, were expressed in a natural logarithm. The consumer Price Index ( $\pi_t$ ), Net Taxes ( $t_t$ ), Government Spending ( $g_t$ ) and monetary aggregates were seasonally adjusted.<sup>8</sup> Both parametric and non-parametric seasonal adjustment tests are performed to identify variables that need to be seasonally adjusted (Appendix A.5).

The starting date for the sample period was determined by the availability of quarterly data for fiscal variables.

### **2.2 Specification of SVAR model and identification of structural shocks**

#### **2.2.1 The empirical model**

The SVAR model with  $p$  lags<sup>9</sup>: The standard lag length selection criteria are used to select optimum lag length in the empirical model. Based on test results for

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<sup>8</sup> Both parametric and non-parametric seasonal adjustment tests were performed to identify variables that need to be seasonally adjusted (see Appendix A.5). A detailed set of variables and their descriptions is available on request.

<sup>9</sup> The standard lag length selection criteria were used to select optimum lag length in the empirical model. Based on test results for serial correlation, model stability, and other diagnostic tests, the lag length is set to four lags and robustness checks were also performed for higher lag orders. Diagnostic test results can be made available upon request.

serial correlation, model stability and other diagnostic tests, the lag length is set to four lags (see Appendix A.3) and robustness checks are also performed for higher lag orders. Other diagnostic test results can be made available up on request and no constant terms can be written as:

$$A\Phi(L)Y_t = Bu_t \quad (1)$$

with  $(u_t) = 0$ ,  $cov(u_t) = \Sigma_u$ , where  $\Phi(L)$  is  $p^{\text{th}}$  order lagged polynomial of the coefficient matrices given by  $\Phi(L) = 1 - \Phi_1L - \Phi_2L^2 - \dots - \Phi_pL^p$ ;  $Y_t = (y_t, \pi_t, e_t, r_t, g_t, t_t)$  is the vector of endogenous variables viz. Interest Rate ( $r_t$ ), Consumer Price Index ( $\pi_t$ ), Real Output ( $y_t$ ), Net Taxes ( $t_t$ ), Government Spending ( $g_t$ ) and Exchange Rate ( $e_t$ ).  $A$  is a  $k$ -dimensional square matrix of contemporaneous coefficients;  $u_t = (u_t^y, u_t^\pi, u_t^e, u_t^r, u_t^g, u_t^t)$  is  $k$  dimensional vector of structural innovations, with  $u_t \sim N(0, \Sigma_u)$  and  $(K \times K)$  matrix  $B$  defines how the structural shocks affect the variables in the system.

The reduced form VAR model with  $p$  lags, a system of reduced-form equations, can be derived by pre-multiplying equation (1) by  $(k \times k)$  inverse matrix of  $A$  as:

$$A^{-1}A\Phi(L)Y_t = A^{-1}Bu_t = \Phi(L)Y_t \quad (2)$$

The  $(k \times 1)$  vector  $\varepsilon_t = (\varepsilon_t^y, \varepsilon_t^\pi, \varepsilon_t^e, \varepsilon_t^r, \varepsilon_t^g, \varepsilon_t^t)$  consists of reduced form residuals ordered with their corresponding observed endogenous variables in vector  $Y_t$ . These reduced-form VAR residuals are generally correlated and are, therefore, not necessarily to be interpreted as purely structural innovations. The relationship between structural disturbances,  $u_t$  and residual disturbances,  $\varepsilon_t$  is given by  $\varepsilon_t = A^{-1}Bu_t \equiv A\varepsilon_t = Bu_t$ . This shows that the reduced form residuals  $\varepsilon_t$  are assumed to be a linear combination of the structural innovations,  $u_t$ .<sup>10</sup>

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<sup>10</sup> The correlations between reduced-form shocks arise due to the absence of contemporaneous relations between endogenous variables. Because such contemporaneous correlations exist in the SVAR, structural shocks can now be taken to be uncorrelated and can be interpreted as structural innovations (Ouliaris et al. 2016).

### **2.2.2 Identification of shocks**

Identification of shocks is one of the challenges for the SVAR approach. Different identification schemes have been used in the existing literature. However, there is no universally agreed identification approach so far. In the current work, while the fiscal shocks are identified using the approach of Blanchard and Perotti (2002), the synthetic monetary policy indicator is estimated by factor analysis, in the spirit of Kucharvcukova et al (2016) and Lombardi and Zhu (2014), based on 13 variables reflecting monetary conditions in Ethiopia and identified, on the basis of Kim and Roubini (2000), in a non-recursive scheme. Moreover, the structural shocks are identified using traditional SVAR restrictions. In order to check the robustness of the empirical results in this paper, various robustness checks have been performed. (See robustness check sections below for details.)

The key to identifying fiscal shocks in Blanchard and Perotti (2002) as well as in Perotti (2002, 2004) is that it takes more than one quarter for discretionary fiscal policy to respond to changes in macroeconomic variables, such as output, inflation, interest rate, and exchange rate. At quarterly frequency, the contemporaneous discretionary response of net taxes and government spending to macroeconomic shocks can, thus, be assumed to be zero. Following their approach, structural shocks to government spending and taxes can be identified by imposing the restrictions on the A and B matrices using AB-model type:<sup>11</sup> A and B matrices are derived here for six variable case following (Blanchard 2002) and (Perotti 2002Perotti 2005) approach.

Fiscal variables are ordered before monetary variables due to the fact that interest rate payments are excluded from the definition of both fiscal policy components (Perotti 2002Perotti 2005, Caldara and Kams 2008, Lozano 2009). It also follows from the assumption that the monetary authority can respond more rapidly to news than fiscal decision-makers can (Ilzetzki 2013)Ilzetzki 2013. This follows much of the literature in the field. However, since there is no both theoretical as well as the empirical ground for ordering the two fiscal policy components, the baseline results are checked for the sensitivity of the result for alternative ordering. See the robustness section for more detailed discussions. Indeed, different alternative orderings of the variables included in the baseline SVAR model are also experimented for checking robustness of the main results.

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<sup>11</sup> A and B matrices are derived here for six variable cases following the approach of Blanchard and Perotti (2002) and Perotti (2002, 2004).

$$\begin{bmatrix} 1 & 0 & \alpha_{gy} & \alpha_{g\pi} & \alpha_{gr} & \alpha_{ge} \\ 0 & 1 & \alpha_{ty} & \alpha_{t\pi} & \alpha_{tr} & \alpha_{te} \\ \omega_{yg} & \omega_{yt} & 1 & \omega_{y\pi} & \omega_{yr} & \omega_{ye} \\ \omega_{\pi g} & \omega_{\pi t} & \omega_{\pi y} & 1 & \omega_{\pi r} & \omega_{\pi e} \\ \omega_{rg} & \omega_{rt} & \omega_{ry} & \omega_{r\pi} & 1 & 1 \\ \omega_{eg} & \omega_{et} & \omega_{ey} & \omega_{e\pi} & \omega_{er} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^g \\ \varepsilon_t^t \\ \varepsilon_t^y \\ \varepsilon_t^\pi \\ \varepsilon_t^r \\ \varepsilon_t^e \end{bmatrix} = \begin{bmatrix} \beta_{gg} & \beta_{gt} & 0 & 0 & 0 & 0 \\ \beta_{tg} & \beta_{tt} & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_{yy} & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_{\pi\pi} & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta_{rr} & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta_{rr} \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^t \\ u_t^y \\ u_t^\pi \\ u_t^r \\ u_t^e \end{bmatrix} \quad [ \quad ]$$

Where  $\alpha'_{jk}$ s are the contemporaneous response of fiscal variables,  $g_t$  and  $t_t$ , to changes in macroeconomic shocks,  $\omega'_{jk}$ s is the contemporaneous response of macroeconomic variables to changes in fiscal and other macroeconomic shocks. Fully identifying structural shocks requires exogenously determined elasticities of the net taxes and government spending to change in macroeconomic variables,  $\alpha'_{jk}$ s. These elasticities are identified based on the techniques used in [Blanchard and Perotti \(2002\)](#); [Perotti \(2002, 2004\)](#); [Caldara and Kamps \(2008\)](#); [De Castro and de Cos \(2008\)](#) and [Lozano and Rodriguez \(2011\)](#). The output elasticity of taxes with respect to output and prices were found to be 0.534.<sup>12</sup> This value is comparable with (0.56) output elasticity of net tax computed by Alemayehu and Befekadu (1998) for Ethiopia and reported in (Geda 2011) and 0.357, respectively. These authors argue that if interest payments are excluded from government spending and net tax, the elasticity of government spending and net taxes is set to zero. In the current paper, definitions of the two fiscal variables excluded interest payment so that  $\alpha_{gr} = \alpha_{tr} = 0$ . Following the literature, the elasticity of government spending and net taxes to exchange rate was also set to zero:  $\alpha_{ge} = \alpha_{te} = 0$ .<sup>13</sup> In the baseline model, this elasticity was set at -0.5, on the basis of [Perotti \(2002, 2004\)](#) who exploits facts regarding spending on health services, wage and non-wage components of government spending.<sup>14</sup> In the case

<sup>12</sup> This value is comparable with (0.56) output elasticity of net tax computed by Alemayehu and Befekadu (1998) for Ethiopia and reported in Geda, (2011).

<sup>13</sup> The absence of contemporaneous response of fiscal shocks to exchange rate innovations is justified on the grounds of the home bias of public spending items (De Castro and Fernandez, 2013; De Castro and Garrote, 2015).

<sup>14</sup> The model was estimated taking this value and the robustness check conducted for slightly higher (-0.6) and lower (-0.4) values. The results were insensitive both qualitatively and quantitatively to these values (see Figure 6 in Appendix A). Many authors have used this value for estimating SVAR: Favero and Giavazzi (2007) and Caldara and Kamps (2008) for the U.S; Lozano and Rodriguez (2011) for Colombia; De Castro and de Cos (2008) and De Castro and Fernandez (2013) for Spain; Claus et al. (2006) for New Zealand; Ilzetzki et al. (2011) for a range of developing and developed countries; and Burriel et al (2010) for the Euro area. These authors, among others, also show their results accepted this assumption.

of the factor analysis, the monetary policy indicator estimated in the factor model was used as a measure of monetary policy shocks.

The model is estimated taking this value and robustness check is conducted for slightly higher (-0.6) and lower (-0.4) values. The results are insensitive both qualitatively and quantitatively to these values (see Figure 6 in Appendix A). Many authors used this value for estimating SVAR in the literature: (Fav 2007) and (Caldara and Kamps 2008) for U.S, (Lozano 2009) for Colombia, (DeCastro 2008) and (Castro 2011) for Spain, (Claus 2006) for New Zealand, (Ilzetzki 2011) for range of developing and developed countries, and (Burriel 2010) Burriel 2010 for Euro area. These authors, among others, also show that their results are intact due to this assumption.

### **3. Empirical Findings**

#### **3.1 Impulse Response Functions**

This section presents empirical results from the SVAR model and checks their robustness to different specifications. The SVAR model was interpreted with the help of impulse response functions (IRF), multipliers and historical decomposition (HD). As is commonplace in SVAR literature, the impulse response functions have been estimated for a sixty-eight percent confidence band.<sup>15</sup> The choice of the confidence interval width is very standard in this kind of SVAR literature and in fact follows, among others, (Edelberg 1999, Kim 2000, Joiner 2001, Blanchard 2002, Perotti 2004, Claus 2006, Buckle 2007, Chung 2007, Kim 2008, Caldara and Kamps 2008, Ramey 2011a) and (Cloyne 2016), who also choose 68% confidence band to discuss their results.

Based on the impulse responses for fiscal variables, short-term and cumulative multipliers were computed for each component of the fiscal policy. Due attention was also given to the relative contributions of each shock in the VAR system on the policy target variables, inflation, and output. Finally, the relative importance of monetary and fiscal policy shocks was also analyzed by

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<sup>15</sup> The choice of the confidence interval width is standard in this kind of SVAR literature, following e.g. Edelberg et al. (1999); Blanchard and Perotti (2002); Perotti (2002); Claus et al. (2006); Buckle et al. (2007); Chung and Leeper (2007); Kim and Roubini (2008); Caldara and Kamps (2008); Ramey (2011a) and Cloyne and Hurtgen (2016), who also chose a 68% confidence band to discuss their results.

generating an aggregated contribution of policy shocks, the monetary policy and fiscal policy effects.

### 3.1.1 Fiscal policy shocks

The impulse responses emanating from shocks in government spending, net taxes, and interest rate are discussed below. Figure 1 shows impulse responses for up to 20 quarters after the shocks. It can be seen that increased government spending is reflected in higher real output, which is consistent with, among others, the results in [Blanchard and Perotti \(2002\)](#); [Perotti \(2002, 2004\)](#); [Claus et al. \(2006\)](#); [De Castro and de Cos \(2008\)](#); [Dungey and Fry \(2009\)](#) and [Mountford and Uhlig \(2009\)](#). However, the size and persistence of output response to government spending shocks varies significantly across studies. In the current paper, for instance, the impact of government spending on real output is small (see fiscal multipliers). [Perotti \(2002, 2004\)](#) also finds for a range of OECD countries and the US that the impact of spending shocks is small. Inflation rises following increased government spending, though it remains statistically insignificant in one-year aftershocks.<sup>16</sup> [Fav 2007](#) also show that spending shocks are have no significant effect on inflation. [Canova 2011](#) find that inflation rises in response to government spending shocks. The spending shocks are shown to have no significant effect on the exchange rate.

The rows show the responses of real output, inflation and exchange rate to shocks in spending, net taxes and interest rate, presented in the three columns, respectively.

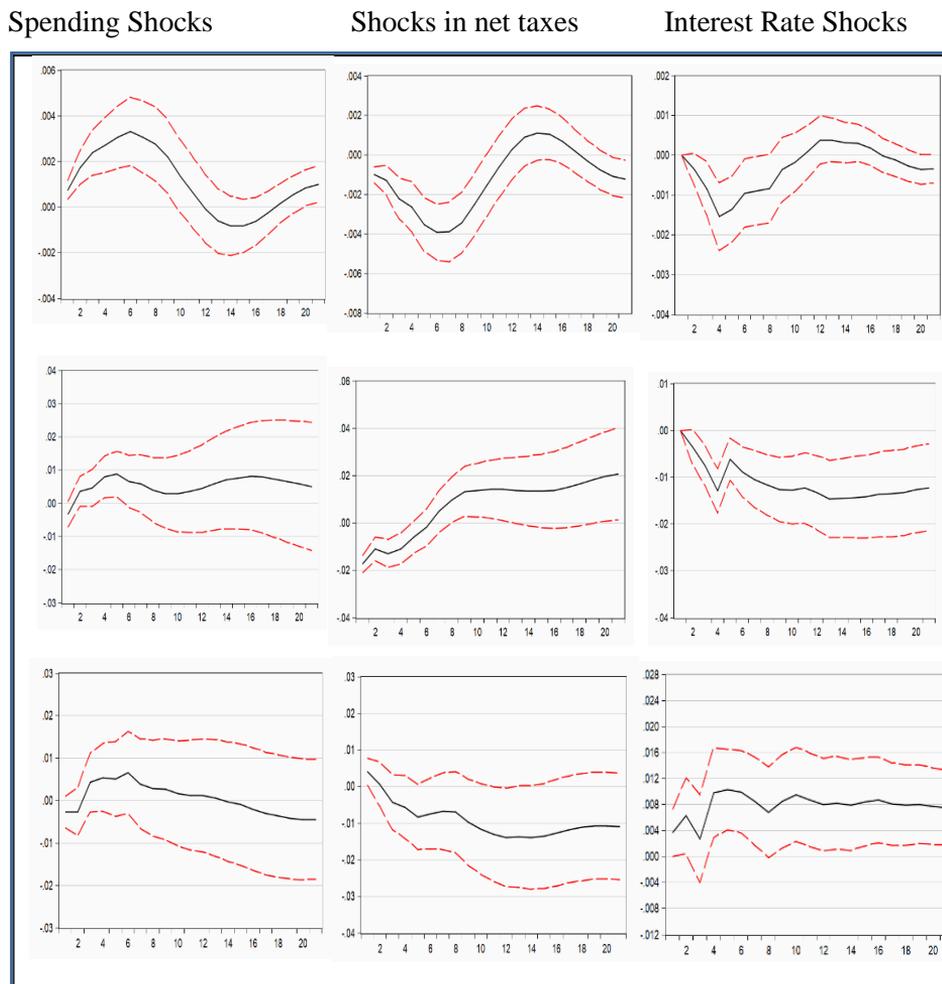
The response of real output to shocks in net taxes in the literature is mixed. [Blanchard and Perotti \(2002\)](#); [Mountford and Uhlig \(2009\)](#) and [Favero and Giavazzi \(2007\)](#) found a fall in output following positive shocks in net taxes. [Dungey and Fry \(2009\)](#), on the other hand, saw a rise in real output in response to increased shocks in net taxes. [Perotti \(2002, 2004\)](#) also found mixed results for the range of OECD countries and the US. In the present paper, an exogenous increase in net tax as expected resulted in a fall in output. This is the standard result. The impact of shocks in net taxes on inflation is also one where the literature offers mixed results. Shocks in net taxes are associated with lower inflation, [Mountford and Uhlig \(2009\)](#) and [Favero and Giavazzi \(2007\)](#) find a fall

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<sup>16</sup> Favero and Giavazzi (2007) also show that spending shocks have no significant effect on inflation. Canova and Paustian (2011) find that inflation rises in response to government spending shocks.

in inflation in response to positive shocks in net taxes. The response to the exchange rate shows that exchange rates do not appear to respond significantly to shocks in net taxes.

**Figure 1: Impulse responses to fiscal and monetary policy shocks.**



However, to consider policy advice and design, it is important to calculate fiscal multipliers<sup>17</sup>. The impulse responses for fiscal shocks were scaled to derive the effect of a one-unit increase in net tax or government spending on economic activity. The short-term impact multiplier was 0.05 for spending shocks and close

<sup>17</sup> Results for short-term and cumulative multipliers with detailed discussions can be made available upon request.

to zero for shocks in net taxes. This effect, while small, is statistically significant. Tax revenue to GDP ratio is 18 percent in sub-Saharan Africa (Zerihun 2016).

Focusing on the short-term multiplier, however, may be misleading because fiscal stimulus packages can only be implemented over time and there may be lags in the economy's response (Ilzetzki et al., 2013). Hence, to see the full impact of the fiscal policy shocks, their cumulative multipliers were computed. The cumulative multiplier for spending shocks rose to 0.22 though it remained relatively small and negative for net taxes.

Though small, the spending multipliers are higher than the net tax multipliers. This is one of the interesting results obtained in most empirical literature. The small size of the fiscal multiplier in Ethiopia is not surprising and it is comparable with the size of fiscal multipliers in other emerging and low-income countries. In many advanced countries, the fiscal multipliers can lie between less than zero to larger than one under normal circumstances (Batini et al., 2014). On the other hand, empirical literature on the fiscal multiplier in developing countries, though scarce, shows that fiscal multipliers are very small, even negative (Ilzetzki et al., 2011; Ilzetzki et al., 2013; Kraay, 2012; Estevao and Samake, 2013). The spending multiplier ranges from negative to 0.3 while revenue multiplier ranges from negative to 0.4. The evidence from a panel of developing countries shows that the impact multiplier for spending is -0.03. It basically depends on a number of factors such as the degree of openness, exchange rate regime and level of indebtedness (Ilzetzki et al., 2013).

### **3.1.2 Monetary policy shocks**

In the literature, monetary policy shocks can be represented by either change in the short-term interest rate or changes in the narrow and broad monetary aggregates. There is, in fact, little consensus regarding the measure of monetary policy shocks, and whether to use monetary aggregate or interest rate (Leeper et al., 1996; Rafiq and Mallick, 2008). While some authors choose short-term interest rates as an indicator of monetary policy shocks (McCallum, 1983; Bernanke and Blinder et al., 1992; Bernanke et al., 1997; Dungey and Fry, 2009; Mountford and Fry, 2009; Cloyne and Hurtgen, 2016), others considered monetary aggregates such as narrow money (M1), broad money (M2) or Non-borrowed reserves (Sims, 1992; Christiano et al., 2005). Monetary aggregates may be preferred over the short-term interest rate due to the argument that one cannot determine the influence of monetary policy by simply observing changes

in interest rates and hence, price increases cannot occur without an increase in the monetary aggregates (Sims1992, Bernanke1998, Rafiq 2008). In addition, short-term interest rates are a ‘polluted’ measure of the monetary policy stances (Sims1992, Christiano1996). In contrast, (McCallum 1983, Bernanke1992) and (Bernanke1998) preferred use short-term interest rates over different measures of monetary aggregates due to the fact that the growth rates of monetary aggregates depend on a variety of non-policy influences. Moreover, the interest rate is probably less contaminated by endogenous responses to contemporaneous economic conditions than is the monetary aggregates.

In the baseline model, the short-term interest rate is used to represent monetary policy shocks. The response of inflation, real output, and exchange rate to interest rate shocks is depicted in Figure 1.<sup>18</sup>

Several VAR empirical studies encountered different puzzles in response to monetary policy shocks. This paper did not engage with these puzzles and remains consistent with the conventional framework. The response of output is contractionary following contractionary monetary policy. Some empirical studies have obtained a positive and significant response of output (or GDP) to a rise in the short-term interest rate. For example, the response of real GDP to contractionary monetary policy is positive in Rafiq and Mallick (2008) for Italy; Uhlig (2005) for the US and Dungey and Fry (2007) for New Zealand.<sup>19</sup> While the result for (Uhlig 2005) and (Rafiq 2008) are from sign restriction approach, it is from block exogeneity recursive scheme for (Dungey 2007).

Similar evidence was found for Austria, Greece, Ireland and the Netherlands (cited in Rafiq and Mallick, 2008). In this paper, however, the contribution of contractionary monetary policy to output fluctuations proved very small compared to the contribution to inflation. Very small effects of monetary policy on output and the larger effect on inflation could partly support the view that monetary policy significantly contributes to nominal variables such as prices. Leeper et al. (1996); Bernanke et al. (1997), Christiano et al. (1999); Bernanke et

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<sup>18</sup> To see the sensitivity of baseline results to different alternative specifications, the model is re-estimated using alternative short-term interest rates and an alternative measure of monetary policy, monetary aggregates. Results presented in the robustness section show that they are robust to this kind of exercises.

<sup>19</sup> While the results for Rafiq and Mallick (2008) and Uhlig (2005) are from the sign restriction approach, for Dungey and Fry (2007) it is from a block exogeneity recursive scheme.

al. (2005) and Cloyne and Hurtgen (2016) also found the response of output to interest rate shocks to be rather small.<sup>20</sup>

The well-known puzzles in the literature on contractionary monetary policy are price and exchange rate puzzles. This paper did not encounter the exchange rate puzzle in the sense that the response of the exchange rate to interest rate shocks was as in a conventional framework where the exchange rate appreciates following interest rate shocks. This is consistent with the response of exchange rate to interest rate in Eichengreen and Evans (1995); Buckle et al. (2007) and Forni and Gambetti (2010). Similarly, an increase in interest rate is associated with a significant fall in price, suggesting the absence of a price puzzle in the model.

Some recent evidence has shown that if a central bank does not raise interest rate sufficiently in response to inflation, structural VAR models are capable of producing price puzzles regardless of the identification of the schemes used (Castelnuovo and Surico 2010). To shed light on the result in Castelnuovo and Surico (2010) and to check the robustness of the standard results in this paper, several specifications were re-estimated alongside with the baseline model. In order to see whether the baseline empirical results can be improved, the synthetic monetary policy indicator is also estimated by factor analysis based on 13 variables reflecting monetary conditions in Ethiopia following works in (Kucharvcukova 2016) Kucharvcukova 2016 Kucharvcukova 2016 and (Lombardi 2014). Then, the estimated factors along with the fiscal policy shocks are identified in non-recursive frameworks. Results from these exercises are not presented here since they are not better than the baseline model results when judge on the ground of theoretical predictions.

These include using alternative identification schemes such as an alternative measure of the short-term interest rate, and alternative monetary policy indicators such as narrow and broad monetary aggregates. The impulse responses presented in the Appendix shows that increased government spending and net taxes are associated respectively with statistically significant expansionary and contractionary effects on the real output.

To see how the size of the response of output and prices to the fiscal and monetary policy shocks was improved, separate fiscal and monetary SVAR models were estimated and the impulse responses from each model extracted. To

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<sup>20</sup> Coibion (2012) and Romer and Romer (2004) show responses of output to interest rate shocks are medium and large respectively.

make the comparison meaningful, fiscal policy and monetary policy shocks were identified exactly as in the case of the baseline SVAR model. Fiscal shocks are identified using ([Blanchard 2002](#)) and ([Perotti 2002](#)) approach while the monetary policy shocks are identified by imposing traditional short run restrictions. To check the robustness of these results, monetary policy shocks are identified following the approach used in ([Kim 2000](#)), and the results are qualitatively identical.

The impulse responses (which can be made available upon request) show that the responses of the output to net tax and spending shocks improved qualitatively and quantitatively when monetary shocks were included in the fiscal SVAR model. Similarly, we could also observe improvements in terms of the response of the output to the monetary policy shocks when fiscal variables were included in the monetary SVAR model. Not only were the sizes of the responses of output to monetary shocks decreased when fiscal shocks were excluded from the monetary SVAR model, but also there was a clear qualitative difference in terms of the output responses. These exercises support the argument that failing to incorporate both monetary and fiscal policies simultaneously might incorrectly attribute to the wrong conclusions on the effects of monetary and fiscal policies in explaining macroeconomic fluctuations ([Rossi and Zubairy, 2011](#); [Fetai, 2013](#)).

### **3.2 Historical analysis of the contributions to Ethiopian growth cycles**

Impulse response functions are helpful to see the respective dynamics of macroeconomic variables and how they respond in the event of particular shocks. In fact, impulse responses can also be supplemented by variance decomposition of forecast errors at various time horizons. However, the connection between variance decomposition and features of the growth cycle is very weak ([Dungey and Pagan, 2000](#); [Buckle et al., 2007](#); [Pagan and Robinson, 2014](#)). Hence, the favored approach for analyzing the relative impact of shocks and to see which shocks have occurred during the sample period, is using historical decomposition. In the following section, the structural VAR model is used to identify the contribution of each shock to the Ethiopian growth cycle and inflation dynamics during the past 20 years.

Traditionally, the growth cycle is represented as the percentage deviation of real gross domestic output from its trend level. The estimated structural VAR

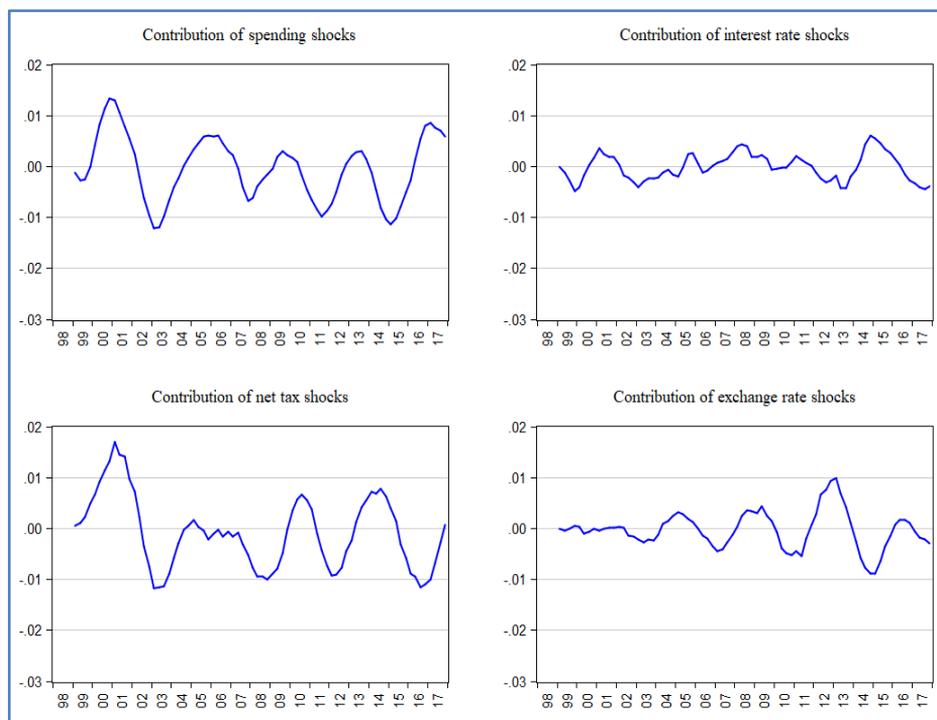
model can be used for this analysis. To identify the contribution of each shock to the growth cycle over the sample period, we first write the SVAR model in an equation in a moving average representation. (Dungey and Pagan, 2000; Claus et al., 2006; Buckle et al., 2007).

$$y_t = y_0 + \sum_{i=1}^{t-1} \sum_{h=1}^6 \omega_{ih} u_{h(t-i)}$$

Where  $y_t$  represents variable of interest, which is real output,  $y_0$  denotes initial conditions,  $\omega_{ih}$  is the  $i^{th}$  impulse response associated with the  $h^{th}$  shocks for six shocks in the VAR system. (Buckle 2002) indicates that initial conditions will contribute also to the deviations of real GDP from trend at the beginning of the sample period. But over time the contributions from initial conditions converge toward zero.

Figure 2 shows the contribution of government spending, net taxes, interest rate and exchange rate to output deviations from the trend over the sample period. It is apparent from this that the relative contribution of each shock varies over time. Broadly speaking, the prominent sources of output fluctuations are government spending and shocks in net taxes. Both shocks were major contributors to the 2002/03 recession of the Ethiopian economy. Though the contribution was small relative to spending and net tax shocks, interest rate shocks were also one of the shocks contributing to the 2002/03 recession. The relatively large contribution of monetary policy shocks to output fluctuations was registered at the beginning and end of the sample period. The contribution of government spending and net tax shocks to output fluctuations increased even in recent sample periods. The relative importance of fiscal policy and monetary policy are considered in the next section.

**Figure 2: Contribution to Growth Cycles**



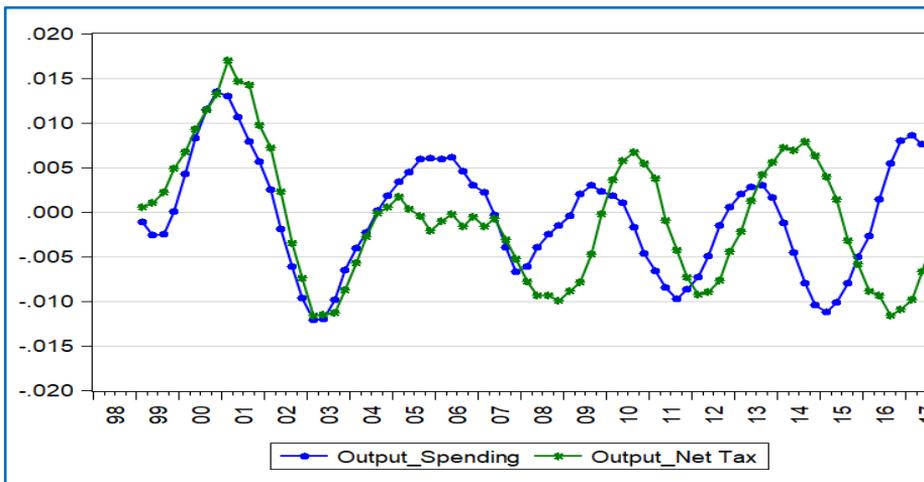
This shows the contribution of spending, net tax, interest rate, and exchange rate shocks to Ethiopia's business cycle fluctuations.

In contrast to the attention they receive at both individual and institutional levels, shocks from the exchange rates have not been important sources of growth cycles during earlier periods. This might be because movements in the exchange rate had marginal effects on foreign trade movements. While the highest negative contribution of the exchange rate was recorded during 2014/15 as a result of a negative growth rate in export values, the largest positive contributions were in 2012/13. In general, each shock has contributed either negatively or positively during the sample periods, with spending and net tax shocks taking the lion's share. The SVAR model equation above ( $y_t = y_0 + \sum_{i=1}^{t-1} \sum_{h=1}^6 \omega_{ih} u_{h(t-i)}$ ) can identify contributing factors to the inflation dynamics in Ethiopia. The results for inflation are not presented here but they are available upon request.

### 3.2 Relative Importance of Policy Variables

The relative contributions of all shocks included in the SVAR model are discussed in the previous section. Here, the focus is paid to the relative importance of policy variables in explaining movement in real output. First, the relative importance of fiscal policy components, government spending, and shocks in net taxes, are discussed followed by the relative importance of monetary and fiscal policies in explaining the growth cycle in Ethiopia during the sample period. Monetary policy shocks are represented by interest rate shocks and identified as the monetary policy effect (MPE). Government spending shocks and shocks in net taxes are aggregated to form a total fiscal policy effect (FPE), as is usual in the literature. The relative importance of fiscal policy components to the growth cycle is depicted in Figure 3. Government spending shocks are more or less pro-cyclical. They contributed negatively to output during the 2002/03 recession and during the slowdown of 2008/09. They also contributed positively to the high growth of 2000/01 and 2006/07. In fact, it does not always act in a pro-cyclical manner and its contribution was negative during high growth in 2014.

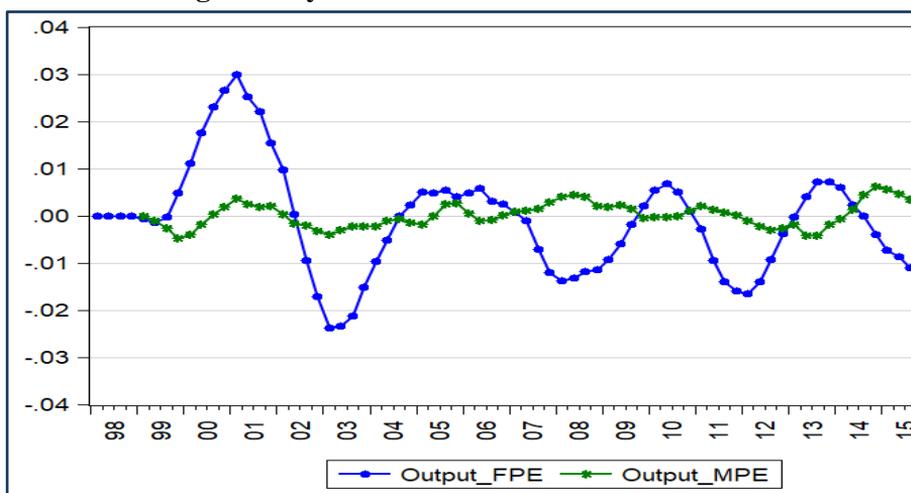
**Figure 3: The relative importance of fiscal policy components to GDP growth cycle.**



The contribution of shocks in net taxes was also pro-cyclical during early periods, particularly up to the first quarter of 2004/05. It also contributed negatively to the 2002/03 recession. Indeed, shocks in net taxes generally contributed negatively to output for the majority of the sample periods, with the

highest positive contributions registered mostly in early or recent periods. In general, as shown in Claus et al. (2006) and Dungey and Fry (2009), the contribution of net tax and government spending shocks to the real GDP growth cycle are roughly equivalent, with both contributing more or less in opposition to each other after 2012/13. The highest positive contributions of both were recorded during high growth of 2000/01.

**Figure 4: The relative importance of fiscal policy and monetary policy to GDP growth cycle.**



The contributions of monetary policy and fiscal policy to real output over the sample period are depicted as the Monetary Policy Effect (MPE) and Fiscal Policy Effect (FPE) in Figure 4. Fiscal policy acted in a pro-cyclical manner for most of the sample period. During the slowdown associated with drought in 2002/03, 2007/08 and 2015/16, fiscal policy was broadly contractionary and acted as expansionary during the high growth of late 2006/07, 2009/10 and 2013/14, in a pro-cyclical manner. This pro-cyclical behavior of a fiscal policy is seen in the literature as a standard result for developing countries - Alesina et al. (2008); Ilzetzki and Vegh (2008) and Petrevski et al. (2016) find similar results. Monetary policy, on the other hand, has been contractionary for the majority of sample period, though it also contributed positively if only on a small scale, to the 2014/15 high growth. In general, as seen in Figure 6, fiscal policy has a greater impact on real GDP fluctuation than monetary policy. This is consistent with the results in Dungey and Fry (2007).

Monetary policy is represented by interest rate shocks. Effects of government spending and shocks in net taxes are aggregated to form total fiscal policy effect.

#### 4. Robustness Check

The baseline results show that, among other results, the relative impact of fiscal policy is higher than that of monetary policy in explaining business cycle fluctuations in Ethiopia. Several robustness checks were performed to establish the sensitivity of the results presented in this paper.<sup>21</sup> These included robustness of results for an alternative ordering of fiscal variables, alternative short-term interest rates, allowing for alternative lags, using different exogenous parameters, alternative interpolation approaches, and an alternative identification approach.

**Alternative ordering:** Under these checks, alternative ordering for fiscal variables as well as ordering net taxes after price and output were performed.

a) **Order of fiscal shocks:** The identification of fiscal policy shocks using the approach of Blanchard and Perotti (2002) depends on decisions about the order of fiscal variables. Since there is little guidance about how to order the two fiscal variables, Blanchard and Perotti (2002) and Perotti (2002, 2004) suggested checking robustness of the results against alternative ordering. Perotti (2002, 2004); Claus et al. (2006); Favero and Giavazzi (2007); De Castro and de Cos (2008); Lozano and Rodriguez (2011) and Ilzetzki et al. (2013), for example, estimated their models and then checked the robustness of their result with the alternative option. The results confirmed the order of the two shocks was immaterial to their results. In this paper, the main results are presented assuming that government spending was ordered first ( $\beta_{gt} = 0$ ). It was, therefore, important to check the sensitivity of results when an alternative order option was chosen, when net tax was ordered first, before government spending ( $\beta_{tg} = 0$ ). The results, depicted in Figure 8, show that results are not sensitive to experimenting with an alternative ordering either quantitatively and qualitatively.<sup>22</sup>

**Ordering net tax after inflation and output:** Caldara and Kamps (2008) argue that since movements in government spending, unlike net tax movements, are

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<sup>21</sup> Impulse responses are presented in Appendix A

<sup>22</sup> Some authors also checked the sensitivity of the results setting both to zero ( $\beta_{tg} = \beta_{gt} = 0$ ) (Ilzetzki et al., 2011). These options were also checked in this paper and the result confirms the insensitivity of findings to these possibilities.

largely unrelated to the business cycle, government spending is not affected contemporaneously by shocks originating in the private sector. This suggests that shocks to output and inflation could have an immediate impact on the tax base and, thus, a contemporaneous effect on net taxes. To check whether this mattered for the main results, the SVAR model was re-estimated after ordering output and inflation before net taxes but after government spending. The result, presented in Figure 8, shows that the impulse responses remain identical. (Ilzetzi 2011)**Effects of contemporaneous relationships.** Blanchard and Perotti (2002)'s identification approach crucially depends on the exogenous elasticities. It is, therefore, vital to examine how results change when there is a small change in the value of the parameters used for a contemporaneous relationship. Perotti (2002) suggested the value of the price elasticity of government spending to be (-0.5) and the baseline model was estimated taking this value as in Perotti (2004); Claus et al (2006); Favero and Giavazzi (2007); De Castro and de Cos (2008); Lozano and Rodriguez (2011) and Ilzetzi et al (2011). To check the robustness of the results for this paper, the model was re-estimated taking a slightly lower value (-0.4) and a slightly higher value (-0.6) of price elasticity of government spending. Figure 6 depicts the findings. The sensitivity of results to small changes in output and price elasticity of net tax was also tested at slightly lower and higher values. The result of these experiments is shown in Figure 5. Overall, the findings are robust to these exercises both quantitatively and qualitatively.<sup>23</sup>

**Alternative interpolation method:** It is usual to explore the sensitivity of the results for alternative interpolation methods in the literature when interpolated data are used. Ramey and Zubairy (2014) estimated a model where data on, among other factors, real GDP, nominal GDP, GDP deflator and population, were interpolated in the pre-WWII period using the linear interpolation method. They also used an alternative interpolation technique and provided robustness of their results from the data. To examine the robustness of the main results in this paper, an alternative GDP series was constructed using Chow and Lin (1971)'s interpolation method.<sup>24</sup> The baseline model was re-estimated using this real GDP series; and the results presented in Figure 7 shows that findings from this exercise are qualitatively very similar.

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<sup>23</sup> Blanchard and Perotti (2002) also examine the sensitivity of their results for different values of the output elasticity of net taxes.

<sup>24</sup> Bernanke et al. (1997) argued that the method of Chow and Lin (1997) was like the state space method.

**Alternative identification approach:** The SVAR shocks are identified using Cholesky Decomposition to check the robustness of the results to the alternative identification scheme. The results are shown in Figure 7 (Appendix A). This showed the responses of the variables in the model to monetary policy shocks were very similar to the baseline results. However, though qualitatively very similar, the responses of output to shocks in net taxes were relatively muted when fiscal shocks were identified by Cholesky Decomposition. Ordering net tax before spending was also checked to see whether impulse responses changes might be due to this alternative ordering. The impulse responses were similar in both cases. In sum, the responses of the model's variables to fiscal and monetary policy shocks based on the traditional Cholesky Decomposition were very similar to the results of the baseline model except for very marginal qualitative differences in the responses of output to fiscal policy shocks.

**Alternative policy variable and lag length:** In order to assess the robustness of the result in this paper, the baseline monetary policy variable is substituted with the short-term deposit rate and the model is also re-estimated with 5 lags. The impulse responses in Figure 8 from the model with the deposit rate and in Figure 9 for the responses with five lags confirm that the results are broadly very similar to the original results.

## **5. Conclusions**

This paper has examined the impact and relative importance of shocks from fiscal policy, monetary policy, and other sources explaining macroeconomic fluctuations in Ethiopia. The sample period for the study ranged from 1998:1 to 2017:4. The model used has non-recursive structures based on the approach of Blanchard and Perotti (2002) and Perotti (2002, 2004) and on the traditional short-run restrictions' approach, with monetary policy indicators estimated on the basis of 13 variables reflecting monetary conditions in Ethiopia. Ethiopia is an interesting case study because its high growth has attracted international attention in recent years. Moreover, inflation has been high and persistent, exceeding double digits and has been a center of policy debate in the country since 2002/03. Despite this, there has been a lack of empirical evidence that explicitly demonstrated the relative importance of monetary and fiscal policy in explaining macroeconomic fluctuations.

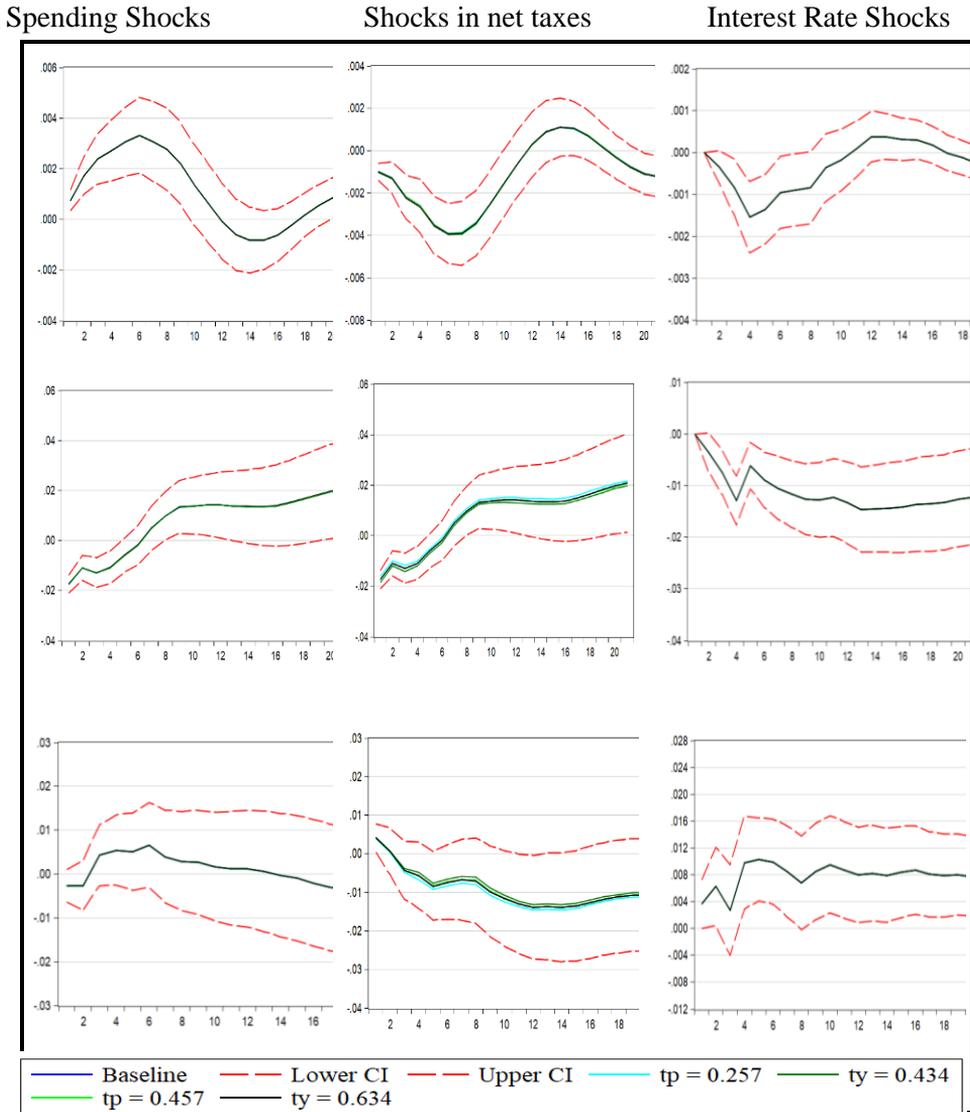
Most empirical literature has neither controlled for tax policy nor estimated separate monetary or fiscal policy models, and evidence using both

monetary and fiscal policies simultaneously has been very limited. Failing to incorporate monetary and fiscal policies simultaneously without the net tax-spending mix can incorrectly reach the wrong conclusions about the effects of monetary and fiscal policies in explaining macroeconomic fluctuations. The empirical exercises in this paper have confirmed this argument - the size of the response of the output significantly improved when both monetary and fiscal variables were jointly analyzed in a single SVAR model. Hence, it is crucial to model both fiscal and monetary policies simultaneously with a net tax-spending mix to show the impact and the relative contribution of each shock to fluctuations in output and inflation.

This paper has provided three key results. First, an increase in government spending has an expansionary effect on output, while an increase in net tax shocks are contractionary with spending multipliers larger than net tax multipliers. Secondly, contractionary monetary policy is associated with a fall in output; and thirdly, the contribution of fiscal policy shocks is greater than monetary policy shocks in explaining fluctuations in output, with roughly equivalent contributions coming from fiscal policy component shocks. It should be emphasized that to check the sensitivity of the results to different specifications, various robustness checks were performed; these showed that the main results were robust. One of the policy implications that can be drawn from this study is that the government could strengthen current economic growth through enhancement of the efficiency of public spending.

**Appendix A: Robustness Checks**

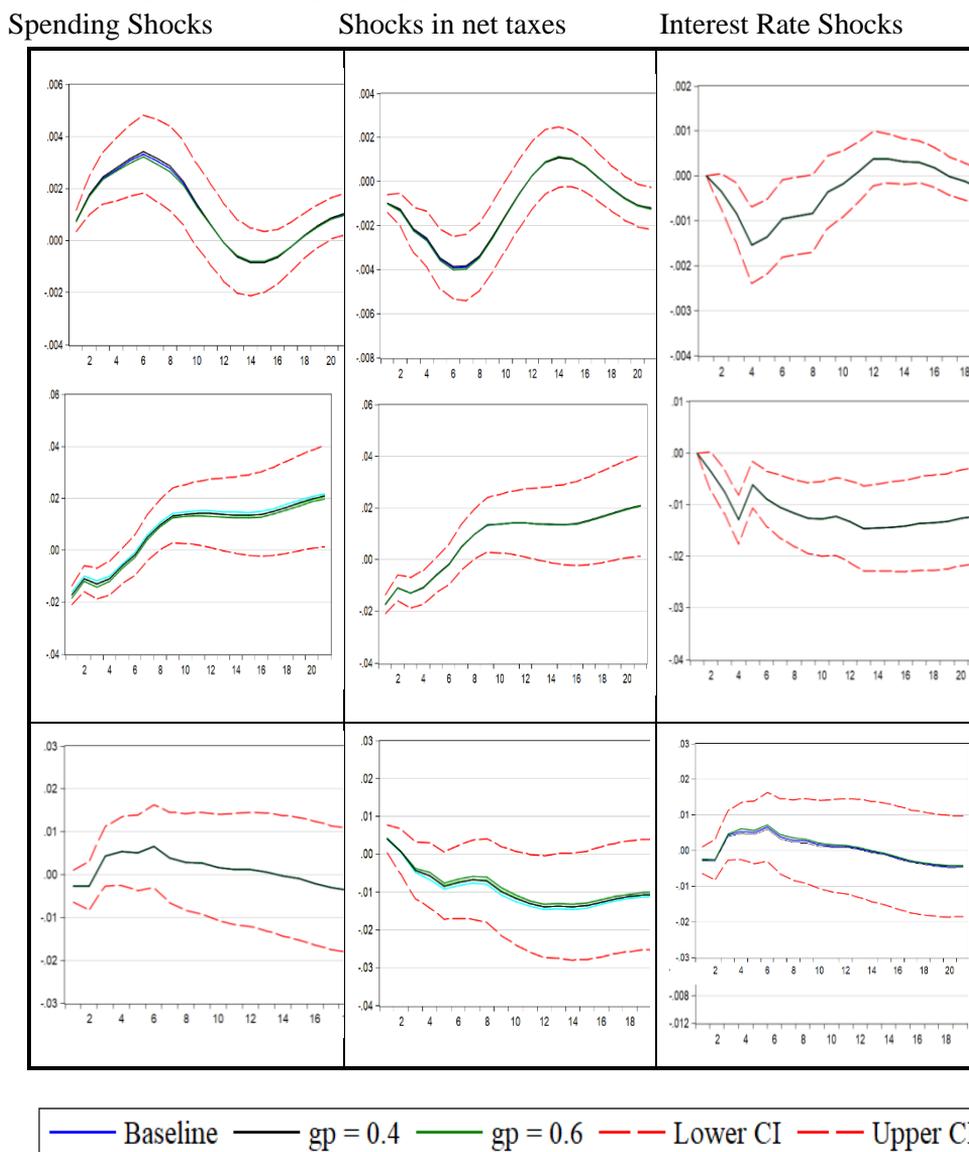
**Figure 5: Impulse responses with slightly lower and upper price and output elasticity of net tax.**



The responses of real output, inflation, and exchange rate to shocks in net taxes, government spending and interest rates are shown in the first, second and third rows respectively. Baseline represents responses from the baseline model,  $tp = 0.257$  ( $\alpha_{t\pi} = -0.257$ ) and  $tp = 0.457$  ( $\alpha_{t\pi} = -0.457$ ) are responses for slightly lower and upper price elasticity of net tax, respectively.  $ty = 0.434$  ( $\alpha_{ty} =$

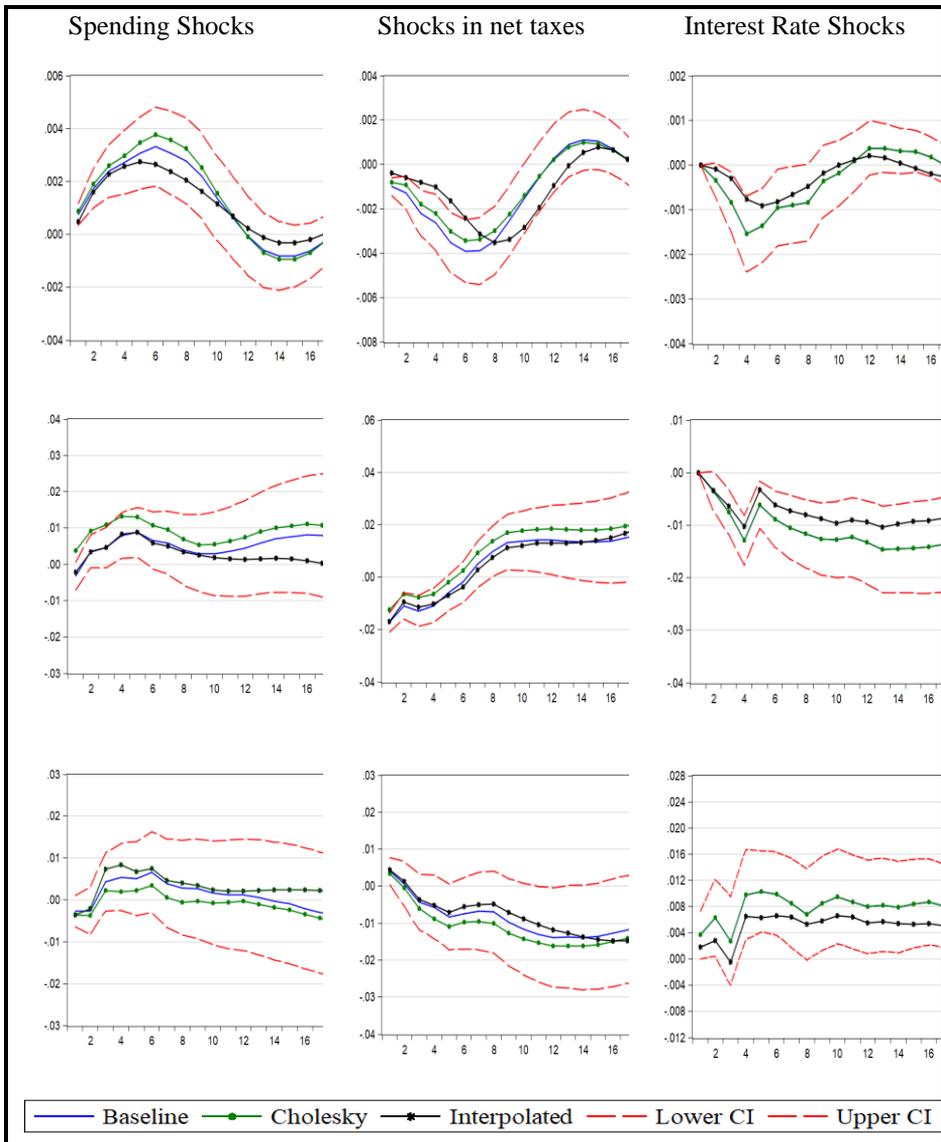
-0.434) and  $\alpha_{ty} = 0.634$  ( $\alpha_{ty} = -0.634$ ) indicate respective responses for slightly lower and upper output elasticity of net tax. Lower and Upper CI means lower and upper confidence intervals, respectively.

**Figure 6: Impulse responses with slightly lower and upper price elasticity of government spending.**



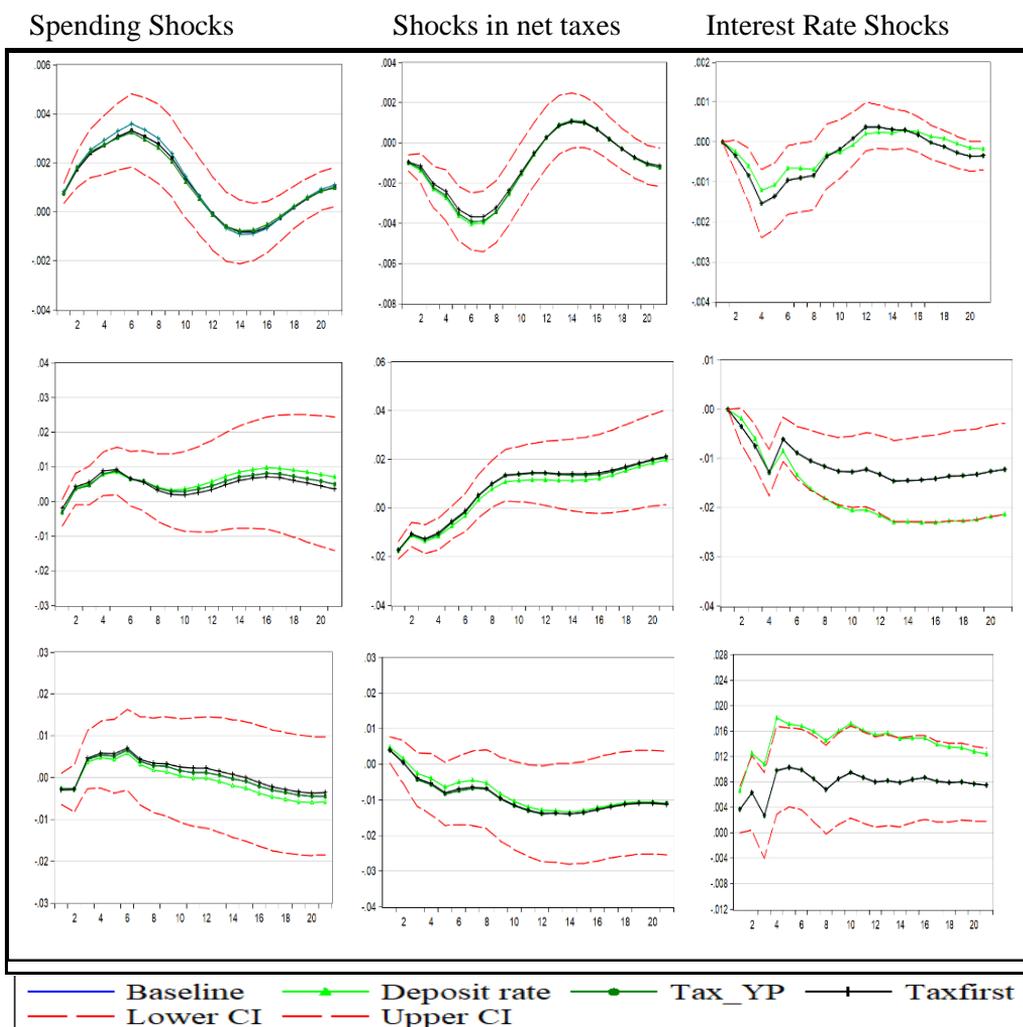
The responses of real output, inflation, and exchange rate to shocks in spending, net taxes and interest rates are presented in the first, second and third rows respectively. Baseline represents responses from the baseline model,  $gp = 0.4$  and  $gp = 0.6$ , are the respective responses for slightly lower and upper price elasticity ( $\alpha_{g\pi} = -0.4$  and  $\alpha_{g\pi} = -0.6$ ) of spending. Lower and Upper CI means lower and upper confidence intervals, respectively.

**Figure 7: Impulse responses based on Cholesky Decomposition and Interpolated series.**



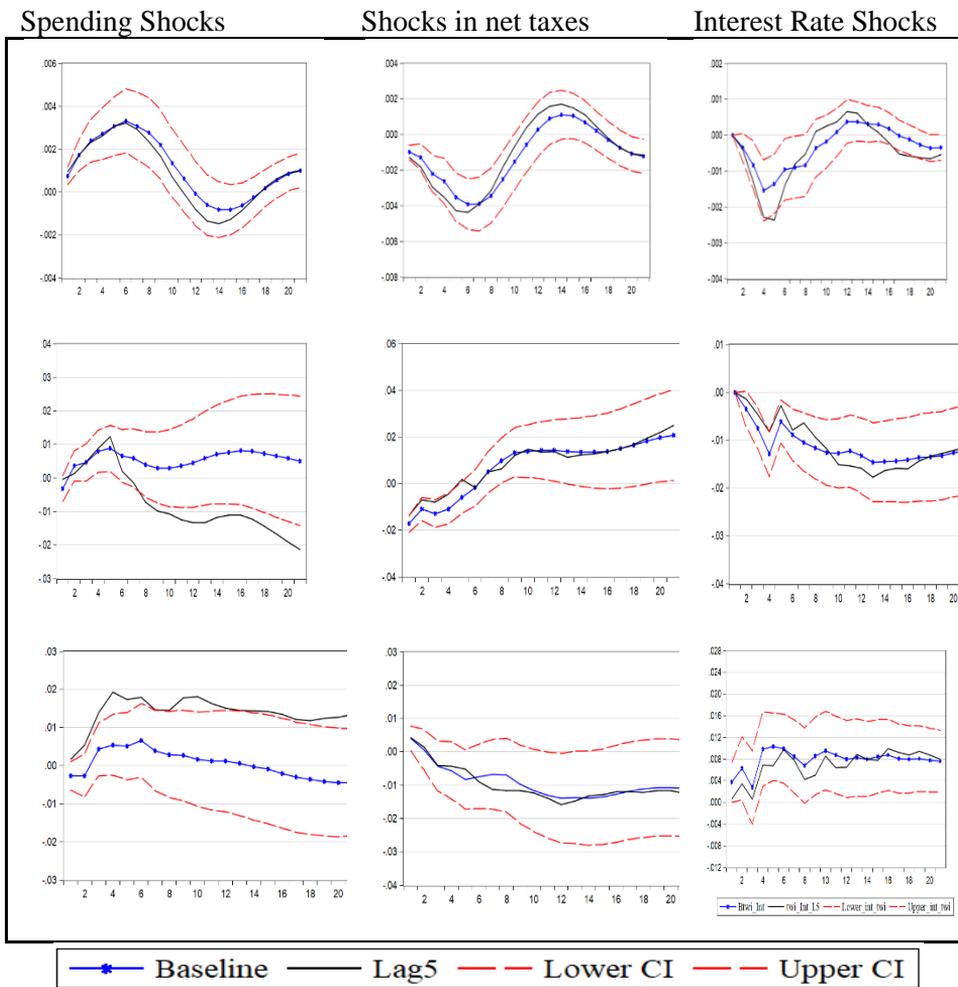
The responses of real output, inflation and exchange rate to shocks in government spending, net taxes, and interest rates are presented in the first, second and third rows, respectively. Baseline represents responses from the baseline model. Cholesky indicates the responses when Cholesky decomposition is used to identify structural shocks. Interpolated represents impulse responses when alternative Real GDP series is used. Lower and Upper CI means lower and upper confidence intervals, respectively.

**Figure 8: Impulse responses based on alternative ordering and alternative short-term interest rate.**



The responses of real output, inflation and exchange rate to shocks in government spending, net taxes, and interest rates are shown in the first, second and third rows. Baseline represents responses from the baseline model. Deposit rate shows responses when the baseline short-term interest rate is substituted with deposit rate. Tax YP represents responses when inflation and output are ordered before net taxes. Tax first indicates when shocks in net taxes comes first ( $\beta_{tg} = 0$ ) and Lower and Upper CI means lower and upper confidence intervals, respectively.

**Figure 9: Impulse responses with five lags.**



The responses of real output, inflation, and exchange rate to shocks in government spending, net taxes and interest rates are shown in the first, second and third rows. Baseline represents responses from the baseline model. Lag5 is responses when the model is estimated with five lags. Lower and Upper CI means lower and upper confidence intervals, respectively.

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# Evaluating the Relative Importance of the Channels of Monetary Policy Transmission in Ethiopia

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## *Abstract*

*This study examines the relative importance of different monetary policy transmission channels and their effect on key macroeconomic variables using quarterly time series data covering 1994/95Q<sub>1</sub> to 2017/18Q<sub>4</sub> in Ethiopia. A Structural Vector Autoregressive model (SVAR) was used to address the issues. All variables were tested for unit root and model stability, and other necessary diagnostic tests were also conducted. The results show that the monetary aggregate, exchange rate and credit channels are effective channels of monetary policy transmission in affecting output and inflation in Ethiopia, while the interest rate channel is found to be weak. From a policy perspective, the results indicate that the National Bank of Ethiopia should continuously monitor developments in the monetary aggregate, the credit and foreign exchange markets in order to design effective monetary policies. In addition, this would help the NBE to implement an effective monetary policy for achieving price and exchange rate stability and support sustainable economic growth through the appropriate monetary channels.*

**Key words:** Monetary Policy, Transmission Mechanisms, Ethiopia, SVAR

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## **1. Introduction**

Monetary policy, through which macro-economic and financial systems can be controlled, is one of the most powerful and influential policy instruments available for an economy. A carefully designed framework of monetary policy can assure sound economic and financial systems, while, on the other hand, a monetary policy that is constructed on minimal consideration of the factors that provide its effectiveness is likely to have a counter effect. In order to run a healthy economy, therefore, it is crucial to understand how monetary policy works, through what mechanisms policy actions are transmitted, what factors affect its transmission mechanisms, which channels are most effective and why they are effective. Equally, studying the transmission channels contributes to the understanding of the effectiveness of such channels as well as the way monetary shocks affect the economy. As Dungey and Fry (2009) also concluded, that understanding the effects of the way monetary shocks impacted via monetary transmission channels contributes to better management of the economy.

Theoretically, the explanation of monetary policy transmission has varied according to different schools of thoughts and the identification of a number of different channels of transmission mechanisms for monetary policy. According to the classical quantity theory of money, monetary policy changes are transmitted directly into price movements. The monetarists led by the Milton Friedman School posit that money matters and argue that monetary policy is transmitted through either interest rate or exchange rate channels or both. Early Keynesians disputed the effectiveness of monetary policy and held the belief that monetary policy worked through bank lending and balance sheet channels. The intermediary school (Real Business cycle) see money as neutral, neither accepting that money matters nor denying the effectiveness of monetary policy on the economy. However, they do argue that there is reverse causation running from other important economic variables such as asset price to the supply of money (Meltzer, 1995). According to Mishkin (1995), the monetary policy transmission mechanism includes interest rates, exchange rates, asset prices and credit channels.

Though extensive research on the transmission mechanism has been conducted in developed countries, such work in developing countries, especially in Africa, is lacking. This could be due to the fact that it has only been since the 1990s that countries in Africa started to adopt modern central bank operations

under a market-based economic and financial system characterized by indirect monetary policy. There has also been a lack of consensus in previous empirical findings. Bank lending channels seem to command popularity in most advanced countries of the world (Morsink and Bayoumi, 2001; and Elbourne, 2008); but for developing and low-income countries the empirical evidence is mixed and full of contradiction (Mengesha and Holmes, 2013; Davoodi et al., 2013; Mishra and Montiel, 2012). For instance, Tang (2006) found the interest rate channel as the most important channel in Malaysia; Aleem (2010) found strong evidence for the credit channel in India, as did Davoodi et al. (2013) for East African countries, while Mengesha and Holmes (2013) found the bank lending channel most relevant in Eritrea.

Despite the accessibility of studies for both developing and developed countries, the literature on Ethiopia is limited. Alemayehu (2011) tried to examine the monetary policy transmission mechanism in Ethiopia using a VAR approach with quarterly data from 1970Q3 to 2004Q2 and found that the monetary aggregate and credit channels were best exchange rate channel not work in Ethiopia. Nuru (2013) using the same methodology, and quarterly data from 1998Q3 to 2010Q2, found direct monetary aggregate and exchange rate channels effective, the credit channel weak and the interest rate channel inactive. This underlines inconsistency in terms of their findings. Moreover, existing studies of Ethiopian monetary policy transmission mechanisms include only domestic monetary policy and non-policy variables in their VAR approach; and since a small open economy is likely to be quite sensitive to a variety of foreign variables, we have included foreign variables also in our model. To the author's best knowledge, there has been no empirical study in Ethiopia that linked foreign shocks, monetary policy, and domestic macroeconomics fluctuations using an open economy SVAR framework. This study, therefore, differs significantly from past empirical studies that have investigated the transmission mechanism of Ethiopian monetary policy.

The remainder of this paper is organized as follows: Section 2 explains the conceptual framework and SVAR methodology used in the study, while Section 3 provides the empirical results and interpretation. Section 4 provides a conclusion and offers some policy recommendations.

## **2. Data and Research Methodology**

### **2.1 Conceptual Framework**

Monetary policy transmission is the process that links changes in policy rates or money supply to a series of other changes in economic variables such as market interest rates, asset prices, exchange rates, cash flow, bank credit supply, private spending and consumption, etc. ultimately affecting prices, economic output and unemployment. The channels through which monetary policy affects the different economic activities identified in the literature are the money, interest rate, credit, exchange rate, asset/equity and expectations channels (Mishkin.1995).

#### **Money Channel**

Monetary policy assumes aggregate demand moves in proportion to the money balances used to finance transactions, affecting the split of nominal GDP between real GDP and the price level. It is this idea that forms the basis for broad money representing the intermediate target in many central bankers' money-focused monetary policies (Mishkin, 2004).

#### **Interest Rate Channel**

This channel can be summarized under the standard Keynesian IS-LM framework, whereby an expansionary monetary policy leads to a fall in real interest rates, thus decreasing the cost of capital and stimulating investment, which then results in an increase in aggregate demand and output. Interest rate channel can be traced by using the following systematic mechanism.

$$M \downarrow \Rightarrow r \uparrow \Rightarrow I \downarrow \Rightarrow AD \downarrow \Rightarrow Y \downarrow$$

#### **Credit Channel**

Since the traditional interest rate channel seems to ignore the importance of the role of bank credit in affecting the aggregate spending in the economy, Bernanke and Gertler (1995) offered the credit channel as an alternative view of the monetary transmission mechanism. There are two major channels relying on credit, the balance sheet channel and the bank-lending channel. While the balance sheet channel focuses on the effect of monetary policy on the balance sheet of borrowers, the bank-lending channel emphasizes the impact of monetary policy action on the supply provided by the banking system.

### **Exchange Rate Channel**

Monetary policy affects economic activity (output) through net exports. On the demand side, an expansionary monetary policy leads to a fall in interest rates relative to foreign-inducing capital outflows resulting in depreciation of local currency making exports cheaper, increased net exports and consequently aggregated demand and output. On the supply side, an expansionary monetary policy which depreciates local currency raises the domestic price of imported goods, leading to inflationary pressures through the exchange rate pass-through (Butkiewicz and Ozdogan, 2009).

Money supply  $\uparrow \Rightarrow$  Interest rate  $\downarrow \Rightarrow$  Exchange rate  $\downarrow$  (devaluation)  $\Rightarrow$  Net exports  $\uparrow \Rightarrow$  Output  $\uparrow$

### **Asset Price Channel**

Traditional monetary theory suggests that monetary contraction, through an increase in the discount rate of financial assets, may lead to a fall in asset prices, which would then further affect the real economy. Mishkin (1995) singles out two main mechanisms through which monetary policy shocks are propagated by changes in equity prices. First, the theory of Tobin's q suggests that when equities are cheap relative to the replacement cost of capital, firms are reluctant to issue new equity to purchase investment goods, leading to a decline in investment.

$M \uparrow \Rightarrow r \downarrow \Rightarrow P_e \uparrow \Rightarrow q \uparrow \Rightarrow I \uparrow \Rightarrow y \uparrow \Rightarrow \pi \uparrow$  (Investment)

Second, equity prices may have substantial wealth effects on consumption because of the permanent income hypothesis. A rise in stock prices increases the value of financial wealth, thus increasing the lifetime resources of households as well as increased demand for consumption and output. A similar mechanism can be applied to the price of other assets such as housing, a substantial component of wealth. The Monetary Transmission Mechanism (MTM) also operates through land and housing price channels.

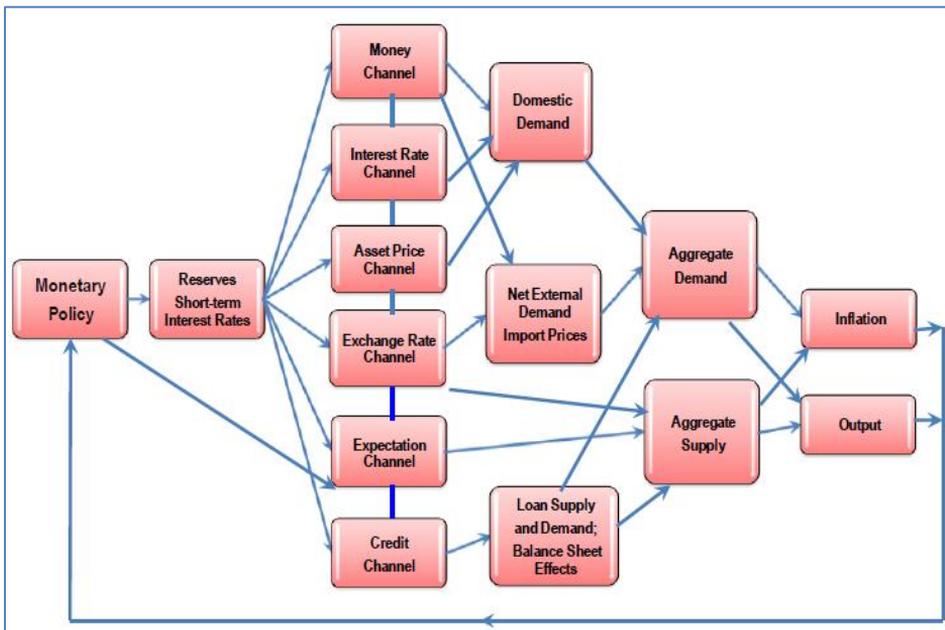
$M \uparrow \Rightarrow I \downarrow \Rightarrow P_e \uparrow \Rightarrow TW \uparrow \Rightarrow C \uparrow \Rightarrow y \uparrow \Rightarrow \pi \uparrow$  (Consumption)

### Expectation Channel

Because modern monetary policy analysis is based on forward-looking and rational economic activities, the expectation channel is in effect fundamental to the working of all channels of MTM. In practice, this channel is mainly operational in developed economies with well-functioning and extensive financial markets. For example; expectations of future changes in the policy rate can immediately affect medium and long-term interest rates. Monetary policy can also guide economic agents' expectations of future inflation and thus influence price developments.

As both asset price and expectation channels operate largely in developed economies in practice and as there is a lack of data and because the financial market in Ethiopia is in its infancy, this model has ignored both of these channels.

**Figure 1: Monetary Policy Transmission Channels Theoretical Framework**



Source: Adapted from Bank of England (1999) and Davoodi et al. (2013)

The author has also chosen to use a SVAR model with contemporaneous restrictions to analyze the Monetary Transmission Mechanism in the case of Ethiopia, a method pioneered by Sims (1980) and Bernanke (1986). It is useful to examine the relationship between forecast errors and structural innovations in an n-variable VAR. In a modeling sense, a SVAR has the following general form:

$$A_0 Y_t = A_1(L)y_t + B\varepsilon_t \quad (1)$$

Where:  $Y_t$  is a  $(n \times 1)$  vector of endogenous variables;  $A_0$  and  $B$  are vector of parameters,  $A_1(L) = \sum_{i=1}^n A_{1i}L^i$  -is a matrix polynomial in the lag operator and  $(\varepsilon_t)$  is a  $(n \times 1)$  vector of structural shocks. A SVAR model is put into a reduced VAR form by multiplying both sides of (1) by the inverse matrix  $A_0^{-1}$

$$Y_t = C(L)Y_t + e_t \quad (2)$$

Where:  $C(L) = A_0^{-1}A_1(L)$  and  $e_t$  represents a vector of reduced-form residual, that is  $A_0^{-1}B\varepsilon_t$

In structural form or compact form, an SVAR system relates to the following relations:

$$A_0 e_t = B\varepsilon_t \quad (3)$$

Equation (3) is known as the AB model (Amisano and Giannini, 1997). Where:  $A_0$ , is  $(n \times n)$  matrix of contemporaneous relations between endogenous variables,  $B$  is  $(n \times n)$  a matrix that linearly relates the SVAR residuals to the structural innovations,  $e_t$  is a vector of reduced-form residual, and  $\varepsilon_t$  is a vector of structural shocks. The residual  $e_t$  in the reduced form is presumed to be white noise. The restrictions imposed on the  $A_0$  matrix should come from the results of reliable empirical macroeconomic models. The more common approach in this regard is to impose a set of identification restrictions that are broadly consistent with economic theory and can be expected to provide sensible outcomes.

Based on the reviewed theoretical and empirical literatures and following the works of Kim and Roubini (2000), Rokon (2008) and Thanabalasingam (2013), an eight-variable non-recursive identification SVAR model has been

established to investigate the monetary policy transmission channel in Ethiopia. Thus, the model employed the following variables for estimation:

$$Y_t = [WOP_t, FFR_t, RGDP_t, CPI_t, M1_t, TBR_t, PSC_t, NEER_t] \quad (4)$$

There are eight variables in the system, divided into two blocks, foreign and domestic. The foreign block includes World Oil Price (WOP) and the Federal Fund Rate (FFR), in which oil is the non-policy external inflationary pressure and the FED was the proxy for external foreign monetary policy pressure. Domestic variables include Real Gross Domestic Product (RGDP) and Consumer Price Index (CPI), the targets of monetary policy; Money Supply (M<sub>1</sub>) and Treasury bill Rate (TBR), which were considered monetary policy instruments; and the Nominal Effective Exchange Rate (NEER), which accounts for the market information force and Private Sector Credit (PSC).

The foreign block is not only set ahead of the domestic block but it is also completely exogenous to the domestic block. This means domestic variables contemporaneously respond to foreign variables, but not vice versa. This is based on the widely accepted view that no small open economy affects world variables.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & a_{53} & a_{54} & 1 & a_{56} & 0 & 0 \\ 0 & a_{62} & a_{63} & a_{64} & 0 & 1 & 0 & 0 \\ 0 & 0 & a_{73} & 0 & a_{75} & a_{76} & 1 & 0 \\ a_{81} & a_{82} & a_{83} & a_{84} & a_{85} & a_{86} & a_{87} & 1 \end{bmatrix} \begin{bmatrix} \mu_{wop} \\ \mu_{ffr} \\ \mu_{rgdp} \\ \mu_{cpi} \\ \mu_{m1} \\ \mu_{tbr} \\ \mu_{psc} \\ \mu_{neer} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & b_{88} \end{bmatrix} \begin{bmatrix} \varepsilon_{wop} \\ \varepsilon_{ffr} \\ \varepsilon_{rgdp} \\ \varepsilon_{cpi} \\ \varepsilon_{m1} \\ \varepsilon_{tb} \\ \varepsilon_{psc} \\ \varepsilon_{neer} \end{bmatrix} \quad -5$$

World Oil Price (WOP stands at the head of all variables as it is most exogenous element in the model; and the inclusion of the FFR accounts for the impact from international monetary policy and the contemporaneous foreign monetary policy response to external inflationary pressure, because the Federal

Reserve needs to adjust policy immediately whenever there is a shock to the international oil price.

Non-policy blocks (RGDP, CPI) are the targeted economic variables assumed to receive contemporaneous influence from foreign variables and lagged impact from other domestic variables. Specifically, GDP and CPI are influenced by oil prices. The rationale behind this assumption is that domestic firms must respond immediately to oil price shocks due to the important role of oil in all sectors of the economy.

Row five represents the reaction function of monetary policy. It is assumed money supply decisions, following the standard Taylor rule, are contemporaneously affected by changes in prices and real economic activity (output). It is also assumed that GDP, CPI, and interest rates contemporaneously impact on  $m_1$ , meaning that while adjusting for the current level of money supply, the National Bank of Ethiopia (NBE) also monitors the growth level of output and price level, as well as other monetary indicators. Row six, the interest rate, is assumed to be affected by FFR, GDP, and CPI contemporaneously, and that the NBE adjusts the refinancing rate based on the international interest rate level and other domestic targeted variables. Row seven represents the credit channel of monetary policy, showing that demands for credit depend upon the interest rate, money supply and the levels of output in the economy. The last row, the exchange rate channel, is assumed to respond contemporaneously to all variables in both the foreign and domestic blocks due to the fact that it is fast moving.

## **2.2 Data Type and Source**

This study is based on the secondary time series quarterly data covering the period from 1994/95Q1 to 2017/18Q4, of total of 96 observations over twenty-four years. The period chosen for this study was influenced by the availability of quarterly data and the banking proclamation of 1994/95 to reorganize the National Bank of Ethiopia according to the government's market-based economic policy.

Domestic variables' data was obtained from Ministry of Finance and Economic Cooperation (MoFEC), the National Bank of Ethiopia (NBE) and the National Plan Commission (NPC); international (foreign) variables were obtained from the World Bank and International Monetary Fund (IMF) online database. All the variables were transformed to natural logs with the exception of

the Treasury Bill Rate and Federal Fund Rate, which remain as percentages. Transformation of variables into natural logarithmic form is to derive elasticity of each variable transformation of variables into natural logarithmic form is derived from the elasticity of each variable. Then variables can be normalized or unit free to avoid problem of serial correlation and multicollinearity in the data.

**Table 1: Sources of data and measurement**

<b>Variable description</b>	<b>Unit</b>	<b>Source</b>
Consumer Price Index (CPI)	Index number	NBE
Nominal Effective Exchange Rate (NEER)	Index number	NBE
Real Gross Domestic Product (RGDP)	In million <i>birr</i>	MoFEC/NPC
Money Supply (M1)	In million <i>birr</i>	NBE
Treasury Bill Rate (TBR)	Percentage	NBE
Private Sector Credit (PSC)	In million <i>birr</i>	NBE
World Oil P rice (WOP)	Index number	World Bank
Federal Fund Rate (FFR)	Percentage	International Monetary Fund (IMF) online CD-room

### **3. Results and Discussion**

#### **3.1 Unit Root Test for Stationary**

The well-known Augmented Dickey- Fuller and Phillips Perron unit root tests were applied to test the existence of unit root. Without this, estimating relationships with non-stationary variables results in spurious regression (Gujarati, 2004). The unit root test is undertaken both in the intercept and intercept plus trend regression forms; and the results of the test for the variables at level and first difference using ADF and PP test are presented in Table 2.

**Table 2: Unit root test**

**Phillips-Perron test statistic (ADF Test)**

variable s	With Intercept				Trend and Intercept			
	ADF		PP		ADF		PP	
	level	1 <sup>st</sup> difference	level	1 <sup>st</sup> difference	level	1 <sup>st</sup> difference	level	1 <sup>st</sup> difference
LWOP	-1.599	7.402***	-1.625	-7.25***	-2.020	-7.405***	-1.251	7.207***
FFR	-1.997	4.256***	-1.398	-4.33***	3.830**	-4.205***	-2.936	-4.279**
LRGDP	2.650*	-1.564	1.480	-4.99***	0.367	-2.937	0.923	-5.15***
LCPI	1.433	7.964***	1.252	-7.96***	-1.936	-8.294***	-1.938	8.294***
LM1	2.7837*	-1.790	4.71***	-7.73***	-1.983	-4.074***	-0.534	9.958***
TB	-2.429	4.389***	-1.329	-4.42***	-1.813	-4.607***	-1.101	4.582***
LPSC	0.328	-3.116**	1.008	-4.07***	-2.198	-3.349**	-0.918	4.416***
LNEER	-1.248	9.055***	-1.377	-9.05***	-0.959	-9.134***	-1.073	9.134***

Source: Author’s estimation

Note: \*, \*\*, \*\*\* indicates significant level at 10%, 5% and 1% level of significance; with critical values with constant but no trend 3.504, 2.893 and 2.584 and critical values with constant and trend 4.063, 3.460 and 3.156 respectively.

### 3.2 Lag length and VAR stability check

To determine the lag length of the reduced form (VAR), the study uses different lag-length selection criteria, including LR, FPE, AIC, SC, and HQ. In Table 3 the lag length selection criterion is tabulated. The entire lag length section test suggests the appropriate lag length for the VAR model is one (1).

**Table 3: VAR Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	2749.931	NA	7.42e-39	-65.09360	-64.63059	-64.90747
1	3184.394	765.4827*	1.11e-42*	-73.91415*	-71.59909*	-72.98351*
2	3131.650	-82.88381	1.86e-41	-71.13452	-66.96741	-69.45938
3	3157.089	35.12995	5.23e-41	-70.21640	-64.19724	-67.79675
4	3208.027	60.63999	8.94e-41	-69.90539	-62.03418	-66.74123
5	3287.544	79.51704	9.18e-41	-70.27485	-60.55158	-66.36618
6	3352.971	52.96502	1.72e-40	-70.30883	-58.73351	-65.65565
7	3431.318	48.50085	3.61e-40	-70.65044	-57.22307	-65.25275
8	3547.682	49.86991	6.65e-40	-71.89718	-56.61776	-65.75498

\* 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

Before using the optimal lag length to estimate the parameters of the SVAR, it is necessary to check the conditions of VAR stability using the AR roots. The results, presented in Table 4, show that all the eigen values in the proposed model lay in the unit circle, that is their value was less than one or unity, so the SVAR model satisfied the stability condition.

**Table 4: Roots of Characteristic Polynomial**

Root	Modulus
0.999691	0.999691
0.969908 - 0.142463i	0.980315
0.969908 + 0.142463i	0.980315
0.931473 - 0.053298i	0.932997
0.931473 + 0.053298i	0.932997
0.749619 - 0.290893i	0.804082
0.749619 + 0.290893i	0.804082
0.784373	0.784373
0.630800 - 0.421556i	0.758695
0.630800 + 0.421556i	0.758695
0.614054 - 0.166841i	0.636316
0.614054 + 0.166841i	0.636316
0.094623 - 0.204394i	0.225234
0.094623 + 0.204394i	0.225234
-0.039197 - 0.024575i	0.046263
-0.039197 + 0.024575i	0.046263
No root lies outside the unit circle.	
VAR satisfies the stability condition.	

Source: Author's estimation

The model requires  $2n^2 - n(n + 1) / 2$  number of restrictions to be the SVAR model identified. Since in our case the numbers of variables are 8 and based on the above formula, we need 92 restrictions for matrix A and B to be

identified. Of these, 56 restrictions are provided by matrix B, since it is a diagonal matrix. Thus, 36 restrictions are required in A for the system to be just identified. The model specified in equation 5 is identified with 36 restrictions in matrix A. Moreover, the identifying restrictions were not rejected at the 5% level (see Table 4). The LR test for the over-identification restriction of the contemporaneous SVAR model finds the additional restrictions to be valid, with a probability value of 0.399 (see Table 3). Checking the over-identifying restriction test to test the validity of the identifying restrictions imposed in the model, we find the likelihood ratio test does not reject the over-identified restrictions for Ethiopia. The Chi-square (8) test for Ethiopia is 8.354, with the corresponding *p*-value of 0.399.

**Table 5: Estimation Results of Structural-VAR Model**

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Log likelihood	910.1109		
LR test for over-identification:			
Chi-square (8)	8.354498	Probability	0.3996

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Source: Author's estimation.

As mentioned earlier the aim of SVAR model analysis is not parameter estimations but a dynamic response of impulse response and variance decomposition. The estimated coefficient exhibits limited significance so the inference relies on the dynamic interaction of the variables. The analysis of impulse response and variance decomposition to show the effects of monetary policy transmission channel on income and price are presented below.

### **3.3 Estimation Results of Impulse Response Function**

This section explains the estimated impulse response function used to understand the dynamic responses of output and price to various domestic and foreign monetary policy shocks within the SVAR system. The estimated impulse responses of the variables, over a 20 quarter (four year) period and with structural one-standard-deviation monetary policy shocks, are described. In Figure 2 below, each of the two dashed lines represents the 95% confidence band; the dotted lines represent the confidence intervals. The values on the vertical line represent the deviation from the baseline level of the variable in response to any given shock

on the policy variable. The results on the horizontal line represent the time passed after the introduction of the shock.

### **3.3.1 Responses of price to domestic and foreign variables shock**

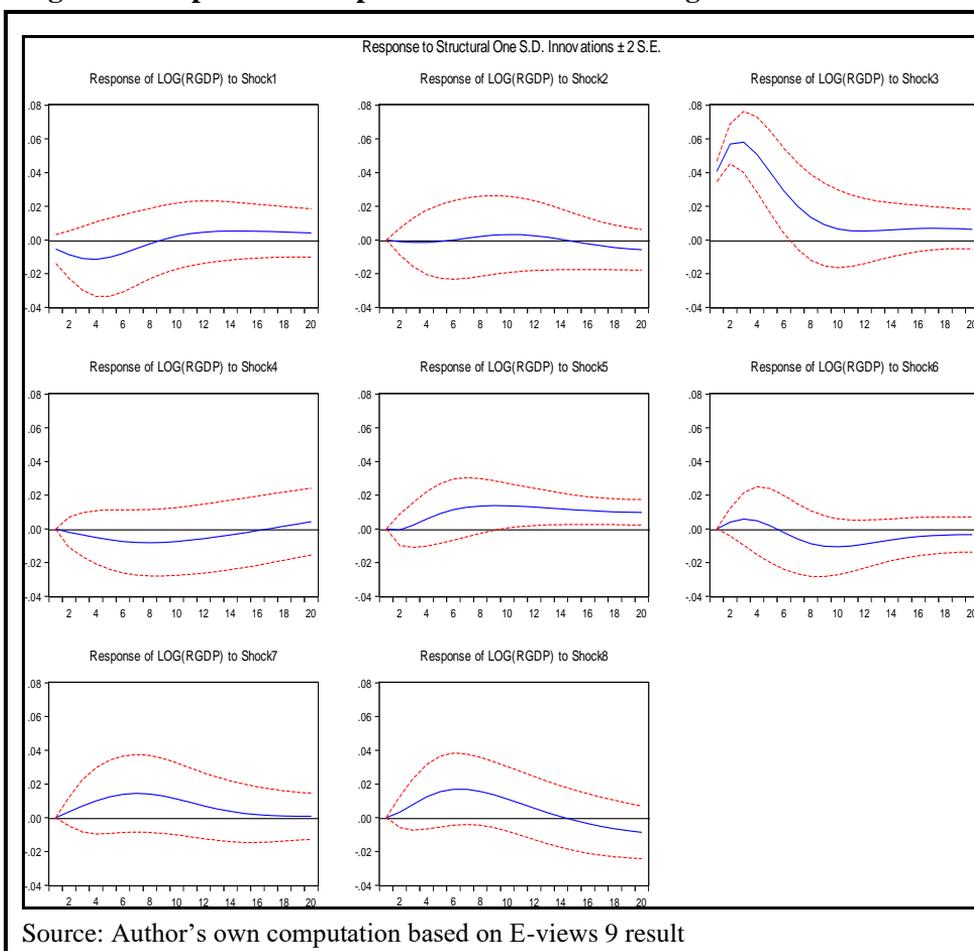
Figure 2 shows the response of output to various foreign and domestic monetary variable shocks. Shock 1 in Figure 2 shows the response of output to world oil price shocks (WOP). As expected, output decreases in response to WOP shocks. The increase in world oil price is expected to transfer to domestic economy through increases in price of exported commodities, which in turn affects domestic output. Negative responses of GDP should be explained by the rising cost of production due to increases in world oil price, since Ethiopia is oil importing country and domestic petroleum price also increase. FFR shock (Shock 2) indicates an increase in output in response to a monetary policy tightening of increases in FFR. One possible explanation is that an increase in FFR might decrease world oil price, and in turn a decrease in oil price might cause a fall in production costs in Ethiopia, since the Ethiopian economy is dependent on imported oil, every sector of the economy.

Shock 5 shows the estimated impulse responses of output to a positive money supply shock. Output increases in response to a positive monetary shock and that means expansionary monetary policy is an important source of economic growth, reducing the cost of investment and encouraging both investment and then aggregate demand and finally leading to a high level of output, which is in line with the theory. The finding is consistent with previous studies, for example, Kim and Roubini (2000), Cushman and Zha (1997), and Sim and Zha (2005). Moreover, Shock 6 in Figure 2 shows the effect of the T-bill rate shock (TB) on output. A positive shock to the T-bill rate has a positive impact on output at least in the short- and medium-term, indicating output puzzle occurred, but after this its effect dies out.

Shock 7 in Figure 2 indicates that a positive credit shock to the private sector affects RGDP positively. This is in line with our expectations and with economic theory. That is, increases in credit create more demand for goods and services and hence increases output level. These results show that there is an effective credit channel of monetary policy transmission in affecting the economic growth of Ethiopia. These findings are consistent with studies on other small open developing economies e.g. Tang (2006) and Aleem (2010).

Finally, Shock 8 in Figure 2 shows the responses of output to nominal effective exchange rate shock. Positive NEER shocks, representing an increase in nominal effective exchange (appreciation), increase real income (RGDP). Since Ethiopia is an import-dependent country with imports mainly composed of capital goods and raw materials which a country cannot now afford, appreciation leads to a decline in the cost of imported goods and encourages investment and then economic growth. Conversely, devaluation makes the price of essential imported goods more expensive and thereby discourages domestic investment activities which in turn affect output levels negatively.

**Figure 2: Responses of output for domestic and foreign variables shock**



### **3.3.2 Responses of price for domestic and foreign variables shock**

Figure 3 shows the responses of price levels in the Consumer Price Index (CPI) to various foreign and domestic monetary variable shocks. Shock 1 and Shock 2 in Figure 3 show the response of price to World Oil Price shock (WOP) and Foreign Interest Rate (FFR) positive shocks respectively. As expected, output decreases in response to WOP (Shock 1). The increase in world oil price can be expected to transfer to domestic economy through increases in price of exported commodities, which in turn affects domestic prices. A negative response of price level is a price puzzle though the effect is small. FFR shock (Shock 2) indicates an increase in output in response to a monetary policy tightening of increase in FFR. One possible explanation is an increase in FFR might limit the effect of world oil prices and a decrease in oil prices might cause a fall in cost of production and a drop in the price level in Ethiopia.

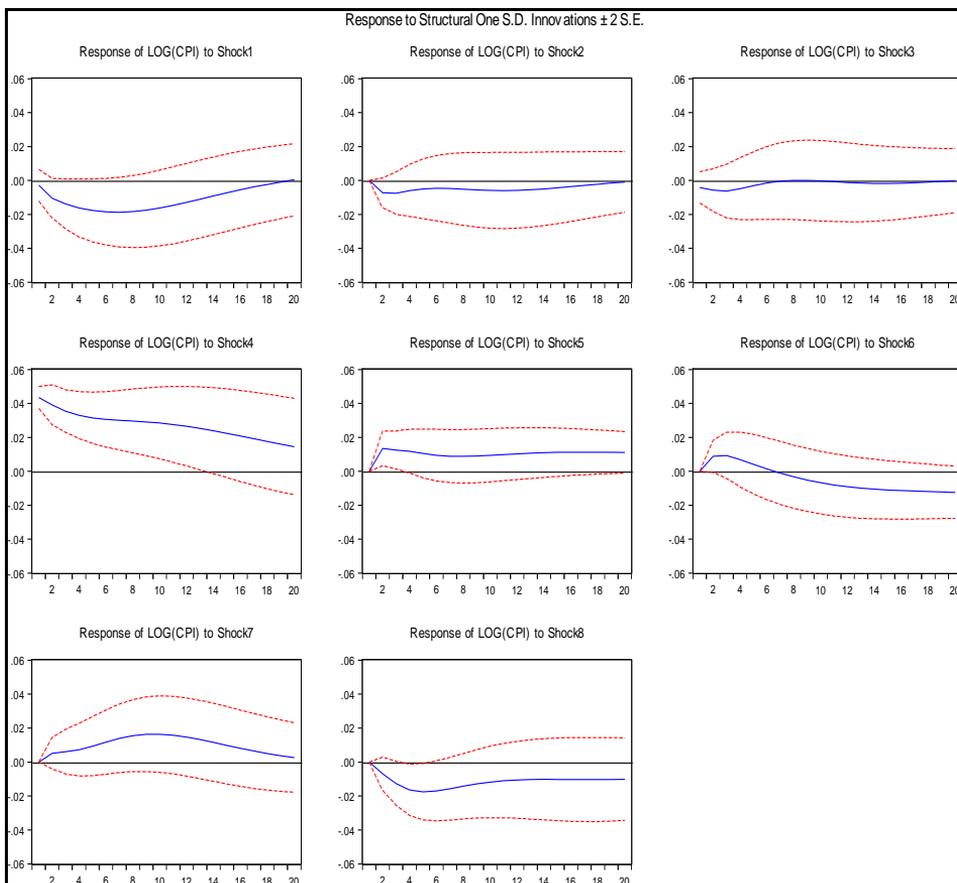
Shock 5 shows the estimated impulse responses of the CPI to a positive money supply shock. Price increases in response to a positive monetary shock means expansionary monetary policy is an important source of inflation, increasing aggregate demand and reducing purchasing power of money. This is in line with monetarist theory that money supply is inflationary. Moreover, Shock 6 in Figure 3 shows the effect of T-bill rate shock (TB) on price level. A positive shock to T-bill rate has a positive impact on price at least in the short- and medium-term, indicating a price puzzle occurred, but its effect subsequently becomes negative, which indicates a positive innovation to interest rate (contractionary monetary policy) having a significant negative effect on price except during the first quarter.

Shock 7 in Figure 3 indicates that positive credit shock to the private sector affects CPI positively, which is in line with our expectations and economic theory: that is, increases in credit create more demand for goods and services and hence increase price levels. These results show that there is an effective credit channel of monetary policy transmission affecting output level.

Finally, Shock 8 in Figure 3 shows the responses of CPI to nominal effective exchange rate shock. Positive NEER shocks, represents an increase in nominal effective exchange (appreciation). Since Ethiopia is an import-dependent country in which imports are mainly composed of capital goods and raw materials, which the country cannot now afford, appreciation leads to a decline in the cost of imported goods and that in turn affects price level negatively, decline in prices.

The finding that the exchange rate plays a significant part in influencing domestic inflation is consistent with the results in Cheng and Tan (2002).

**Figure 3: Responses of Price for Domestic and Foreign Variables Shock**



Source: Author's computation based on E-views 9 result

### 3.4 Estimation results of variance decomposition function

Variance decomposition of output (Q) and prices (P) was carried out to look at the strengths of the channels of the monetary transmission mechanism. This was achieved by using forecast horizons of one through 20 quarters. The first column lists the quarters ahead, the second column refers to standard error (SE), the forecast error of the variable in different quarters. The other columns

represent the variables for the different Shocks: WOP, FFR, RGDP, CPI, m1, TB, PSC and NEER. The decomposition values for the 1<sup>st</sup>, 4<sup>th</sup>, 8<sup>th</sup>, 12<sup>th</sup>, 16<sup>th</sup>, and 20<sup>th</sup> horizons in the future are displayed in Table 6 and Table 7 below.

First, as shown in Table 6, the fluctuations of Y (output) are mainly explained by its own shocks (Shock 3), money supply (Shock 5) and NEER (Shock 8) over the short- and medium-term. In terms of transmission channels, nominal effective exchange rate shocks (Shock 8) explain more output fluctuations than credit shocks (Shock 7) and money supply shocks (Shock 5). The impacts of the three channels (exchange rate, money supply and credit) provide effective transmission channels of monetary policy in affecting output, while the influence of the interest rate channel is ineffective as can be seen in its contribution in affecting output in Table 6.

The contribution of world oil prices (Shock 1) and foreign interest rates (Shock 2) are small. This indicates, in both over both the short- and medium-term, internal factors play a more crucial role in the fluctuations of output than foreign monetary variables. In sum, the variance decomposition of RGDP in Table 6 indicates the significant role played by money supply (Shock 5), exchange rate (Shock 8), credit (Shock 7) and Treasury bill rate (Shock 6) in accounting for the fluctuation of output growth (RGDP) in Ethiopia. At the 20 quarters (5 year) horizon, the fraction of the variation in output growth of Ethiopia that can be attribute to the variations in M1, NEER, PSC and TBR are 10.2 %, 8.6%, 6.2 % and 3.6 % respectively

**Table 6: Variance decomposition of RGDP**

<b>Variance Decomposition of LOG (RGDP):</b>									
<b>Period</b>	<b>S.E.</b>	<b>Shock 1</b>	<b>Shock 2</b>	<b>Shock 3</b>	<b>Shock 4</b>	<b>Shock 5</b>	<b>Shock 6</b>	<b>Shock 7</b>	<b>Shock 8</b>
1	0.04095	1.7234	1.47E-9	98.276	5.56E-3	0.0000	0.0000	0.000	0.0000
4	0.10835	3.0788	0.0481	92.250	0.3601	0.3350	0.6249	1.3740	1.9291
8	0.13302	3.1885	0.0677	78.351	1.5486	3.3917	1.0976	5.1437	7.2109
12	0.14183	3.0019	0.2314	69.815	2.3552	6.6063	2.9768	6.6186	8.3947
16	0.14566	3.3551	0.2612	66.972	2.4374	8.8156	3.5540	6.5251	8.0797
20	0.14917	3.5704	0.6756	64.617	2.4552	10.206	3.6269	6.2356	8.6197

Source: Author’s computation based on E-views 9 result

The variance decomposition of CPI in Table 7 shows the significant role played by money supply, exchange rate, and the credit and Treasury bill rates in accounting for the fluctuation of price levels (CPI) in Ethiopia. At the 20 quarters (5 years) horizon, the fractions of the variation in price or inflation growth in Ethiopia that can be attributed to the variations in NEER, PSC, M1 and TBR are 10.2 %, 8.1%, 7.7% and 5.3% respectively. The impact of the world oil price on price level increases over longer horizons remains a significant contribution, implying that the world oil price affects domestic price level with some lag. An examination of the transmission channels shows that the exchange rate, credit channel and money supply channels are more effective in their relative order of effectiveness than the interest rate channel.

**Table 7: Variance decomposition of CPI**

<b>Variance Decomposition of LOG(CPI):</b>									
<b>Period</b>	<b>S.E.</b>	<b>Shock 1</b>	<b>Shock 2</b>	<b>Shock 3</b>	<b>Shock 4</b>	<b>Shock 5</b>	<b>Shock 6</b>	<b>Shock 7</b>	<b>Shock 8</b>
1	0.043	0.4097	3.21E-3	0.9126	98.678	0.0000	0.0000	0.0000	0.0000
4	0.086	7.3400	1.8606	1.4527	73.111	6.0429	2.6821	1.4608	6.0495
8	0.123	12.733	1.6037	0.8386	62.515	5.4920	1.6009	5.1182	10.090
12	0.143	13.440	1.7641	0.6005	58.563	5.6029	2.1557	8.2562	9.6165
16	0.167	12.289	1.8071	0.5440	56.941	6.5394	3.5767	8.6749	9.6265
20	0.168	11.169	1.6928	0.5029	55.398	7.6637	5.2704	8.1379	10.168

Source: Author's computation based on E-views 9 result

#### **4. Conclusion and Policy Recommendations**

This study has examined the transmission mechanisms of monetary policy in Ethiopia using quarterly time series data from 1994/95Q1 to 2017/18Q. A small open economy structural Vector Auto Regression (SVAR) model, with two foreign and six domestic variables, was used to examine the effectiveness of the different monetary transmission channels. All the variables were tested for unit roots using ADF and PP test and model stability with other necessary tests.

The results derived from structural impulse response and structural variance decompositions derived from the Structural VAR model showed that direct monetary transmission, credits to the private sector and nominal effective exchange rate have significant impacts on output and price levels in Ethiopia

indicating that monetary policy transmission channel is effective in influencing macroeconomic variables in the Ethiopian economy. The results of the interest rate channel in affecting output and price was, however, less effective relative to other channels.

It is recommended, therefore, that monetary authorities target monetary aggregate as a policy variable for effective monetary policy implementation, because the interest rate channel is ineffective. This implies that National Bank of Ethiopia is effective in choosing intermediate monetary policy targets. Since the credit channel provides an important mechanism through which monetary policy is transmitted in Ethiopia, encouraging the informal sector to extend credit into the formal system will increase benefits to the economy by channeling funds to more productive and key economic sectors which have been less financed by the banking sector. To make the interest rate channel effective, the National Bank of Ethiopia and other stakeholders need to support current trends in the development of financial markets to increase the participation of households and non-bank institutional investors in treasury bills of different maturity date. They should also provide for substitution between bank lending and other types of external finance, equity or bond markets, by developing capital markets.

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# Nexus Between Economic Growth, Unemployment and Inflation in Ethiopia

Adem Feto Bedhaso<sup>1</sup> and Jayamohan M. K.<sup>2</sup>

## *Abstract*

*Empirical literature reveals that the fast-economic growth in Ethiopia during 2004-2016, averaging 10.6 percent, was affected by inflationary and unemployment pressures. In this context, the question of how to maintain low and stable unemployment levels as well as relatively stable prices and achieve high economic growth was and remained a puzzle for policy makers in Ethiopia. And identifying the nexus between those variables became very relevant. This study tries to answer the appropriate questions: Do short run causalities link inflation, unemployment and economic growth? Do inflation, unemployment and economic growth have a long run relationship? If so, what is its direction and magnitude? Time series data from WB: WDI databases, triangulated with domestic sources for the period 1991 – 2016, were employed. The study adopted Okun's model (Okun, 1962) and modified it to incorporate unemployment, inflation and economic growth. Stationary test, VAR, ARDL bounds testing for cointegration, VECM models, Granger Causality, and Wald tests were used for analysis. The bounds test for cointegration results indicated the existence of a long run relationship among the variables. The findings indicate that in the short-run a mild rise in price promotes economic growth in Ethiopia. An inverse relationship between unemployment and economic growth, and a trade-off between unemployment and inflation, were observed in line with Okun's law and a Philips curve. There is a short run causality running from inflation to real GDP; and in the long run economic growth and inflation move together. The short run, long run and ECM estimates all agree over significance and causation: inflation and unemployment estimates have inverse and significant relations while inflation and GDP have positive and significant relations. The speed, at which inflation returns*

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*to equilibrium after changes in unemployment and real GDP, as measured by ECM, is 112 percent, indicating the strength of the economy's ability to accommodate shocks. Since unemployment and GDP have diverse and opposite effects on inflation, policy choices need to be taken with care and vigilance.*

**Keywords:** Real GDP, Inflation, Unemployment, ARDL, VECM, Ethiopia

### **List of Abbreviations**

ADF	Augmented Dickey Fuller
ARDL	Autoregressive Distributed Lag
CPI	Consumer Price Index
CUSUM	Cumulative Sum of Recursive
CUSUMSQ	Cumulative Sum of Squares of Recursive Residuals
ECM	Error Correction Model
ETB	Ethiopian Birr
GDP	Gross Domestic Product
LINFL	Log Inflation Rate
LRGDP	Log Real Gross Domestic Product
LUNEMPL	Log Unemployment Rate
PP	Philips-Perron
WB: WDI	World Bank: World Development Indicator

## **1. Introduction**

Ethiopia recorded 10.6 percent economic growth, one of the fastest in Africa, for the period 2004-2016, but during the same period it was accompanied by an inflation rate of 16.3 percent and an unemployment rate of more than 17 percent (WB: WDI, 2018).

There are different theories and empirical testimonies on the relation between major macroeconomic variables like economic growth, inflation and unemployment. In the short run, according to Phillips (1958) and Dornbusch, et al (2011), inflation and unemployment have an inverse relationship. Classical economists observe no relationship between inflation and unemployment in the

long run, further emphasizing that inflation is caused by alterations in the supply of money. Monetary economists were of the opinion that inflation was a Monterey phenomenon (Friedman, 1968); and Keynesians (Keynes (1936), regarded inflation as an aftermath of increases in money supply.

During 1990s Ethiopia experienced economic stagnation. In 1990/91 the Ethiopian economy registered a 7.2 percent decline in Gross Domestic Product (GDP), with 12 percent unemployment, 35.7 percent inflation and a budget deficit/GDP ratio of 29 percent (WB: WDI, 2018). Since then Ethiopia has marked steady economic growth. The Economic Commission for Africa (ECA), appreciated Ethiopia's six percent average economic growth over the last previous decade (ECA, 2007). Unfortunately, that achievement was attended by the challenges of inflation and unemployment (Demissie, 2008; Kassahun, 2002 and NPC, 2016).

The Ethiopian economy is characterized by unpredictable growth in output owing to the economy's reliance on nature. The agricultural sector comprises about 50 percent of GDP, and when climatic conditions are unfavourable, output in the agricultural sector shrinks sharply. GDP and prices systematically follow this trend (Alemayehu, 2008).

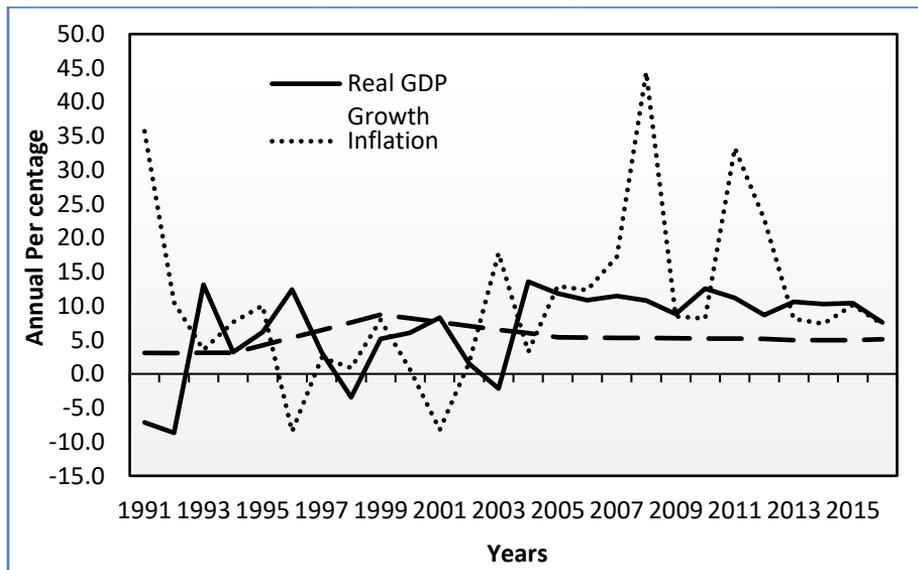
The inflation rate in Ethiopia jumped from its 1.7 percent level in 2002 to 17.8 percent in 2003 and 44.4 percent in 2008, and the average inflation rate has been 15.3 percent since 2003 (IMF, 2018). The fast-economic growth coupled with growing money supply arising from fiscal deficits created an inflationary spiral (Alemayehu and Kibrom, 2011 and MoFED, 2000). Inconsistent price rises led to less profitability, higher costs of production and low international competitiveness (WB: WDI, 2013).

Unemployment and underemployment are features of the informal labour market in Ethiopia. Unemployment has undesirable social, economic and psychological effects. In least developing countries like Ethiopia in which physical capital is in short supply, labour resources and stable price levels play a significant role in economic growth. However, a sizeable portion of the labour force in Ethiopia is unemployed and the inflation rate is alarming. Indeed, unemployment and inflation caused by political instability, operational problems in industry, volatile investment and a large and growing flow of new graduates into the labor market from an increasing number of higher educational institutions, have been a widespread phenomenon in Ethiopia for several decades Gizaw (2016) and Guglielmo and Marinko (2011). These factors continue to pose

a huge burden on current economic growth of the country. “The existing literature considered inflation and unemployment as constituting twin problems that explains the endemic nature of poverty in developing countries” (Temple, 2000)

Most of the macroeconomic policy initiatives in Ethiopia have been unable to realize the anticipated target of continued economic growth, price stability and lower unemployment levels. The economic fluctuations observed in last couple of decades necessitate the importance of taking measures to provide efficiencies of allocation, distribution and stabilization.

**Figure 1: Inflation, unemployment and GDP growth in Ethiopia**



Source: WB: WDI, 2018

In Figure 1, the inflation, unemployment and GDP growth trends show how the economy has fluctuated. Ethiopia achieved a record high level of economic growth in 2004 - 13.6 percent. Inflation recorded an extreme of 44.4 percent in 2008, at a time when the global economic down turn affected the Ethiopian economy moderately. After two years of single digit inflation, prices skyrocketed to 33.3 percent in 2011, possibly the result of the exchange rate devaluation carried out in 2010. The unemployment level in Ethiopia remained high after the downfall of the Derg, the military regime, in 1991 and increased further in the mid 1990's. It again showed a tendency to rise in 2009-2010 following the global financial crisis. However, since 2004, with the country's

broad-based and continues achievement of double-digit economic growth, the overall employment rate has slightly improved (WB: WDI 2018). The aim and intention of managing the economy has underlined the rationale of increasing government intervention; however, the Ethiopian government has not been in a position to treat the troubles of the economy successfully (Alemayehu and Kibrom, 2011; NPC, 2016; Nandeewara and Abate, 2015 and Simpasa and Daniel, 2011).

The economic growth in Ethiopia in the last decades has been clearly affected by inflation and unemployment levels, but the magnitude and direction of short run and long run causalities, and the statistical significance of those relationships, have not been properly addressed. This was despite the fact that studies on the matter could be expected to add to the literature and policy makers would be able to use their findings as an input for policy design and intervention. In fact, research encompassing unemployment, inflation and economic growth together have not taken place in Ethiopia. The studies conducted have either covered the relationship between economic growth and inflation, or between unemployment and economic growth. The intention of this study was therefore to identify the type and nature of the relationships that exist among those three central macroeconomic indicators. Specifically, the study intended:

- To determine the short-run and long run relationships among inflation, unemployment and economic growth in Ethiopia, and
- To examine the causalities of inflation, unemployment and economic growth in Ethiopia.

## **2. Literature Review**

Okun's law, the empirical relation between unemployment and output, states that "if GDP grows rapidly, the unemployment rate declines and if growth is very low or negative, the unemployment rate rises. When the actual growth equals the potential, unemployment rate remains unchanged" (Okun, 1962). Since the inception of Okun's law, several studies have been done to validate Okun's coefficient. Some have adopted a single country approach (Caraianni, 2006; Evans, 1989 and Weber, 1995); others consider a pool of countries (Fouquau, 2008) and regional data (Guisinger, et al, 2015 and Freeman, 2000). A remarkable stable result was observed in the United States, but in OECD countries, the estimates have been less stable.

Several studies have been performed relating to the supposedly inverse relationship between inflation (wage) and unemployment. Stock and Watson (1999) used the conventional Phillips curve to investigate the forecasts of the United States. Inflation at the 12-month horizon and inflation forecasts produced by Phillips curve have generally been more accurate than forecasts based on other macroeconomic variables. In a related study, Popovic and Popovic (2009) on a comparative analysis of Philips' regularity in the European Union for the period 1998-2007, using a correlation analysis, found an inverse relation of unemployment and inflation.

The work of Fakhri (2011) on the connection between economic growth and inflation in Azerbaijan provides a nonlinear link of those variables with the threshold level of 13 percent. In China, Chang-Shuai and Zi-Juan (2012) researched the link between inflation, unemployment and economic growth by applying time series models. They found that unemployment and inflation affected economic growth negatively and positively, respectively. Regarding the short run causality, they observed a two-way causality between economic growth and inflation, a one-way causality between economic growth and unemployment, and no causality between inflation and unemployment.

In Nigeria, a study focused on the links among economic growth, inflation and unemployment (Mohammed et al., 2015). The long run ordinary least squares analysis found that unemployment and inflation had a negative effect on economic growth. Guglielmo and Marinko (2011) employed a panel co-integration method and causality tests by pooling data from 119 countries for the period 1970-2010 to assess the short run and long run linkages among employment, inflation and output. It revealed that employment and output were caused by inflation positively in the short run and negatively in the long run.

Studies in Ethiopia have specifically focused analysis either on the relationship between inflation and economic growth, unemployment and economic growth or one of the variables only, not on the relationship of all three indicators together. In addition, the analytical procedures and datasets adopted in those studies have been diverse. Findings have been contradictory.

Gizaw (2016) assessed the relationship between inflation and economic growth in Ethiopia using co-integration and an Error Correction Model (ECM) for the period from 1991 to 2014. The results indicated the existence of a long run relationship in which the causality runs from economic growth to inflation.

The error correction term in the study showed that any disequilibrium in a given period would adjust back to equilibrium by 80.3 percent.

The multiple regression analysis results of Asayehgn (2009) on the relationship between economic growth and inflation concluded that “the main determinants of inflation in Ethiopia are imports, depreciation of the Ethiopian Birr (ETB), and a decline in the domestic lending interest rates or an increase in broad money supply”. A study by Nandeeswara and Abate (2015) on inflation and economic growth used the framework of VAR, ECM, and causality test and threshold level analysis using annual data covering the period from 1974 to 2012. The results provided a short run and long run connection and bidirectional causality between inflation and economic growth. A 9-10 percent threshold inflation level was among the findings.

Even if unemployment has been prevalent in urban centres in Ethiopia, Nzinga and Tsegay (2012) found that national youth unemployment had steadily fallen since 1999. Women, however, had not benefited from this reduction, and this could possibly explain the severity of poverty prevailing among households headed by females in urban Ethiopia Jayamohan and Amenu (2014).

Gizaw (2016), Nandeeswara and Abate (2015) and Asayehgn (2009) focused only on the relationship between inflation and economic growth; unemployment was not included in their work. Nzinga and Tsegay (2012) focused on the youth labour market and their study did not cover the relationship of employment with inflation and economic growth. Contrary to these studies, this paper extends the analysis of the association of the variables by bringing in unemployment, one of the significant variables in macroeconomic analysis, and including all the three variables together.

### **3. Materials and Methods**

Macroeconomic theory produces few models that link the unemployment rate with economic growth. A simple law of empirical association between cyclical unemployment rate and economic growth was first introduced in the early 1960s. That law by Okun indicates a short run inverse relation of those variables in the United States of America economy in the period from 1947 (q. 2) to 1960 (q. 4). The association is not directly derived from macro-economic theory but rather from purely statistical and empirical data. The law has helped

many academicians, researchers and policy makers in macroeconomic and policy analysis since its inception.

Okun's law uses four types of estimation technique, (Javeid, 2007). The difference version/growth rate form relates change in output to change in unemployment; the gap version, which contains the deviation of actual output and unemployment rates from their respective potential (natural) rates; the dynamic version relating current unemployment rates with current and past values of output and past values of unemployment rate; and finally, a production function version, using output as a function of labor, capital and technology.

### 3.1 Data

This study has employed World Bank (WB) World Development Indicator (WDI) data. It considered the data of three main economic indicators, viz. economic growth, unemployment, and inflation in Ethiopia for the period 1991 to 2016. The WB: WDI data were triangulated with available domestic sources of data such as National Bank of Ethiopia (NBE), the Central Statistical Agency of Ethiopia (CSA) and the Ethiopian Economic Association (EEA) database.

### 3.2 Model Specification

The study adopted the basic Okun's law to offer a sound reflection on the relationship of the main macroeconomic indicators. By assuming a linear relationship among the rate of growth of GDP, unemployment and inflation, the model looks like the following:

$$Rgdp = \beta_0 + \beta_1 Unempl + \beta_2 Infl + u \quad (1)$$

Where: *Rgdp*- Real GDP growth rate, it is measured as increasing in the amount of goods and services produced by an economy over time (Mankiw, 2013).

*Real GDP Growth Rate* =  $\frac{Y_t - Y_{t-1}}{Y_{t-1}} * 100$ , Where:  $Y_t$  - current year GDP and  $Y_{t-1}$  - previous year GDP

*Unempl* – unemployment rate, refers to the percentage of people who are currently unemployed but actively searching for a job.

$$UnemploymentRate = \frac{UnemployedPeople}{LaborForce} \text{ (Dornbusch et al., 2011) .}$$

*Infl* – inflation rate, is a sustainable increase in the general (average) price level of goods and service.  $InflationRate = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} * 100$ ,

Where:  $CPI_t$ - current CPI and  $CPI_{t-1}$  - preceding year CPI (Romer, 2012).  $u$ - error term.

**Testing Stationary:** The first task in analysing econometric time series data is the testing 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) and Phillips-Perron (PP) tests were used in this study to test the status of unit root in data series (Dickey and Fuller, 1979, 1981 and Phillips and Perron, 1988). The ADF test is presented as follows:

$$\Delta Y_t = \alpha + \beta Y_{t-1} \sum_{i=1}^n \beta_1 \Delta Y_t + \varepsilon_t \quad (2)$$

Where: Y- linear time series, n- optimum number of lags and  $\varepsilon$ - random error term.

Autoregressive Distributed Lag (ARDL) bounds testing for co-integration: This study used Akaike Information Criterion, Schwarz Information Criterion, and Hannan-Quin Information, which are the widely applied criteria for selecting the lag order. 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 and Pesaran, et al., 2001). The single reduced form ARDL bounds testing equation that simultaneously estimate long run and short run parameters is specified as follows:

$$\begin{aligned} \Delta GDP_t = & \alpha_0 + \sum_{i=1}^n \alpha_{1i} \Delta GDP_{t-i} + \\ & \sum_{i=0}^m \alpha_{2i} \Delta UNEMPL_{t-i} + \sum_{i=0}^q \alpha_{3i} \Delta INFL_{t-i} + \delta_{1i} GDP_{t-1} + \delta_{2i} UNEMPL_{t-1} + \\ & \delta_{3i} INFL_{t-1} + \varepsilon_{it} \end{aligned} \quad (3)$$

Granger causality tests: These examines whether a variable with its lagged values has any predicting ability on another variable. The F-statistic value determine the parameter under consideration is zero or different from zero (Granger, 1969). It was employed in this study to examine the causal relationship among economic growth, unemployment and inflation.

**Error Correction Model:** An ECM 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 is:

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^q \beta_{1i} \Delta GDP_{t-i} + \sum_{i=0}^m \beta_{2i} \Delta UNEPL_{t-i} + \sum_{i=0}^n \beta_{3i} \Delta INFL_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \quad (4)$$

Where:  $ECT_{t-1}$ - error correction term,  $\lambda$ -the speed of adjustment parameter is negative and statistically significant as a condition for long run co-integration (Kremers, et al., 1992)

**Diagnostics test:** The pre- and post- estimation tests applied in this study include: a serial correlation test (Breusch, 1978 and Godfrey, 1978), heteroscedasticity test (Pearson, 1905; Goldberger, 1964 and Johnston, 1972) and an outlier (and missing data) detection test. In addition, Jarque-Bera normality (Jarque and Bera, 1987), and the Cumulative Sum of Recursive (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) (Brown et al., 1975) tests were used to check the data distribution and post-estimation stability, respectively.

#### 4. Results and Discussion

Table 1 shows the descriptive statistics of Log Real Gross Domestic Product (LRGDP), Log Inflation Rate (LINFL) and Log Unemployment Rate (LUNEMPL). Of the three, the highest dispersion during the period was for inflation. The normality test showed that compared to the actual data distribution, the data series in the logarithm form were normally distributed. The summary

statistics, such as minimum and maximum values and the status of missing values proved the absence of serious outliers in the data series.

**Table 1: Real GDP, inflation and unemployment during 1991-2016**

Description	LOG(RGDP)	LOG(INFL)	LOG(UNEMPL)
Mean	23.63634	2.061320	1.659370
Median	23.44145	2.116374	1.658317
Maximum	24.68116	3.793043	2.164472
Minimum	22.85752	-0.411798	1.125254
Std. Dev.	0.565414	1.074439	0.289429
Skewness	0.447234	-0.639473	-0.412439
Kurtosis	1.885977	3.042669	2.781371
Jarque-Bera	2.211213	1.637525	0.788908
Probability	0.331010	0.440977	0.674048

From WB: WDI (2018) data, it is evident that the average growth rate of GDP in Ethiopia was 6.8 percent, lower than the 10.7 percent average growth rate of inflation. The average unemployment rate during the period according to the modelled International Labour Organization (ILO) estimates of WB was 5.5 percent.

#### 4.1 Unit Root Test

The 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 2 indicate that LRGDP and LINFL were I(1) order of integration, i.e. stationary at first difference and LUNEMPL was stationary at level, I(0) order of integration.

**Table 2 Augmented Dickey-Fuller test**

Variables	ADF Test	
	Level	1st difference
LRGDP	(-1.741484) [ 0.7021]	(-3.699606) [0.0430]**
LINFL	(0.625797) [0.9969]	(-4.697650) [0.0208]**
LUNEMPL	(-4.910994) [0.0041]*	

Note: \* and \*\* symbolize rejection of the null hypothesis (unit root) at 1% and 5% level of significance, respectively.

: ( ) and [ ] present t-statistics and probability values, respectively.

## 4.2 Bounds Test for Co-integration

Since the variables in our model are stationary at different levels, the ARDL bounds test for co-integration method is the appropriate tool to observe the long run relationship. To conduct the test, the maximum lag length for each variable was determined. The maximum lag length for real GDP, inflation and unemployment, were found to be three, zero, and two, respectively. The co-integration test results in Table 3 showed a long run relationship between inflation, unemployment and real GDP. The F-statistics and t-statistics values indicated the existence of the long run relationship when the inflation rate was used as the dependent variable.

**Table 3: Bounds test for co-integration**

Dependent variable	F-statistics and t –statistics	Co-integration	Estimation procedure
LRGDP	FLRGDP = 1.917001, tLRGDP= 1.919901	NO	ARDL (Short run model)
LINFL	FLINFL = 6.535460, tLINFL = - 4.380743	YES	ECM (Long run model)
LUNEMPL	FLUNEMPL = 1.661981, tLUNEMPL= -1.747666	NO	ARDL (Short run model)

## 4.3 Short Run Estimates

Short run estimation results are presented in Table 4 by considering GDP growth as the dependent variable. The variables are denoted by differences and lags of different period such as  $D(LRGDP(-1))^3$ ,  $D(LRGDP(-2))$  and  $D(LRGDP(-3))$ . In the short run, inflation and real GDP exhibit a causal relationship. They are positively related and the coefficients are statistically significant. A Wald test was also used to examine the short run causation and direction of causality. The Wald test's hypothesis that inflation lags do not jointly affect real GDP was rejected at five percent significance level. The test, therefore, confirmed that inflation lags jointly affect real GDP.

The short run estimates and the Wald test results indicate inflation affects economic growth. A moderate rise in price supplements returns to savers, enhances investment and improves productivity. A small increase in prices

<sup>3</sup> the differenced real GDP lagged by one period.

encourages consumers to buy goods and services. It then appreciates aggregate demands and the growth rate of the economy. A low inflation rate is also accompanied by low interest rates which increase investment activities and productivity. Therefore, the economic growth and price relationship is justified by a situation where a mild rise of price promotes short run economic growth. Furthermore, as shown in Table 4, the first and second lags of LR GDP positively and significantly affect LR GDP itself at 5% level, though as the lag passes the effect turns out to be negative.

**Table 4: A short run estimates of real GDP**

Dependent Variable: D(LR GDP):

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C <sup>4</sup>	-0.062005	0.045539	-1.361594	0.2450
D(LR GDP(-1))	1.107034	0.305906	3.618874	0.0224
D(LR GDP(-2))	0.785757	0.275846	2.848532	0.0465
D(LR GDP(-3))	-0.275950	0.095459	-2.890761	0.0445
D(LINFL(-2))	0.007032	0.002422	2.903351	0.0440
D(LINFL(-3))	0.007470	0.002111	3.538585	0.0240
D(LUNEMPL(-1))	0.425918	0.103927	4.098258	0.0149
R-squared	0.963278	Mean dependent var		0.095117
Adjusted R-squared	0.880653	S.D. dependent var		0.016969
S.E. of regression	0.005862	Akaike info criterion		-7.264745
Sum squared resid	0.000137	Schwarz criterion		-6.808276
Log likelihood	60.85322	Hannan-Quinn criter.		-7.307000
F-statistic	11.65845	Durbin-Watson stat		2.577853
Prob(F-statistic)	0.015307			
Breusch-Godfrey Serial Correlation LM Test: 12.26640 (0.2062)				

In the short run, real GDP and inflation are negatively related to unemployment and the coefficients are statistically significant (Table 5). Real GDP and inflation lags, rejected at five percent significant level, each independently estimated, do not jointly affect unemployment. The Wald test confirms that the joint lags of real GDP and inflation have a negative effect on unemployment.

Those results are in line with the inverse relationship between unemployment and GDP growth and the trade-off between unemployment and inflation of Okun's law and augmented Philips curve, respectively. The Philips

<sup>4</sup> Coefficient of constant term

curve, which works along the short run aggregates supply curve, describes the empirical connection between unemployment and inflation.

Short run estimation was tested using various pre- and post- diagnostics tests such as serial correlation, heteroscedasticity and stability. As exhibited in Tables 4 and 5, the post-diagnostics test results confirm the absence of serial correlation in the data series. Furthermore, the CUSUM and CUSUMSQ tests were employed to detect the post-stability of the estimation. The plots do not cross the five percent critical lines, implying the existence of stability of estimated coefficients over the sample period of investigation.

**Table 5: Short run estimate of unemployment**

Dependent Variable: D(LUNEMPL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.313116	0.092633	3.380189	0.0070
D(LUNEMPL(-1))	0.411766	0.215160	1.913773	0.0847
D(LUNEMPL(-2))	-1.076143	0.318747	-3.376169	0.0070
D(LRGDP(-1))	-3.390371	0.851147	-3.983296	0.0026
D(LINFL(-2))	-0.036975	0.014221	-2.599941	0.0265
R-squared	0.806636	Mean dependent var		0.014447
Adjusted R-squared	0.690618	S.D. dependent var		0.102748
S.E. of regression	0.057151	Akaike info criterion		-2.593348
Sum squared resid	0.032662	Schwarz criterion		-2.250261
Log likelihood	29.04346	Hannan-Quinn criterion		-2.559245
F-statistic	6.952655	Durbin-Watson stat		1.956654
Prob(F-statistic)	0.003999			
Breusch-Godfrey Serial Correlation LM Test: 0.474215 (0.6388)				

#### 4.4 Granger Causality Analysis

The Granger causality test results in Table 6 show the effect of variables on one another. The test was performed to predict whether the former variable Granger causes the later variable or otherwise. Accordingly, the hypothesis that a real GDP Granger test predicts unemployment was acceptable at one percent significance level. On the other hand, the hypothesis that an unemployment Granger test can predict inflation works at the 10 percent significance level. It also shows unemployment does have weak predicting power for inflation but inflation itself does not predict unemployment. There was also short run causality

that runs from inflation to real GDP at five percent significance level. All the causalities found at this point are unidirectional, which in turn paves a way for policy makers to design targets for short run macroeconomic objectives.

**Table 6: Granger causality tests**

Pairwise Granger Causality Tests	Lags: 3	
Null Hypothesis:	F-Statistic	Prob.
D(LRGDP) does not Granger Cause D(LUNEMPL)	12.3933	0.0002*
D(LUNEMPL) does not Granger Cause D(LINFL)	4.22840	0.0773***
D(LINFL) does not Granger Cause D(LRGDP)	9.72810	0.0158**

Note: \*, \*\* and \*\*\* symbolize statistically significance at 1%, 5% and 10% levels, respectively

### ***Long Run Estimates***

Regression results of long run estimates indicate that unemployment and real GDP coefficients are statistically significant at five percent and 10 percent levels, respectively. Real GDP contains positive coefficient, indicating GDP and inflation grow together. When economic activities rise by one percent, the price level in the economy increases by 0.7 percent. General government total expenditure in Ethiopia rose from 4.9 billion ETB in 1991 to 280.7 Billion ETB in 2016, with a sharp increase starting from 2005 (IMF, 2018). This suggests the recent Ethiopian government expansion of fiscal and monetary policies and the fast-economic growth in the country leading to excess demand for goods and services, could be reasons for the persistent annual increase in inflation. Besides the effect of cost inflation, pricing power inflation and sectoral inflation would be contributing factors.

**Table 7: Long run estimations**

Dependent Variable: LINFL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.26715	7.890415	-1.427954	0.1680
LRGDP	0.690416	0.337824	2.043715	0.0537**
LUNEMPL	-1.832380	0.671656	-2.728153	0.0126*
R-squared	0.323726	Mean dependent var		2.061320
Adjusted R-squared	0.259319	S.D. dependent var		1.074439
S.E. of regression	0.924692	Akaike info criterion		2.797757
Sum squared resid	17.95617	Schwarz criterion		2.945014
Log likelihood	-30.57308	Hannan-Quinn criter.		2.836824
F-statistic	5.026251	Durbin-Watson stat		2.086447
Prob(F-statistic)	0.016455			
JB -1.509976 (0.470016)				
Heteroskedasticity Test: Breusch-Pagan-Godfrey - 1.897033 (0.1748)				
Breusch-Godfrey Serial Correlation LM: Test - 0.171270 (0.6834)				

Note: \* and \*\* symbolize statistically significance at 5% and 10% levels, respectively.

The F-statistic value of 5.02 represents the two explanatory variables are jointly accountable for inflation change in the long run. The estimated model is free from serial correlation and heteroscedasticity.

**Figure 2: Normality test of long run estimates**

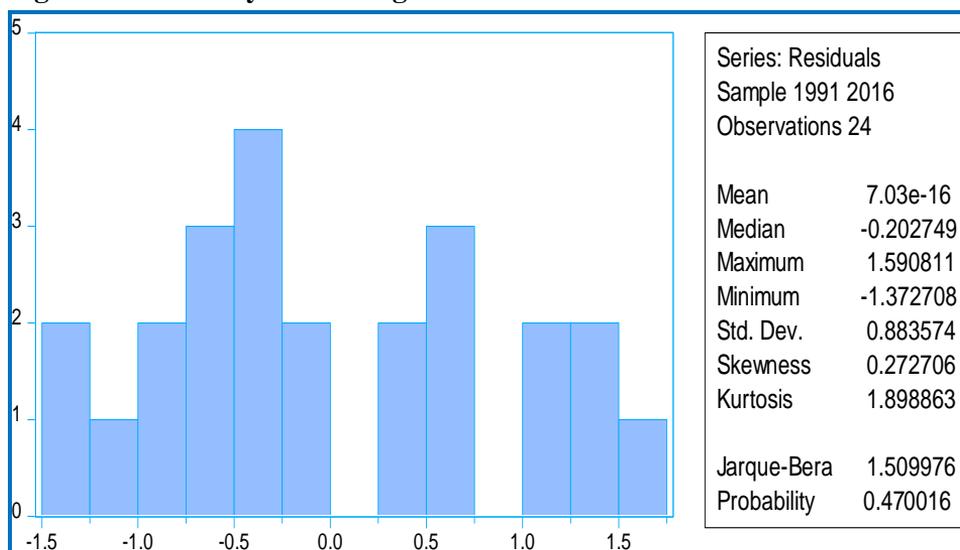
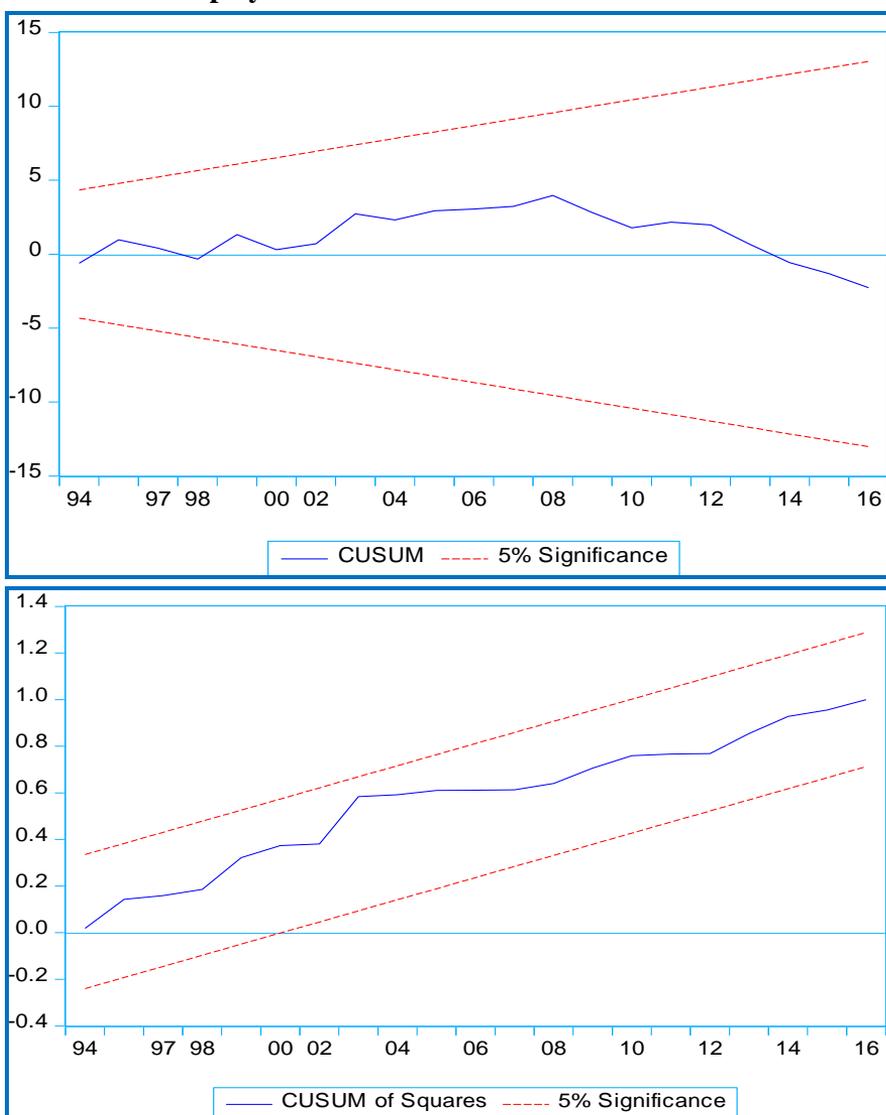


Figure 2 presents the Jarque-Bera statistic of 1.51 with P-value of 0.47, so the data series is normally distributed. Furthermore, the CUSUM and CUSUMS plots as presented in Figure 3 do not cross the five percent critical lines, which implies the existence of stability of variables over the entire sample period of investigation.

**Figure 3: Stability tests of long run estimates of inflation, real GDP and unemployment**



#### 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 a negative and statistically significant error correction term at one percent level, proving the existence of the long run relationship and short run dynamics. The speed of adjustment of the whole system from short run deviation to long run equilibrium is 1.122. The system is being adjusted towards long run equilibrium at the speed of 112 percent. The ECM (-1) explains the previous period's deviation from long run equilibrium influence short-run movement in the dependent variable. The Ethiopian economy in the last two and half decades has been hit by a series of policy and non-policy shocks; however, as the ECM result demonstrates, the effect of these shocks was not persistent.

**Table 8: Error Correction Model results**

Dependent Variable: D(LINFL)

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005157	0.352716	0.014621	0.9885
D(LRGDP)	0.993794	3.884987	0.255804	0.8012
D(LUNEMPL)	-2.315229	2.565732	-0.902366	0.3795
ECM(-1)	-1.121449	0.263570	-4.254837	0.0005*
R-squared	0.519296	Mean dependent var		-0.051241
Adjusted R-squared	0.434466	S.D. dependent var		1.280183
S.E. of regression	0.962723	Akaike info criterion		2.931541
Sum squared resid.	15.75620	Schwarz criterion		3.130498
Log likelihood	-26.78118	Hannan-Quinn criter.		2.974720
F-statistic	6.121600	Durbin-Watson stat		1.774355
Prob(F-statistic)	0.005118			
JB	-1.226526 (0.541581)			

Heteroskedasticity Test: Breusch-Pagan-Godfrey - 0.171861(0.9139)

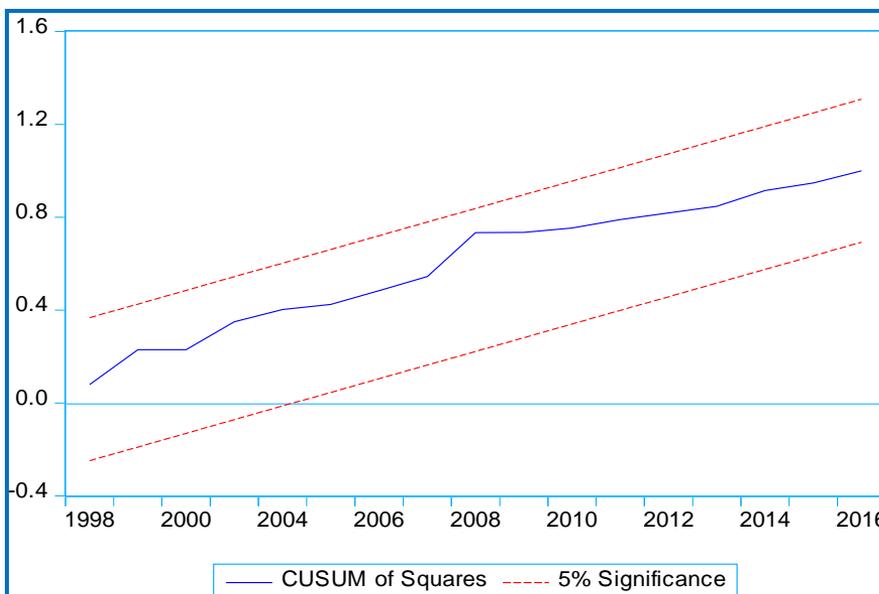
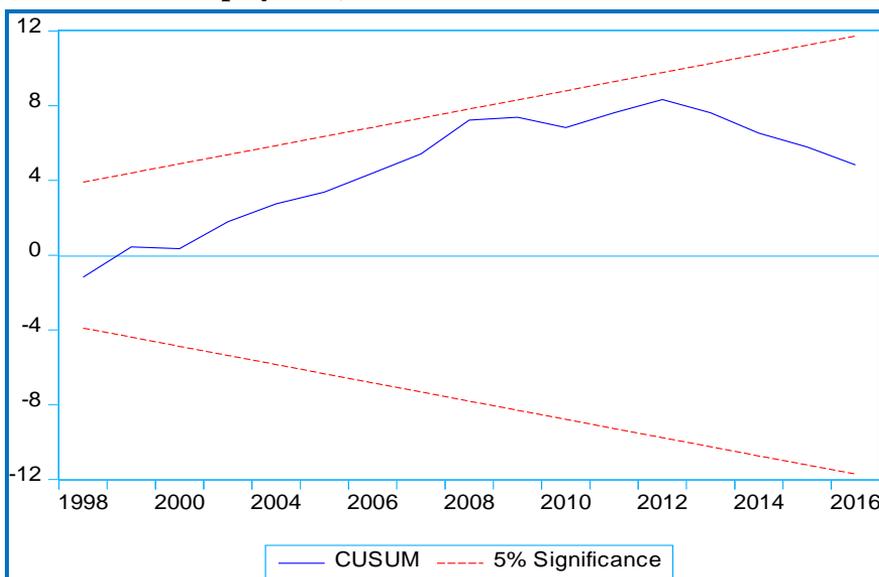
Breusch-Godfrey Serial Correlation LM: Test - 0.084609 (0.7749)

Note: \* symbolizes the error correction model is negative and statistically significant at 1% level.

As observed in Table 8, there are no serial correlation and heteroscedasticity problems in the model estimation. The normality test of

Jarque-Bera statistics value is 1.23 with P-value of 0.54, implying the data is normally distributed. Figure 4 indicates that the post-estimation procedure is stable; this allows us to rely on the estimated coefficients for policy-making.

**Figure 4: Stability tests of ECM estimates (inflation, real GDP and unemployment)**



Overall, the coefficient estimates of inflation, unemployment and real GDP, all agree with the effect of causation and significance. The estimates show that inflation and unemployment have significant inverse relations, and that inflation and GDP have a significant and positive relationship. The speed at which inflation has returned to equilibrium after changes in unemployment and real GDP and after economic shocks, has been impressively fast. It implies the Ethiopian economy has been experiencing fluctuations in the past two and half decades on a regular basis, but the main economic activities have quickly been able to return to long run equilibrium, indicating the vigour of the domestic economy. Nevertheless, since unemployment and real GDP have diverse effects on inflation, policy decisions on the matter require proper attention. The government and policy making institutions in Ethiopia should adopt a combination of fiscal, monetary, price and income policies for careful analysis and close observation.

## **5. Conclusion**

Growth in Ethiopia in recent decades has been strongly influenced by unemployment and inflation rates. The objective of this study was to find the nature of the relationship between central macroeconomic indicators. The data set covered the period between 1991 and 2018. ARDL bounds testing for cointegration methods was used for analysis. The short run model and Wald test results indicated a subsequent mild rise in price promoted short run economic growth in Ethiopia. The short run results were in line with the inverse relationship between unemployment and GDP growth and the trade-off between unemployment and inflation of Okun's law and augmented Philips curve, respectively. All causalities found were unidirectional, which offers a way for policy makers to design suitable targets for short run macroeconomic objectives. In the long run, GDP growth and inflation rise together. This can be explained by the expansionary policies adopted by the government and the fast-economic growth's increasing demand for goods and services. The Bounds test for cointegration results demonstrated the existence of a long run relationship among the variables. The speed, as measured by ECM terms, at which inflation returns to equilibrium after changes in real GDP and unemployment, is 112 percent. A study by Gizaw (2016) has indicated an 80.3% speed of adjustment to long run in Ethiopia. However, this study, by including unemployment in the model and

extending the time to 2016, found that the economic fluctuations Ethiopia has experienced can be cured by fast restoration of the economy to long run ahead of time, allowing the economy to remain vigorous enough to deal with shocks. However, since unemployment and real GDP have diverse effects on inflation both in the short and the long term, policy choices need careful and vigilant decisions. All estimations and diagnostics tests proved stable paving the way for significant policy decision making. Inflation targeting and Taylor's rule measures should be adopted by the National Bank of Ethiopia to stabilize the economy and achieve long run goals.

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# Government Revenue, Expenditure and Fiscal Deficits in Ethiopia: An asymmetric Co-integration Approach

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## *Abstract*

*This paper is an attempt to verify the nexus between the increasing public expenditure and revenue of Ethiopia using the data of a 42 year time series, for the period from 1974 to 2016. The specific objectives of the study were to verify the long run relationship between public expenditure and revenue and to assess the effects of fiscal deficits on economic growth. An asymmetric co-integration test based on NARDL was used and a Toda-Yamamoto test employed to verify the causality. The findings show that there is long run co-integration between expenditure and revenue; and the causality test confirmed the fiscal synchronization hypothesis for Ethiopia. Moreover, there is both a long run and a short run asymmetric relationship between real total government expenditure and real total revenue. With regard to the fiscal deficit, the NARDL co-integration results reveal that positive shocks in fiscal deficit lead to positive changes in GDP while negative shocks reduce GDP. Additionally, there is bi-directional causality running between GDP, human capital and labor but a unidirectional causality running from fiscal deficit to economic growth. In view of these findings some policy measures for improving tax revenues and minimizing fiscal deficits have been suggested.*

**Key Words:** Government expenditure, Revenue, Fiscal deficits.

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## 1. Introduction

Unless the market is perfect and competitive, infant or emerging economies require governments to create policies to regulate fluctuations in the economy and create equilibrium. Among the possibilities, the Ethiopian government has given most attention to fiscal policy. Fiscal Policy largely concentrates on balancing and regulating government revenue and expenditure to provide goods and services. It also has functions of allocating resources, disseminating resources, stabilization and sustaining growth and development of an economy. Barro and Sala-i-Martin (1992, p. 645) note: "the recent literature on endogenous economic growth allows for effects of fiscal policy on long-term growth. If the social rate of return on investment exceeds the private return, then tax policies that encourage investment can raise the growth rate and levels of utility. An excess of the social return over the private return can reflect learning-by-doing with spillover effects, the financing of government consumption purchases with an income tax, and monopoly pricing of new types of capital goods".

Current economic activities have arisen in a number of different ways; the complex development of today's systems of taxation and government expenditure are not recent phenomena but are based on a numerous development over time. In Ethiopia, for example, there were a considerable number of structural, political and economic changes during the last three regimes, with the first efforts to provide a fiscal policy dating back to the 1930s. The first written Ethiopian Constitution (July 1931) Article 55 states: "The law lays down that the receipts of the government treasury, of whatever nature they may be, shall only be expended in conformity with the annual budgeting, the sums to be at the disposition of each ministry. The annual budget shall be framed on the basis proposed by the ministry of finance during deliberations in the Chamber of Deputies and in the Senate, whose resolutions shall be submitted for the approval of the Emperor".

The imperial regime was overthrown by the military in 1974, and the salient feature of this Derg regime was a decrease of economic growth due to ideological conflict, political instability, and a non-democratic system of administration. Chole and Manyazewal (1992) in their study of the macro-economic performance of Ethiopia between 1974 and 1990, argue that the average rate of growth of gross domestic product (GDP) in real terms between

1974/5 – 1978-9 was 4% per annum. And also in 1979-80 the GDP growth rate was 2.5%, underlining a significant decrease in per capita GDP. The main reason for the reduction of the growth of aggregate output was the decline in agricultural productivity, the main element in the Ethiopian economy, then and today. Throughout the Derg regime, Ethiopia also experienced a substantial deficit; from 1974-1991 the overall government budget deficit, including grants, averaged 7% of GDP.

Following regime change in 1991, a broad range of reforms and policy changes were introduced, including the introduction of a fiscal policy which paid attention to tax reform and public expenditure in order to induce economic growth. The subsequent taxing system in Ethiopia can be divided into three broad categories: taxes on income and profits; taxes on goods and services and taxes on international trade (Geda and Shimeles, 2005). Most of these were reformed and amended in the decade following the 1992 general liberalization policy.

Another of the basic reforms of fiscal policy after 1991 was in public expenditure. As the government shifted to a market-based economic policy, it reduced its intervention in production and focused on supporting and encouraging private enterprises to reduce government expenditure. Public expenditure policy went beyond sectorial priorities and focused on financing reforms and developmental strategies including expenditure on civil service reforms, capacity building, and research and development. The 1994 budget signaled a significant shift in the emphasis in public expenditure policy. The allocation for defense spending continued to decline, while expenditure on “core” government activities, infrastructure, education, and health in particular, increased significantly (World Bank, 1994). During this period, several fiscal reforms were applied to improve revenue collection capacity and expenditure both at federal and regional levels. In the first Growth and Transformation Plan (2010/11 to 2014/15) fiscal reforms were aimed to ensure sustainable economic growth and reduce poverty through financing expenditure mainly from tax revenues. The Plan also aimed to keep the budget deficit below 3% of the GDP. Total domestic revenue increased from Birr 53.9 Billion in 2009/10 to Birr 186.6 Billion in 2014/15, (National Planning Commission, 2016); and in 2014/15, tax revenue accounted for Birr 165 Billion (88.4%) of the total domestic revenue collected. The remainder came from non-tax revenue sources.

Most government financial policies and strategies are derived from theories or hypotheses systematically or scientifically intended to resolve specific

problems or promote alternatives to improve existing situations. However, there is still a considerable debate among scholars over theories and hypotheses regarding the relationship between public revenue and expenditure, emphasizing contributions to economic growth on the basis of the four hypothetical approaches - tax and spend, spend and tax, fiscal synchronization or institutional separation. Any growing disparity between public revenue and expenditure causes a fiscal deficit which has a negative impact on economic growth. Ethiopia is no exception and has been facing continuing fiscal deficits. It is against this background, that this study has made an empirical analysis of government revenue and expenditure and examined the effects of fiscal deficit on economic growth in Ethiopia.

Section 2 of this paper deals with a review of the literature; our methodology is presented in Section 3, with discussion of results in Section 4. Our conclusion, Section 5, includes some policy implications.

## **2. Literature Review**

“Realizing the relationship between revenue and expenditure is a crucial prerequisite for any effective fiscal consolidation process” (Loloh and Amoah, 2008, p. 2). In general, fiscal policy deals with the adjustment of public revenue and expenditure in order to stabilize the economy, and there are four main schools of thought on how to consider the relationship between total revenue and expenditure, each offering a different hypothesis: Tax and Spend; Spend and Tax; Fiscal Synchronization; and Institutional Separation.

The basic concept of the Tax and Spend hypothesis is that the government should first generate the required optimum amount of revenue and then spend it according to the priority of required programs or projects (Al-Qudair, 2005; Elyasi and Rahimi, 2012)).

Friedman argues that high taxation implies more spending ultimately leading to a larger budget deficit, indicating a positive relationship between government revenue and expenditure. Buchanan and Wagner, claim there is a negative causal relationship between government revenue and expenditure (as cited in Rezaei, et al. 2015). Tax spend is a fiscal exchange model of public finance in which the state only raises and uses public finance to provide the levels of services chosen by citizens to secure their democratically determined negative and/or positive rights. Voter-citizens make tax and other such payments in exchange for services (Bailey (2004)

According to Rezaei, et al. (2015) Spend and Tax hypothesis is proposed by Peacock and Wiseman. They contend that expenditure causes revenue, and that government should first spend and then increase tax revenue. Al-Qudair (2005) argued the government should first determine its expenditure according to priority with respect to revenue.

The Fiscal Synchronization hypothesis is about bi-directional causality between public revenue and public expenditure when a government decides to run both policies at the same time or concurrently. When a government makes revenue and expenditure decisions simultaneously, it means there is a bi-directional relationship between government revenues and expenditure (Musgrave (1966), and Meltzer & Richard (1981) as cited in Al-Qudair, 2005).

The Institutional Separation hypothesis argues there should be separation of objectives between government expenditure and revenue as there is no relationship between government revenue and expenditure (Wildavsky (1988), Baghestani and McNown (1994) as cited in Bolat, S., (2014))

Ghebre is clear that “Fiscal deficits as conventionally defined on a cash basis, measure the difference between total government cash outlays, including interest outlays, but excluding amortization payments on the outstanding stock of public debt and total cash receipts, including tax and non-tax revenue and grants but excluding borrowing. In this manner, fiscal deficits reflect the gap to be covered by net government borrowing including borrowing from the central bank ” (Ghebre, 1994, p. 49).

Persistent growth of fiscal deficit will also have impact on macroeconomic variables such as interest rates, inflation, dependence on debt and aid or reduction of private investment. Oblath (1995) and Easterly and Schmidt-Hebbel (1993) stress that a fiscal deficit could mean that any printing of extra money would cause inflation; domestic financing and higher interest rates might lead to a credit squeeze and crowd out private investment, while external debt would lead to an increase in tax rates, discouraging investment and causes deficit.

While Alehile (2012), a Keynesian, is clear that a fiscal deficit has a positive effect on macroeconomic activity, neoclassical economics argues that fiscal deficits have a detrimental effect on economic growth. Ricardian equivalence approaches, however, state that fiscal deficits are neutral to economic growth.

Abdulrasheed (2017) studied the nexus between government expenditure and government revenue in Nigeria using time series data covering 1986 to 2015.

The study applied a co-integration statistical method and vector autoregressive techniques with an Error Correction Model (ECM). The findings provide a long run co-integration between government revenue and expenditure, and, the causal relationship confirms the Spend and Tax approach.

Eshetu (2016) examined the government revenue and expenditure nexus in Ethiopia using the Engle-Granger co-integration technique and a Granger causality test with Error Correction Modelling (ECM). Based on the results, he recommended government expenditure should be accompanied by revenue and control measures to ensure fiscal sustainability.

Ghumro (2014) investigated the causal relationship between expenditure and tax revenue of Pakistan applying co-integration with error-correction methodology for the period 1979 to 2012. The results showed unidirectional causality running from public expenditures to tax revenues, supporting the Spend to Tax hypothesis. He underlined the importance of controlling or reducing expenditures (Ghumro, 2014).

Wolde Rufael (2008) investigated the causal relationship between government revenue and government expenditure for 13 African countries within a multivariate framework using a modified version of the Granger causality test from Toda and Yamamoto (1995). The empirical evidence suggested that there was bi-directional causality running between expenditure and revenue for Mauritius, Swaziland and Zimbabwe; no causality in any direction for Botswana, Burundi and Rwanda; unidirectional causality running from revenue to expenditure for Ethiopia, Ghana, Kenya, Nigeria, Mali and Zambia; and a unidirectional causality running from expenditure to revenue for Burkina Faso only.

### **3. Data and Methodology**

This study has used quantitative research method in a positivist framework, employing time series annual data from 1974 – 2016 extracted from the National bank of Ethiopia. One of the basic criteria necessary to apply co-integration approach using time series data is detecting unit root and different diagnostic test models for economic analysis. The paper, therefore, used unit root test and diagnostic tests - serial correlation, heteroskedasticity, and normality distribution of data and stability of the model. All variables were determined and transformed from nominal to real form.

Different methods have been advocated for long run relationships in time series data. Among the most well-known co-integration methods are Engle Granger's Residual-based test, the Error Correction Method (ECM) Vector Error Correction Method (VECM) and Autoregressive Distributed Lag (ARDL). Hundie (2014) argued the Autoregressive Distributed Lag (ARDL) model, avoiding the integration of a variable whether level,  $I(1)$  or  $I(0)$ , had an advantage as the long run and short run parameters could be estimated simultaneously, and the ECM was more robust and responded better to small sample sizes.

NARDL is a new and recently developed method that has addressed the limitation of conventional methods in assuming a constant speed of adjustment (ECT) despite the effect of a long period of economic fluctuations and externalities.

Since the main purpose of time series analysis is to study the dynamic features of series over both short- and long-term periods, irrespective of the relationship between variables, most of the conventional co-integration methods assume the relationship to be linear. This isn't always true. In most cases, the ARDL model does not consider non-linear relationships that can be affected by both positive and negative shocks. In a time series, linear relationships imply that the effect of the regressor variable on the corresponding dependent variable is constant. However, in the case of nonlinear links, the effects of one variable on other variables may not alter the same unpredictable value. It also implies the effects of an independent variable over a dependent variable may not correspond and may be smaller or greater. It underlines that the justification for dissecting time series data is due to the unpredictability of its dynamic effects. The method is also important to verify long run relationships, looking at positive and negative changes under any given variable.

Non-linear ARDL (NARDL) approach is important to see shocks in a given variable that tends to increase or decrease due to the effects of events that occur suddenly. It incorporates asymmetry both in the long run and short run relationship and at the same time, it captures asymmetries in the dynamic adjustment as well as it allows regressing  $I(0)$  and  $I(1)$  order of the variable. Non-linear ARDL represents the simplest method of modeling combined short and long-run asymmetries yet developed (Shin et al., 2014).

According to Tursoy et al., (2018), one of the advantages of a NARDL model is that it allows synchronized discrepancy between the short-term and long-term effects of the exogenous variables on the dependent variable. In

general, a Non-Linear ARDL Model has several advantages over conventional co-integration, though it includes all the basic assumptions of the ARDL method.

It is crucial to detect the effects of the short run and long run dynamics of any shock with respect to positive and negative effects; it is important when determining co-integration in small samples; it can be applied irrespective of whether the regressors are stationary at a level or first difference I(1); and it is more advanced than ARDL due to the analysis of asymmetric phenomena. NARDL can be applied when the variables are of order I(0) or I(1), though not if a variable is stationary at order I(2). The optimum lag length is needed to run NARDL, which can be run with both orders I(0) and I(1) at the same time, and the output should pass all diagnostic tests (Meo, 2018).

The NARDL method includes the following steps:

First, conduct a unit root test to verify whether any variable is stationary at the second difference. If the variable is stationary at the second difference, NARDL cannot be applied.

Generate positive and negative series for those variables for which you want to see the asymmetric relationship and nonlinear relationship.

Test co-integration, using bound test with Wald test

Running NARDL, using stepwise regression under ECM

Detect the asymmetries with a Wald test. Step 4 shows if an asymmetric relationship exists or not but a Wald test provides further confirmation

This study has, therefore, applied NARDL to verify the long run relationship between total government expenditure and total revenue, using NARDL to capture asymmetric effects, the model is divided into the positive change and negative change.

$$RTR_t = \alpha_0 + \beta_1^+ RTGEX_t^+ + \beta_2^- RTGEX_t^- + \mu_t \quad (1)$$

$$RTGEX_t = \alpha_0 + \beta_1^+ RTR_t^+ + \beta_2^- RTR_t^- + \mu_t \quad (2)$$

The general form of NARDL is

$$RTR_t = \alpha_0 + \gamma RTR_{t-1} + \beta_1^+ RTGEX_{t-1}^+ + \beta_2^- RTGEX_{t-1}^- + \sum_{t=1}^p \delta_t RTR_{t-i} + \sum_{t=0}^q \theta_i RTGEX_{t-1}^+ + \sum_{t=0}^q \theta_i RTGEX_{t-1}^- + \mu_t \quad (3)$$

$$RTGEX_t = \alpha_0 + \gamma RTGEX_{t-1} + \beta_1^+ RTR_{t-1}^+ + \beta_2^- RTR_{t-1}^- + \sum_{t=1}^p \delta_t RTGEX_{t-i} + \sum_{t=0}^q \theta_i RTR_{t-1}^+ + \sum_{t=0}^q \theta_i RTR_{t-1}^- + \mu_t \quad (4)$$

Where,  $\alpha$ ,  $\gamma$ ,  $\beta$ ,  $\delta$  and  $\theta$  are parameters to be estimated, RTR is Real Total Revenue, RTGEX is Real Total Government Expenditure.

On the basis of the above equation, the following steps show the estimation of NARDL to verify the relationship between real total revenue and real total government expenditure for equation (1)

To detect long run coefficient: We can calculate the long run coefficient of RTGEX<sub>t</sub> by dividing the negative of the coefficient of RTGEX<sub>t</sub>,  $\beta_1^+$  by the coefficient of RTR<sub>t-1</sub>,  $\gamma$ , and the long run coefficient of RTGEX<sub>t-1</sub> by dividing the negative of the coefficient of RTGEX<sub>t-1</sub>,  $\beta_2^-$  by the coefficient of RTR<sub>t-1</sub>,  $\gamma$ .  $(-\beta_1^+ / \gamma)$  and  $(-\beta_2^- / \gamma)$  are the long run coefficients of RTGEX<sub>t</sub> and RTGEX<sub>t-1</sub>, respectively.

Asymmetric Co-integration test: A long run relationship or co-integration is present if the joint null hypothesis,  $\gamma = \beta_1^+ = \beta_2^- = 0$  is rejected when the critical value are the same critical values for ARDL.

Testing Symmetry: Clearly, if the long run coefficients  $(-\beta_1^+ / \gamma)$  and  $(-\beta_2^- / \gamma)$  are not same then there is asymmetry in the long run. So, we test the null hypothesis of  $(-\beta_1^+ / \gamma) = (-\beta_2^- / \gamma)$ . If the null is rejected then there is evidence of long run asymmetry in the model. The same procedure was applied for equation (2).

In order to confirm the results of NARDL and to check causality among variables, the study applied the Toda-Yamamoto Granger Causality test. This test is applicable irrespective of the integration and co-integration properties of the model. Toda and Yamamoto (1995) suggest the technique requires estimation of an augmented VAR which assures the asymptotic distribution of the Wald statistic (an asymptotic  $\chi^2$  -distribution), since the testing procedure is robust to the integration and co-integration properties of the process (Alimi & Ofonyelu, 2013). “The basic idea behind the Toda-Yamamoto Granger Causality test is to artificially augment the correct VAR order,  $k$ , with  $d_{max}$  extra lags, where  $d_{max}$  is the maximum likely order of integration of the series in the system” (Hundie, 2014, p. 5). To check causality among the variables, the Toda-Yamamoto Granger Causality test first uses VAR to determine optimum lag length ( $m$ ) and secondly, identification of the maximum order of integration ( $d_{max}$ ) for the variables in the system.

The study applied the following model specifications: bivariate VAR (m + dmax) adopted from Alimi and Ofonyelu (2013) which constituted two separate equations.

General form of the Toda Yamamoto causality test:

$$RTR_t = \alpha_0 + \sum_{i=1}^m \beta_1 RTR_{t-i} + \sum_{i=m+1}^{m+dmax} \beta_2 RTR_{t-i} + \sum_{i=1}^m \beta_3 RTGEX_{t-i} + \sum_{i=m+1}^{m+dmax} \beta_4 RTGEX_{t-i} + \mu_t \quad (5)$$

Where RTR is Real Total Revenue, RTGEX is real total government expenditure, while  $\varepsilon$  stands for an error,  $\alpha_0$  and  $\alpha_1$  are intercepts,  $\beta_1 - \beta_4$ , and  $\delta_1 - \delta_4$  are coefficients of Parameters.

To see the effect of fiscal deficit on economic growth the study used the Non-linear Auto Regressive Distributed Lag (NARDL) model and the Toda-Yamamoto Granger Causality test was employed as above. The study also adopted an endogenous economic growth model argument and derived the regression model from an expenditure approach of GDP measure including human capital and labor force.

GDP= f (Fiscal Deficit, Human Capital, and Labor Force)

The general form of NARDL

$$RGDP_t = \alpha_0 + \beta_1 RGDP_{t-1} + \beta_2^+ RFD_{t-1}^+ + \beta_3^- RFD_{t-1}^- + \beta_4^+ RHC_{t-1}^+ + \beta_5^- RHC_{t-1}^- + \beta_6^+ LF_{t-1}^+ + \beta_7^- LF_{t-1}^- + \sum_{t=1}^p \beta_8 RGDP_{t-i} + \sum_{t=0}^q (\gamma_i^+ RFD_{t-1}^+ + \gamma_i^- RFD_{t-1}^-) + \sum_{t=0}^q (\delta_i^+ RHC_{t-1}^+ + \delta_i^- RHC_{t-1}^-) + \sum_{t=0}^q (\theta_i^+ LF_{t-1}^+ + \theta_i^- LF_{t-1}^-) + \mu_t \quad (6)$$

Where  $\alpha$ ,  $\gamma$ ,  $\beta$ ,  $\delta$  and  $\theta$  are parameters to be estimated, RGDP represents Real Gross Domestic Product, RFD is Real Fiscal Deficit and RHC is Real Human Capital Expenditure Proxy by total capital expenditure on education and health. LF is total labor force proxy by population, ages 15-64 (% of total). All variables are first difference of natural logarithmic form.

General form of Toda Yamamoto causality test:

$$RGDP_t = \alpha_0 + \sum_{i=1}^m \beta_1 RGDP_{t-i} + \sum_{i=m+1}^{m+dmax} \beta_2 RGDP_{t-i} + \sum_{i=1}^m \beta_3 RFD_{t-i} + \sum_{i=m+1}^{m+dmax} \beta_4 RFD_{t-i} + \sum_{i=1}^m \beta_5 RHC_{t-i} + \sum_{i=m+1}^{m+dmax} \beta_6 RHC_{t-i} + \sum_{i=1}^m \beta_7 LF_{t-i} + \sum_{i=m+1}^{m+dmax} \beta_8 LF_{t-i} + \mu_t \quad (7)$$

#### 4. Results and Discussion

It is known that any time series data has an assumption for the convenience of any co-integration test. To use the stated model, a unit root test was conducted and both total real revenue and total real government expenditure were found to be stationary at first difference level, respectively. All variables were taken as a real value.

**Table 1: Unit root test Real Total Revenue and Real Total Government Expenditure**

ADF test statistic	First Difference RTR		First Difference RTGE	
	t-Statistic	Prob.	t-Statistic	Prob.*
	-4.727453	0.0004	-6.71122	0.0001
1% level	-3.600987		-3.60099	
Test critical values: 5% level	-2.935001		-2.935	
10% level	-2.605836		-2.60584	

Source: Author's computation using NBE Data

**Table 2: Lag selection for Real Total Revenue and Real Total Government Expenditure**

Selection-order criteria								
Lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	-462.086			1.10E+09	26.5192	26.5499	26.6081	
1	-389.142	145.89	4	0.000	2.20E+07	22.5796	22.6716	22.8462*
2	-387.13	4.0251	4	0.403	2.50E+07	22.6931	22.8465	23.1375
3	-384.64	4.9792	4	0.289	2.70E+07	22.7794	22.9942	23.4016
4	-376.897	15.486	4	0.004	2.20E+07	22.5655	22.8417	23.3654
5	-374.301	5.1919	4	0.268	2.40E+07	22.6458	22.9833	23.6234
6	-367.807	12.988	4	0.011	2.20E+07	22.5033	22.9021	23.6587
7	-361.342	12.93	4	0.012	2.00E+07	22.3624	22.8226	23.6956
8	-346.847	28.989*	4	0.000	1.2e+07*	21.7627*	22.2843*	23.2736

Source: Author's computation using NBE Data

Thus, maximum lag length for Total Revenue and Government Expenditure is 8

$$RTR_t = \alpha_0 + \gamma RTR_{t-1} + \beta_1^+ RTGEX_{t-1}^+ + \beta_2^- RTGEX_{t-1}^- + \sum_{t=1}^p \delta_t RTR_{t-i} + \sum_{t=0}^q \theta_i RTGEX_{t-1}^+ + \sum_{t=0}^q \theta_i RTGEX_{t-1}^- + \mu_t$$

**Table 3: NARDL co-integration result RTGEX on RTR**

Source	SS	df	MS	Number of observation = 35		
Model	173650.458	20	8682.52292	F(20, 14) = 9.70		
Residual	12533.9595	14	895.282821	Prob > F = 0.0000		
Total	186184.418	34	5476.01229	R-squared = 0.9327		
				Adj R-squared = 0.8365		
				Root MSE = 29.921		

_dy	Coef.	Std.Err.	t	P>t	[95%Conf.	Interval]
_y						
L1.	-0.483	0.179	-2.710	0.017	-0.867	-0.100
_x1p						
L1.	0.545	0.146	3.730	0.002	0.232	0.857
_x1n						
L1.	0.693	0.209	3.320	0.005	0.245	1.142
_dy						
L1.	-0.131	0.237	-0.550	0.589	-0.641	0.378
_dx1p						
--.	0.445	0.130	3.430	0.004	0.167	0.723
L1.	0.035	0.179	0.200	0.847	-0.349	0.419
L2.	-0.052	0.189	-0.280	0.787	-0.458	0.354
L3.	-0.190	0.173	-1.100	0.291	-0.562	0.181
L4.	-0.066	0.169	-0.390	0.703	-0.427	0.296
L5.	-0.095	0.187	-0.510	0.619	-0.497	0.306
L6.	-0.204	0.201	-1.020	0.327	-0.635	0.227
L7.	-0.124	0.179	-0.690	0.500	-0.508	0.260
_dx1n						
--.	0.911	0.172	5.290	0.000	0.542	1.281
L1.	-0.269	0.245	-1.100	0.290	-0.794	0.256
L2.	-0.485	0.186	-2.600	0.021	-0.885	-0.086
L3.	-0.473	0.173	-2.730	0.016	-0.844	-0.102
L4.	-0.223	0.174	-1.280	0.222	-0.597	0.151
L5.	-0.380	0.185	-2.050	0.059	-0.777	0.017
L6.	-0.439	0.201	-2.190	0.046	-0.869	-0.009
L7.	-0.473	0.194	-2.440	0.028	-0.889	-0.058
_cons	66.888	28.087	2.380	0.032	6.647	127.128

(8 missing values generated)

Asymmetry statistics:

	Long run	effect	[+]	Long run	effect	[-]
Exog. var.	coef.	F-stat	P>F	coef.	F-stat	P>F
RTGEX	1.126	25.770	0.000	-1.434	27.740	0.000
<i>Long run asymmetry</i>				<i>Short run asymmetry</i>		
		F-stat	P>F		F-stat	P>F
RTGEX		5.905	0.029		1.325	0.269

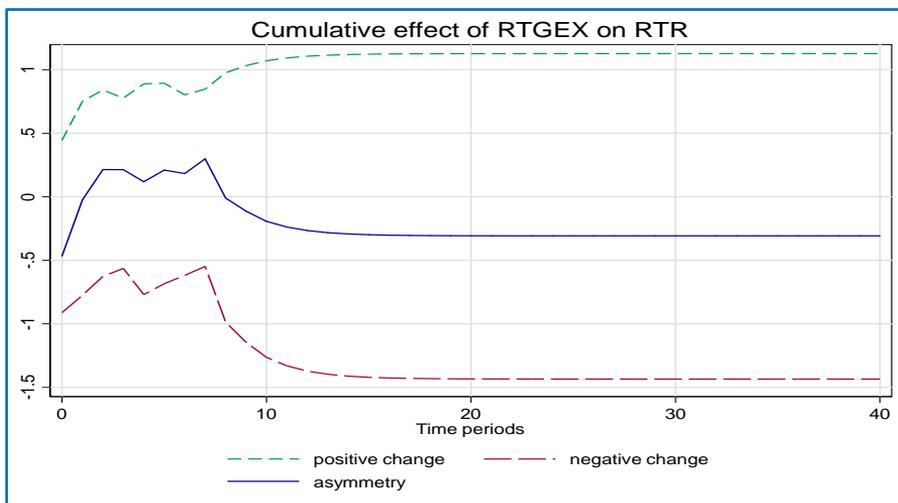
Co-integration test statistics:  $t_{BDM} = -2.7057$ ,  $F_{PSS} = 6.203$

Model diagnostics	stat.	p-value
Portmanteau test up to lag 15 (chi2)	8.942	0.8805
Breusch-Pagan heteroskedasticity test (chi2)	2.064	0.1509
Ramsey RESET test (F)	.8518	0.4942
Jarque-Bera test on normality (chi2)	.1876	0.9104

Source: Author's computation using NBE Data

As indicated in Table 3, the model passed all the diagnostic tests perfectly and it is possible to interpret the results. Since the Co-integration test statistics of  $F_{PSS}$  (6.203) are beyond the critical value for the upper bound test in case III unrestricted intercept and no trend at 5% of significance level I (6.135), the result shows there is a long run relationship from total revenue to total government expenditure. The p-values of the NARDL test are significant and hence there is both a positive and a negative long run effect from real total government expenditure to real total revenue. Running a positive effect as real total government expenditure change, there is a positive change in real total revenue. Running a negative effect when real total government expenditure declines, real total revenue decreases. There is only the long run asymmetry relationship from real total government expenditure to real total revenue.

**Figure 1: Cumulative effect of RTGEX on RTR**



Source: Authors' computation using NBE Data

$$RTGEX_t = \alpha_0 + \gamma RTGEX_{t-1} + \beta_1^+ RTR_{t-1}^+ + \beta_2^- RTR_{t-1}^- + \sum_{i=1}^p \delta_i RTGEX_{t-i} + \sum_{i=0}^q \theta_i RTR_{t-1}^+ + \sum_{i=0}^q \theta_i RTR_{t-1}^- + \mu_t$$

**Table 4: NARDL co-integration result RTR on RTGEX**

Source	SS	df	MS	Number of obs=35 F(20, 14)= 9.9
Model	415031.557	20	20751.5779	Prob > F=0.0000
Residual	29343.9482	14	2095.9963	R-squared=0.934 Adj R squared= 0.8396
Total	444375.506	34	13069.8678	Root MSE = 45.782

_dy	Coef.	Std.Err.	t	P>t	[95%Conf. Interval]
_y					
L1.	-1.198	0.353	-3.400	0.004	-1.955 -0.442
_x1p					
L1.	1.325	0.524	2.530	0.024	0.201 2.450
_x1n					
L1.	0.442	0.282	1.570	0.139	-0.162 1.047
_dy					
L1.	0.076	0.260	0.290	0.773	-0.481 0.633
_dx1p					

<b>_dy</b>	<b>Coef.</b>	<b>Std.Err.</b>	<b>t</b>	<b>P&gt;t</b>	<b>[95%Conf.</b>	<b>Interval]</b>
--.	1.178	0.291	4.050	0.001	0.555	1.801
L1.	-0.523	0.636	-0.820	0.425	-1.887	0.841
L2.	-0.306	0.461	-0.660	0.518	-1.295	0.683
L3.	-0.336	0.567	-0.590	0.563	-1.551	0.880
L4.	-0.567	0.458	-1.240	0.236	-1.550	0.415
L5.	-0.092	0.452	-0.200	0.841	-1.062	0.877
L6.	0.067	0.488	0.140	0.892	-0.980	1.115
L7.	0.097	0.403	0.240	0.813	-0.767	0.962
<b>_dxln</b>						
--.	0.833	0.442	1.880	0.081	-0.116	1.781
L1.	1.100	0.591	1.860	0.084	-0.168	2.367
L2.	0.538	0.534	1.010	0.331	-0.607	1.683
L3.	1.310	0.557	2.350	0.034	0.115	2.505
L4.	1.114	0.452	2.470	0.027	0.146	2.083
L5.	0.688	0.520	1.320	0.207	-0.427	1.803
L6.	0.969	0.549	1.770	0.099	-0.208	2.146
L7.	1.430	0.672	2.130	0.052	-0.012	2.871
<b>_cons</b>	<b>368.351</b>	<b>107.260</b>	<b>3.430</b>	<b>0.004</b>	<b>138.302</b>	<b>598.401</b>

<b>Long run effect [+]</b>				<b>Long run effect [-]</b>		
<b>Exog. var.</b>	<b>coef.</b>	<b>F-stat</b>	<b>P&gt;F</b>	<b>coef.</b>	<b>F-stat</b>	<b>P&gt;F</b>
RTR	1.106	47.350	-*	-0.369	4.503	0.052
<b>Long run asymmetry</b>			<b>Short run asymmetry</b>			
	<b>F-stat</b>	<b>P&gt;F</b>	<b>F-stat</b>	<b>P&gt;F</b>		
RTR	49.540	0.000	6.546	0.023		
<b>Model diagnostics</b>			<b>stat.</b>	<b>p-value</b>		
Portmanteau test up to lag 15 (chi2)			20.28	0.1613		
Breusch-Pagan heteroskedasticity test (chi2)			0.2107	0.6462		
Ramsey RESET test (F)			1.766	0.2116		
Jarque-Bera test on normality (chi2)			1.106	0.5753		

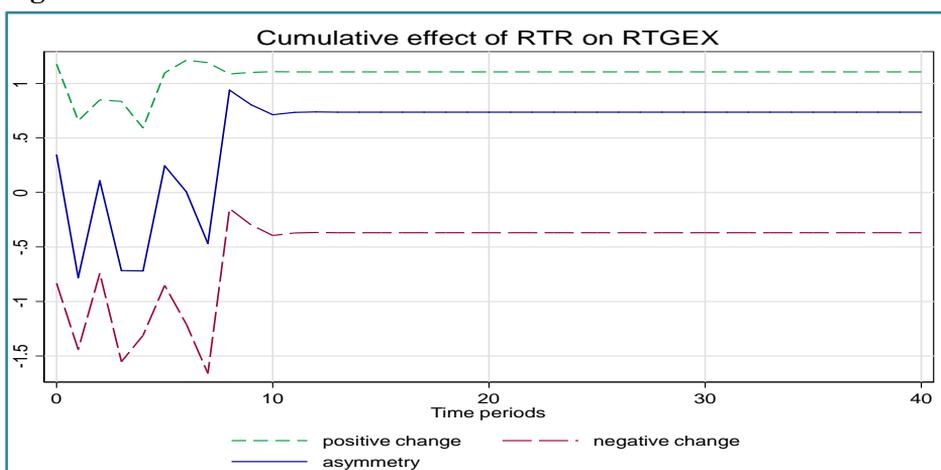
Co-integration test statistics:  $t_{BDM} = -3.397$ ,  $F_{PSS} = 6.422$

Source: Authors' computation using NBE Data

Since the co-integration test statistics of  $F_{PSS}$  (6.422) are beyond the critical values for the upper bound test in case III unrestricted intercept and there is no trend at 5% of significance level I (6.135), the result shows that there is a long run relationship from total revenue to total government expenditure.

According to the NARDL result, the p-value is significant and hence there is both positive and negative long run effect from real total revenue to real total government expenditure. As a positive effect, when real total revenue changes, the real total government expenditure will also change positively. However, a negative effect means that when real total revenue declines, the real total government expenditure will also decrease. The NARDL result shows that there are long run asymmetric and short run asymmetric relationships from real total government expenditure to real total revenue.

**Figure 2: Cumulative effect of RTR on RTGEX**



Source: Authors’ computation using NBE Data

To see the causal relationship, the study applied Toda-Yamamoto causality test.

**Table 5: Toda-Yamamoto causality test for RTR and RTGEX**

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1974 2016

<b>Dependent variable: RTR</b>			
<b>Excluded</b>	<b>Chi-sq</b>	<b>df</b>	<b>Prob.</b>
RTGEX	14.66297	8	0.0660
All	14.66297	8	0.0660
<b>Dependent variable: RTGEX</b>			
<b>Excluded</b>	<b>Chi-sq</b>	<b>df</b>	<b>Prob.</b>
RTR	18.93785	8	0.0152
All	18.93785	8	0.0152

Source: Authors’ computation using NBE Data

All the results of NARDL and Toda-Yamamoto causality tests about the nexus between real total revenue and real total government expenditure show that there is long run co-integration and that implies a bi-directional causal relationship in the long run.

For policy makers, analyzing the long run relationship among macroeconomic variables helps to design appropriate policy and strategies. Fiscal policy is the main concern of any government which desires to maintain sustainable development in the long run. Two or more variables are said to be cointegrated if they share a common trend. In other words, the series is linked by a long run equilibrium relationship from which they may deviate in the short run but they must return to in the long run. Attesting the causal relationship between public revenue and expenditure is quite essential to create an appropriate fiscal policy that can enhance sustainable economic growth and development.

One of this study's aims was to verify the long run relationship between total revenue and total government expenditure in Ethiopia from 1974 to 2016. It tried to assess which theoretical approach the Ethiopian fiscal policy has been applying, whether tax to spend, spend to tax, fiscal synchronization or the institutional approach). The empirical evidence of a Nonlinear ARDL model test revealed that there is bi-directional (fiscal synchronization), a long run causal relationship between real total revenue and real total government expenditure.

This result is in agreement with the findings of the studies of Aladejare and Ani (2012) study on Nigeria, based on the VAR Granger Causality Approach, and of Al-Qudair (2005) on the Kingdom of Saudi Arabia using ECM method. Paleologou (2013) using an ECM model for Sweden, Greece and Germany also found that there was a bi-directional relationship between public revenue and expenditure. However, it does not concur with the results of the work of Eshetu (2016) and Wolde Rufael (2008). They concluded there was a long run relationship with positive unidirectional causality from government revenue to public expenditure.

Obioma and Ozughalu (2010) give three major justifications for the need to study the relationship between government revenue and government expenditure: If the tax to spend hypothesis is applied, then budget deficits can be eliminated or avoided by implementing policies that stimulate or increase government revenue. If the spend to tax hypothesis applied, it suggests that government behaviour is such that it spends first and raises taxes later in order to pay for the spending. This situation can bring about a capital outflow as a result

of consumer fear that they will have to pay paying higher taxes in the future (Narayan and Narayan, 2006; Eita and Mbazima, 2008). If the fiscal synchronization hypothesis does not hold, if there is no bi-directional causality between government revenue and government expenditure, it implies that government expenditure decisions are made without reference to government revenue decisions, and vice versa. That situation can bring about high budget deficits if government expenditure increases faster than government revenue.

So, in the Ethiopian context, according to MOFEC (2018) Fiscal Policy Document articulated a number of fundamental principles and tax policies for Ethiopia in order to enhance economic growth and eradicate poverty as well as reiterate the aim of becoming a lower middle-income country by 2025. It called for the introduction of taxes to enhance economic growth, broaden the tax base and increase government revenue, it helps to implement social policies that discouraged the consumption of substances hazardous to health and social problems. It aimed to provide a modern, efficient, fair and equitable tax system that supported economic development; a system that accelerated industrial growth, achieved the transformation of the country and improved foreign exchange earnings, as well as creating a conducive environment for domestic products to become competitive in international commodity markets. It also wanted a tax system that enhanced saving and investment and minimized tax avoidance or evasion. Its overall intention was to shift government revenue dependence from foreign trade taxes to domestic taxes.

The policy for public spending has been similarly based on sector priority. Indeed, Ethiopian Government expenditure policy has emphasized the need of effective assessment through proper planning, budgeting, funding, accounting, auditing and reporting activities.

Finally, to see the effect of fiscal deficit on economic growth, NARDL brought the following result

$$\begin{aligned}
 \text{RGDP}_{t=0} &= \alpha_0 + \beta_1 \text{RGDP}_{t-1} + \beta_2^+ \text{RFD}_{t-1}^+ + \beta_3^- \text{RFD}_{t-1}^- + \beta_4^+ \text{RHC}_{t-1}^+ \\
 &+ \beta_5^- \text{RHC}_{t-1}^- + \beta_6^+ \text{LF}_{t-1}^+ + \beta_7^- \text{LF}_{t-1}^- \\
 &+ \sum_{t=1}^p \beta_8 \text{RGDP}_{t-i} + \sum_{t=0}^q (\gamma_i^+ \text{RFD}_{t-1}^+ + \gamma_i^- \text{RFD}_{t-1}^-) \\
 &+ \sum_{t=0}^q (\delta_i^+ \text{RHC}_{t-1}^+ + \delta_i^- \text{RHC}_{t-1}^-) + \sum_{t=0}^q (\theta_i^+ \text{LF}_{t-1}^+ \\
 &+ \theta_i^- \text{LF}_{t-1}^-) + \mu_t
 \end{aligned}$$

**Table 6: Unit root test RGDP, RFD, RHCEXP, and LF**

	First difference RGDP		First difference RFD		First difference RHCEXP		First difference LF	
	t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
	ADF test statistic	-6.81	0.0000	-8.696	0.0000	-6.244	0.0001	-3.532
1% level	-3.606		-3.606		-3.606		-3.606	
5% level	-2.937		-2.937		-2.937		-2.937	
10% level	-2.607		-2.607		-2.607		-2.607	

Source: Author's computation using NBE Data

As indicated in Table 6, all variables are stationary at difference order I (1) and it is, therefore, possible to examine the long run co-integration test by using NARDL.

**Table 7: Detecting optimum Lag for RGDP RFD RHC RINVST LF**

**VAR Lag Order Selection**

Endogenous variables: RGDP RFD RHCEXP LF

Exogenous variables: C

Sample: 1975 2016

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-769.6872	NA	2.00e+12	39.67627	39.84689	39.73748
1	-624.3598	253.3914	2.65e+09	33.04409	33.89720*	33.35018
2	-610.3973	21.48071	3.03e+09	33.14858	34.68417	33.69954
3	-576.9056	44.65566*	1.33e+09*	32.25157*	34.46965	33.04740*

\* indicates lag order selected by the criterion

Source: Author's computation using NBE Data

Note: Maximum lag is 3

**Table 8: NARDL co-integration result: RGDP RFD RHCEXP LF**

Source	SS	df	MS	Number of obs.=35, F(27, 11)=12.12		
Model	4294134.72	27	159042.027	Prob > F =0.0001		
Residual	144353.457	11	13123.0416	R-squared=0.9675, Adj R-squared=0.8876		
Total	4438488.17	38	5476.01229	Root MSE = 114.56		
<b>_dy</b>	<b>Coef.</b>	<b>Std.Err.</b>	<b>t</b>	<b>P&gt;t</b>	<b>[95%Conf.</b>	<b>Interval]</b>
_y						
L1.	-1.537	0.410	-3.750	0.003	-2.440	-0.634
_x1p						
L1.	9.852	3.421	2.880	0.015	2.323	17.381
_x1n						
L1.	2.716	1.748	1.550	0.149	-1.131	6.562
_x2p						
L1.	43.964	7.632	5.760	0.000	27.166	60.761
_x2n						
L1.	150.658	33.414	4.510	0.001	77.115	224.201
_x3p						
L1.	1649.747	874.759	1.890	0.086	-275.585	3575.080
_x3n						
L1.	885.663	467.997	1.890	0.085	-144.392	1915.717
_dy						
L1.	0.139	0.274	0.510	0.621	-0.463	0.742
_dx1p						
--.	2.167	1.627	1.330	0.210	-1.414	5.748
L1.	-1.681	2.185	-0.770	0.458	-6.489	3.127
L2.	-2.181	1.892	-1.150	0.273	-6.346	1.984
_dx1n						
--.	1.338	2.457	0.540	0.597	-4.070	6.745
L1.	-3.757	2.045	-1.840	0.093	-8.257	0.743
L2.	0.832	1.597	0.520	0.613	-2.682	4.346
_dx2p						
--.	5.646	3.420	1.650	0.127	-1.882	13.174
L1.	-27.910	4.723	-5.910	0.000	-38.305	-17.516
L2.	-15.537	5.524	-2.810	0.017	-27.694	-3.379
_dx2n						
--.	33.824	14.313	2.360	0.038	2.321	65.327
L1.	-75.375	22.017	-3.420	0.006	-123.835	-26.915
L2.	-15.332	13.353	-1.150	0.275	-44.723	14.058
_dx3p						
--.	-3831.821	1263.777	-3.030	0.011	-6613.376	-1050.266
L1.	-4981.314	1239.956	-4.020	0.002	-7710.440	-2252.189
L2.	-5677.801	1760.240	-3.230	0.008	-9552.063	-1803.540
_dx3n						
--.	155.958	548.890	0.280	0.782	-1052.141	1364.058
L1.	-966.520	606.870	-1.590	0.140	-2302.231	369.191
L2.	92.899	538.557	0.170	0.866	-1092.457	1278.255
dummy	278.184	124.378	2.240	0.047	4.429	551.938
_cons	2772.827	891.816	3.110	0.010	809.953	4735.701

**Asymmetry statistics:**

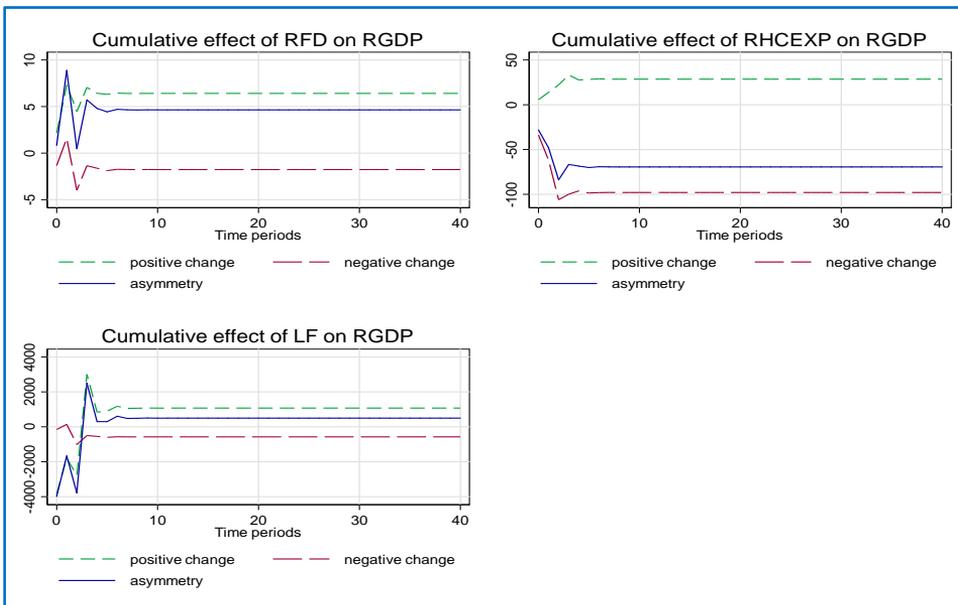
<b>Long run effect [+]</b>				<b>Long run effect [-]</b>		
<b>Exog. var.</b>	<b>coef.</b>	<b>F-stat</b>	<b>P&gt;F</b>	<b>coef.</b>	<b>F-stat</b>	<b>P&gt;F</b>
RFD	6.410	35.610	0.000	-1.767	2.522	0.141
RHCEXP	28.603	9.911	0.009	-98.019	22.990	0.001
LNLF2	1073.332	7.686	0.018	-576.216	10.790	0.007
<b>Long run asymmetry</b>			<b>Short run asymmetry</b>			
	<b>F-stat</b>	<b>P&gt;F</b>	<b>F-stat</b>	<b>P&gt;F</b>		
RFD	18.670	0.001	0.001	0.977		
RHCEXP	20.860	0.001	0.307	0.590		
LNLF2	2.041	0.181	22.690	0.001		
Co-integration test statistics: $t\_BDM = -3.7455$ , $F\_PSS = 7.0672$						
<b>Model diagnostics</b>			<b>stat.</b>	<b>p-value</b>		
Portmanteau test up to lag 16 (chi2)			25.96	0.0752		
Breusch -Pagan heteroskedasticity test (chi2)			.3744	0.5406		
Ramsey RESET test (F)			4.003	0.0612		
Jarque-Bera test on normality (chi2)			4.706	0.0951		

Source: Authors' computation using NBE Data

In Table 8 the co-integration test result that  $F\_PSS$  (7.0672) is greater than the critical values for the upper bound test in case III unrestricted intercept and no trend at 5% of significance level I (4.083), indicates there is a long run co-integration among variables. In the long run, positive effect, fiscal deficit and labor force are statistically significant. Human capital, however, is statistically not significant.

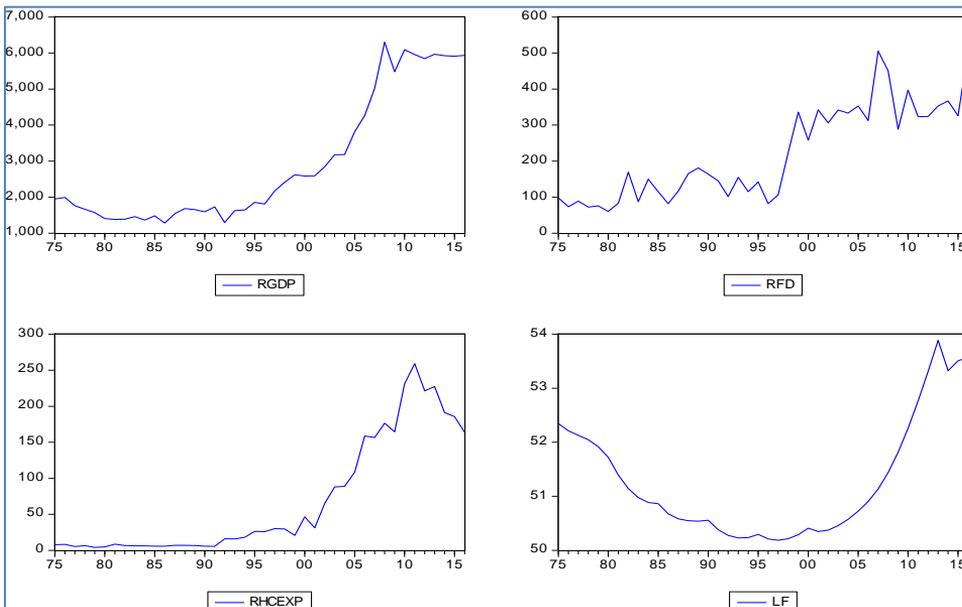
When fiscal deficits and labor force are identified as positive changes, economic growth will change positively. With a negative long run effect when human capital and labor forces are reduced, growth will decline. The fiscal deficit, however, is statistically not significant. The NARDL result also shows that a long run asymmetry between both fiscal deficit and human capital associated with growth. There is no long run asymmetry for labor force and growth while only the labor force has short run asymmetry.

**Figure 3: Cumulative effect on GDP**



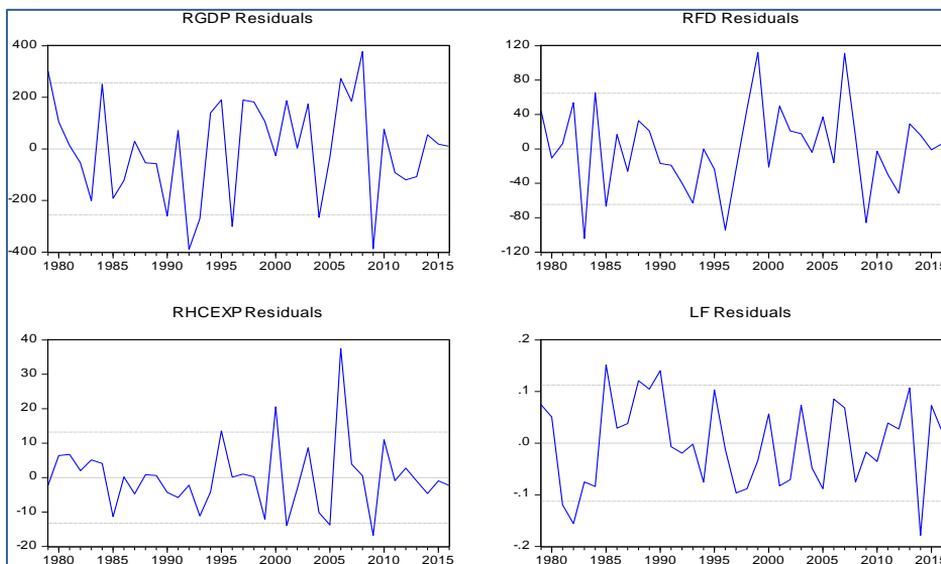
Source: Authors' computation using NBE Data

**Figure 4: RGDP RFD RHCEXP LF**



Source: Authors' computation using NBE Data

**Figure 5: Residuals RGDP RFD RHCEXP LF**



Source: Authors' computation using NBE Data

**Table 9: VAR Granger Causality/Block Exogeneity Wald Tests for RGDP, RFD, RHCEXP and LF**

Sample: 1975 - 2016

Dependent variable: RGDP			
Excluded	Chi-sq	Df	Prob.
RFD	9.407932	3	0.0243
RHCEXP	9.547567	3	0.0228
LF	6.612385	3	0.0853
All	25.28626	9	0.0027
Dependent variable: RFD			
Excluded	Chi-sq	Df	Prob.
RGDP	4.207013	3	0.2400
RHCEXP	3.007572	3	0.3905
LF	8.492194	3	0.0369
All	14.81373	9	0.0962
Dependent variable: RHCEXP			
Excluded	Chi-sq	Df	Prob.
RGDP	10.69783	3	0.0135
RFD	3.242826	3	0.3557
LF	3.353433	3	0.3403
All	34.14679	9	0.0001

Source: Authors' computation using NBE Data

In Table 9 the result of the Toda-Yamamoto Granger Causality test revealed that there is a unidirectional causality of long run relationship from fiscal deficit to GDP. However, GDP has a bi-directional causal relationship to human capital and labor force.

## **5. Conclusion and Policy Implications**

All the results of NARDL and Toda-Yamamoto causality tests about the nexus between real total revenue and real total government expenditure indicate that there is a co-integration and bi-directional causal relationship in the long run. The NARDL results show that there is long run and short run asymmetric relationships from real total government expenditure to real total revenue; only a long run asymmetry from total government expenditure to total tax revenue.

Among the four hypotheses, tax and spend, spend and tax, fiscal synchronization or institutional separation, our findings show that Ethiopia has practiced fiscal synchronization. This emphasizes decisions that determine cost and benefit analyses over cross-checking public revenue and expenditure interdependently. It is also clear from the NARDL results that a fiscal deficit has a positive long run effect on economic growth while being statistically insignificant for the long run negative effect. According to our study, human capital has statistically insignificant long run positive effect but a significant negative effect on economic growth. GDP has long run asymmetry with fiscal deficit and human capital, but there is no long run asymmetry for labor force and growth while there is short run asymmetry. The labor force has both a long run positive effect and a short run negative effect on economic growth.

With regard to the causal relationship, the Toda-Yamamoto Granger Causality test revealed that there is a unidirectional causality long run relationship from fiscal deficit to GDP. Thus, the theoretical implications of this study confirm the Keynesian approach.

### **Policy Implications**

Since fiscal synchronization characterized the relationship between total revenue and expenditure, analyzing the impact of government expenditure, revenue and fiscal deficits on economic growth is quite essential for effective implementation of fiscal policy. Policy makers should emphasize determining cost and benefit analysis over cross-checking public revenue and expenditure

mutually as the findings demonstrate bi-directional causality between total revenue and government expenditure. It would be better if policymakers followed an agreed decision with respect to revenue and expenditure for effective implementation of fiscal policy. Furthermore, as the findings of this study have shown a positive relationship between fiscal deficit and economic growth, the government should manage expenditure by controlling and limiting current expenditure and increasing capital expenditure. The importance of improving tax revenues and minimizing fiscal deficits are also clear.

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# Intertemporal Government Budget Constraint: Debts and Economic Growth in Ethiopia, 1990–2018

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## *Abstract*

*This paper uses the intertemporal government budget constraint model, linear logarithmic functions (for better regression results), annual time series data and the generalized least squares technique to examine the effects of external debt and external debt servicing on economic growth in Ethiopia between 1990 and 2018. Alemayahu and Zerfu (1998) confirm that the level of debt in Ethiopia is beyond the capacity of the country to service it. This problem then begs the following major research questions: Does external debt or its servicing crowd out investment in Ethiopia? What have been the effects and estimates of (i) external debt and (ii) external debt servicing on economic growth in Ethiopia? The major hypotheses are: (a): External debt does not enhance economic growth. (b) External debt servicing depresses economic growth.*

*Data were collected from the World Bank and United Nations. The major findings of the paper are: (1) That increases in external debt enhanced economic growth in Ethiopia within the sample period, ceteris paribus; and (2) That external debt servicing had negative effect on economic growth in Ethiopia.*

*The paper also suggests maintaining reasonable levels of external debt by the government of Ethiopia to enhance economic growth, and avoiding excessive borrowing that might create difficulties in debt servicing (i.e. debt overhang). As a result of its findings, one future research topics this paper would propose is: "Determination of the Sustainable Debt Levels for Enhancing Rapid Economic Growth in Ethiopia."*

**Keywords:** intertemporal government budget constraint, external debt, debt servicing, and economic growth.

**JEL classification:** F34, O4, O47

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## **1. Introduction**

Many macroeconomic analysts and policy makers argue that fiscal deficit does not enhance economic growth and can affect future economic growth by crowding out private investment expenditure. Concern about public debts has led some governments to embrace fiscal restraints in order to reduce levels of outstanding debt (Elliott and Kearney, 1988), although economic theory suggests that reasonable levels of borrowing by a developing country are likely to enhance its economic growth through capital accumulation and productivity growth (Ayele and Kalluraya, 2017).

In order to solve external debt problems, Shabbir and Yasin (2015) suggest that developing countries need to mobilize their own resources and minimize dependence on external borrowing as much as possible. External debts are typically contracted to finance the public investment needs required to enhance the economic growth of a country, but debt servicing can easily crowd out investments in the agricultural and service sectors, causing a reduction in the size of the manufacturing sector.

The result is that large debt repayments impose constraints on economic growth by draining away the limited resources that could have been spent on domestic development needs. Indeed, the external debt for Ethiopia is expected to increase significantly in the near future due to the need to secure finance from external sources to undertake infrastructure projects (Mohanty, 2017). Although nominal debt outstanding has increased dramatically, the deflated series data have tended to be low in recent years (Elliott and Kearney, 1988).

Research studies on the influence of external debt on economic growth have, however, shown mixed results. For instance, among similar empirical results, Jonse (2002) found that external debt has no direct effect on economic growth in Ethiopia, while Mohanty (2017) decided that external debt contributed positively to economic growth in Ethiopia.

Given this dichotomy of views, this study has employed the intertemporal budget constraint model and empirical data to examine the influence of external debt on economic growth in Ethiopia from 1990 to 2018.

## **2. Literature Review**

Fiscal deficit is a common problem for the majority of developing countries. According to the World Bank (2017), fiscal deficits have been increasing in most emerging and developing economies worldwide. The majority of these economies have strengthened their policies and accumulated significant savings over the past two decades, but they have still failed to resolve their fiscal or economic problems. In emerging countries, fiscal deficits on average continuously rose from about 1% of GDP back in 2007 up to around 5% of GDP in 2016 (Kose et al., 2017). Nevertheless, although fiscal deficits have been continuously increasing in emerging countries worldwide, the effect on economic growth generally in developing countries still lacks sufficient empirical evidence (Tung, 2018).

Consideration of the issue is compounded by contradictory conclusions from available research results. For example, Cebula (1995), Ghura (1995), Biza et al. (2015) and Arjomand et al. (2016) find that there is evidence that shows the negative effects of fiscal deficit on economic growth. However, Ahmad (2013) and other researchers have found that fiscal deficit can have a positive effect on economic growth while Rahaman, (2012); Velnamy and Achchuthan, (2013); Tung, (2018) see the effects on economic growth as relatively insignificant.

Tung (2018) examines the effect of fiscal deficit on economic growth in Vietnam where the Vietnamese government has been facing large fiscal deficits for many years. He employs the Error Correction model on the quarterly data for 2003–2016; and his empirical results indicate that fiscal deficit during the sample period had harmful effects on economic growth in both short and long run. He also confirms that a fiscal deficit can hurt not only the gross output but also private investments, foreign direct investments, and net exports.

Navaratnam and Mayandy (2016) employ cointegration analysis, error correction modelling and Granger causality test under a Vector Autoregression (VAR) framework to examine the effect of fiscal deficit on economic growth in several selected South Asian countries, Bangladesh, India, Nepal, Pakistan and Sri Lanka, using time series annual data over the period 1980 to 2014. Their results confirm that during the sample period fiscal deficit had a negative effect on economic growth in these countries though there is the exception of Nepal, where the fiscal deficit had a positive effect on economic growth.

Rana and Wahid (2017), conducting a time–series analysis using data covering the period 1981 to 2011, while using ordinary least squares estimation, vector error correction model, and granger causality tests, found that the government budget deficit had a statistically significant negative impact on economic growth in Bangladesh. Kurantin (2017) using data for the period 1994 to 2014 finds that the budget deficit had adverse effects on economic growth in Ghana during the sample period. Huynh (2007) analysed data on Vietnam for the period 1990 to 2006 finding the budget deficit had a negative effect on the country’s GDP growth rate.

One of the greatest problems facing economic growth in many Sub-Saharan African countries, including Ethiopia, is certainly very high indebtedness, indebtedness beyond repayment capacity. The external debt problem has been becoming more acute because the size of the debt relative to the size of the economy is so huge that it causes capital flight, as well as discouraging private investment; and debt servicing payments take up a significant proportion of annual export earnings. In other words, meeting debt servicing obligations significantly drains the resources that could otherwise have been used for financing basic services needed for the welfare of the citizens (Ajayi, 1991, p.1; Maruta, 2013, p.5).

Foreign borrowing may be beneficial for low income countries in need of inducing substantial investment, and attaining rapid economic growth. However, these countries soon face difficulties in both servicing their debt obligation as scheduled, and attaining a rapid economic growth. Frequent large debt repayment means the external debt stock continues to grow and reduces future output growth potential.

External debt repayments drain the available resources needed for the sustenance of economic growth of a country like Ethiopia (Pattillo et al. 2004, p.5). Ethiopia as a result of its huge debt service obligations, has benefited very little from the marginal rates of return generated from any additional investments that new external loans provide. Debt servicing has drained the foreign currency reserves required for the import of capital goods and machinery for further investment and economic growth (Maruta, 2013, p.6). The Ethiopian economy is characterized by: low human development index (0.47%), relatively low life expectancy (66.2 years), low road density (12 km. of road per 100 sq. km.), and reasonable capital investment as a percent of GDP e.g. 34% in 2017 (World Bank, 2017).

The country requires huge investments to overcome the lack of development demonstrated by these figures. Financing the necessary major investments through domestic resource mobilization is exceptionally difficult for the government because the country's financial system is underdeveloped and characterized by: low population to financial service coverage, only 136 bank accounts per 1000 adults in 2018, bank credit to private sector as percent of GDP (only 18% in 2018), and low branch branches per 100,000 people (2.93 in 2018). The country's tax system is also underdeveloped, having a low tax to GDP ratio (7.5% in 2018) and reasonable savings to GDP ratio of only 33%. With no other source of funding, the government has had no other option apart from external borrowing to finance major investments. The result is that the country's external debt has been increasing steadily and servicing huge debts has had adverse effects on the domestic economy (World Bank, 2019).

However, Maruta (2013) examining the effect of external debt on economic growth in Ethiopia using data covering the period 2000–2010, found external debt did not affect economic growth and that debt service payments had a positive influence on gross domestic product. According to Ayele and Kalluraya (2017) low-income countries like Ethiopia frequently keep on taking debts because they are in the phase of development and need extreme support in this regard.

Clements et al. (2003) suggested that foreign borrowing has a positive impact on investment and economic growth of a country if only up to a threshold level after which external debt service would adversely affect economic growth as most of the funds would be remitted for the repayment of debt rather than used as investments. More generally, economic theory suggests that reasonable levels of borrowing by a developing country are likely to enhance economic growth as Ayele and Kalluraya, (2017) indicate for Ethiopia. However, Alemayahu and Zerfu (1998) confirm that the level of debt in Ethiopia is beyond the capacity of the country to service it. Ethiopia, in fact, faces debt problems arising from repayment because servicing debts costs more than the amounts borrowed.

The indications and uncertainties in the literature provided motivation of the need to conduct a country specific study to investigate the effect of public debt on economic growth in Ethiopia from 1990 to 2016 not least because, although it remains an agrarian economy with more than 30 percent of its population classified as poor, it is endowed with abundant natural resources which should be able to create favorable conditions for rapid economic growth.

### 3. Theoretical Framework

#### 3.1 Intertemporal budget constraints

There are two approaches to the study of intertemporal budget constraint (IBC). One technique analyses the budget constraint mathematically; the other technique examines the IBC econometrically (Landolfo, 2008). The theoretical framework for subsequent empirical analysis consists of the following fiscal deficit arithmetic:

$$B_t = B_{t-1} + r_t B_{t-1} + G_{t-1} - T_{t-1}. \quad (2.1)$$

Where  $B_t$  is public debt at the beginning of the fiscal year  $t$ ,  $B_{t-1}$  is public debt at the beginning of the fiscal year  $t - 1$ ,  $r_t$  is the real interest rate at the beginning of year  $t$ ,  $r_t B_{t-1}$  are interest payments at the beginning of the fiscal year  $t$ ,  $G_{t-1}$  is the government expenditure net of interest during the fiscal year  $t - 1$ , and  $T_t$  are tax revenues net of transfers during the fiscal year  $t - 1$ .

Rewriting Equation 2.1 provides Equation 2.2., which is the exact opposite of the theoretical framework of what this study represents, whereby  $-(T_{t-1} - G_{t-1})$  technically represents government deficit and new government borrowing is given by  $(B_t - B_{t-1})$  during the fiscal year  $t$ .

$$-(T_{t-1} - G_{t-1}) = (B_t - B_{t-1}) - r_t B_{t-1}. \quad (2.2)$$

Thus, in the theoretical framework of the study for this paper, budget constraint is given by

$$(T_{t-1} - G_{t-1}) = (B_t - B_{t-1}) - r_t B_{t-1}. \quad (2.3)$$

Equation 2.3 is an intertemporal budget constraint that can be derived by supposing that government can collect tax revenues and spend its incomes in two fiscal periods, denoted by subscripts  $t - 1$  and  $t$ . In each period government can collect taxes ( $T$ ) and choose how much to spend ( $G$ ) as well as purchase bonds ( $B$ ) and pay for the bonds at a constant interest rate ( $r$ ) (Obstfeld and Rogoff, 1996, pp.76–78; Doppelhofer, 2009).

The budget constraint arising from the tax revenues and government spending for the two periods, therefore, becomes:

$$T_{t-1} = G_{t-1} + B_{t-1}. \quad (2.4)$$

$$T_t + B_{t-1}(1 + r_t) = G_t + B_t. \quad (2.5)$$

Hence, Equations 2.4 and 2.5 for the two periods can be combined and rewritten as an intertemporal budget constraint given by

$$T_{t-1} + \frac{T_t}{1+r_t} = G_{t-1} + \frac{G_t}{1+r_t} + \frac{B_t}{1+r_t}. \quad (2.6)$$

Consequently, manipulation of either Equation 2.5 or Equation 2.6 provides Equation 2.3. This indicates the intertemporal budget constraint consists of tax revenue, government spending, government deficits, government savings and debts. It implies the effects of the intertemporal budget on economic growth is the same as the effects of tax revenue, government spending, government deficits, government savings and debts on economic growth.

To examine the effects of government deficits on real income and consequently economic growth, it is appropriate to begin with some national income accounting identities. Thus, real GDP ( $Y_t$ ) is composed of consumption ( $C_{nt}$ ), savings ( $S_t$ ), and taxes ( $T_t$ ).

$$Y_t = C_{nt} + S_t + T_t. \quad (2.7)$$

Therefore, real income ( $Y_t$ ) increases in line with either household consumption ( $C_{nt}$ ), investment spending ( $I_t$ ), government spending ( $G_t$ ), or the level of foreign exports ( $X_t$ ), minus import ( $M_t$ ).

$$Y_t = C_{nt} + I_t + G_t + X_t - M_t. \quad (2.8)$$

Equating Equations 2.7 to 2.8 gives:

$$-(G_t - T_t) = (X_t - M_t) + (S_t - I_t). \quad (2.9)$$

Equation 2.9 implies that the government budget deficit equals the trade surplus plus the excess of investment over savings (Bernheim, 1988).

Equation 2.8, the equation must be rewritten in logarithm form as follows:

$$Y_t = C_{nt}^{\beta_1} I_t^{\beta_2} G_t^{\beta_3} X_t^{\beta_4} M_t^{-\beta_5}. \quad (2.10)$$

Or  $\log(Y_t) = \beta_1 \log(C_{nt}) + \beta_2 \log(I_t) + \beta_3 \log(G_t) + \beta_4 \log(X_t) - \beta_5 \log(M_t)$ . (2.11)

Next, suppose that government deficit is defined as  $\log(G_t/T_t)$  then

$$\log(G_t/T_{nt}) = \log(G_t) - \log(T_t). \quad (2.12)$$

Thus, substituting Equation 2.12 in Equation 2.11 provides

$$\log Y_t = \beta_1 \log C_{nt} + \beta_2 \log I_t + \beta_3 \frac{G_t}{T_t} + \beta_6 \log T_t + \beta_4 \log C_{nt} - \beta_5 \log M_t + u_t. (2.13)$$

From Equation 2.13 it can be discerned that government deficit and tax revenues have positive effects on real income and consequently economic growth.

### 3.2 Government borrowing choices and constraints

Consumption choices made over time are called intertemporal choices (Varian, 2010) pp.182–184). Assume that government can choose how much spending to incur in each of two time periods. We denote the amount of government spending in each period by  $(G_{t-1}, G_t)$  and suppose that the amount of expenditure is at constant prices. The amount of money the government will have as tax revenue in each period is denoted by  $(T_{t-1}, T_t)$ .

#### *The Government Intertemporal Budget Constraint 1 (Ricardian Equivalence)*

Government spending (i.e. purchases) is its consumption, while tax revenue is its income. Government saving is defined as part of national income that is saved. Government saving ( $S_g$ ) is tax revenue ( $T$ ) minus government expenditure( $G$ ) and is given by

$$S_g = T - G. \quad (3.1)$$

Meanwhile, government deficit ( $G - T$ ), is defined as government saving preceded by a minus ( $-S_g$ ) (Krugman, Obstfeld and Melitz, 2012, p.304; Blanchard and Johnson, 2013, pp.496–497) and is given by

$$GD = -(T - G). \quad (3.2)$$

The paper analyses the welfare effects of timing in lump-sum taxation in the presence of government expenditure.

In this dynastic model, government has the authority to levy taxes on consumers and sequentially spends ( $G$ ) the taxes it collects. The sequence of both debts ( $D$ ) and taxes ( $T$ ) overtime satisfies a budget constraint ( $B$ ) at every time  $t$  and is given by

$$G_t + GB_{t-1} = r_t GB_{t-1} + T_t. \quad (3.3)$$

Or 
$$T_t - G_t = GB_{t-1} - r_t GB_{t-1}. \quad (3.4)$$

Or 
$$GB_t = GB_{t-1} - r_t GB_{t-1}. \quad (3.5)$$

Or 
$$\Delta D_t = \Delta D_{t-1} - r_t \cdot \Delta D_{t-1}. \quad (3.6)$$

Thus 
$$D_t = D_{t-1} - r_t \cdot D_{t-1}. \quad (3.7)$$

Also let 
$$GB_{t-1} = \omega D_{t-1}. \quad (3.8)$$

Hence, substitution of Equations (3.8) in Equation (3.4) gives Equation (3.9)

Or 
$$T_t - G_t = \omega D_{t-1} - \omega r_t D_{t-1}. \quad (3.9)$$

The Ricardian Equivalence requires that sources and uses of funds must equalize in every period. Thus, government borrows funds to finance expenditures ( $G_t$ ) to repay debts ( $GB_{t-1}$ ) i.e. bonds that are issued at time  $t - 1$  that must be settled at time,  $t$ .

Therefore, the sources of funds are lump-sum taxes ( $T_t$ ) and new government borrowing ( $GB_t$ ) and  $r_t$  is the interest on the bonds (Krusell, 2004, p.166).

*The Government Intertemporal Budget Constraint 2 (Intertemporal Choices)*

Here the government is assumed to be borrowing at interest rate  $r_t$ . If government decides to be a borrower, its first period consumption ( $G_{t-1}$ ) is greater than its first period income ( $T_{t-1}$ ). Thus, the government is a borrower if  $G_t > T_t$ , and the interest that government has to pay is  $r_t(T_{t-1} - G_{t-1})$ .

Meanwhile, government also has to pay back the amount that it has borrowed  $r_t(T_{t-1} - G_{t-1})$  (Varian, 2010, pp.182 – 184). Therefore, the budget constraint is given by

$$G_t = T_t - (T_{t-1} - G_{t-1}) - r_t(T_{t-1} - G_{t-1}). \quad (3.10)$$

Rearranging Equation 10 provides

$$T_{t-1} - G_{t-1} = (T_t - G_t) - r_t(T_{t-1} - G_{t-1}). \quad (3.11)$$

### 3.3 Regression Analyses

Relevant regression econometric analyses were performed after making sure that time series data for each of the variables were stable. Some of the variables were made stable by dividing each of them by an appropriate numeraire. For each of the 24 regression results the coefficient of determination was very high, mainly due to the application of the national income model and variables from the national income model when running each of the respective regressions.

The  $t$  –tests showed that the coefficients of elasticity of each of the variables in the respective regression results was greater than the corresponding critical  $t$  value from the  $t$  – distribution table. So, each of the variables in the regression results had significant influence on the respective independent variables.

The  $F$  –statistic for each of the regression results indicates that the independent variables for each of the respective regressions had a joint effect on each of the respective independent variables. It implies that each of the respective  $F$  – statistics appearing in the respective regression results was greater than the corresponding critical  $F$  value from the  $F$  – table.

The  $DW$  test indicated that each of the 24 regressions was free from serial correlation, and finally, that the test for heteroskedasticity, the  $H_T$  –statistic for each of the 24 regressions was less than the critical  $t$  value from the  $t$  – table, showing that each of the 24 regressions reported was free from heteroskedasticity.

Various western international organizations have criticized higher government spending but the government of Ethiopia continued to implement its fundamental principle of government intervention and investment for high social return. And it is clear, this bold policy has generated sustained economic growth and social transformation.

High government spending and pro-poor resource allocation decreased absolute poverty from 44 percent in 2000 to 26 percent in 2014 (Teshome, 2015). Economic growth during the 1992 to 2016 was generated by household consumption (0.79%), investment spending (0.23%), government spending (0.12%), exports (0.11%) and imports (-0.241%) following a 1% increase in each of the given variables as shown in Regression Model 1.

### Regression Model 1

Dependent Variable:  $(d(\log(Y_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$

Variable	Coefficient	t-statistic
$(d(\log(Cn_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.788	29.22
$(d(\log(I_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.228	18.70
$(d(\log(G_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.116	20.13
$(d(\log(X_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.105	5.42
$(d(\log(M_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	-0.244	-15.13

$R^2 = 0.9988$      $DW = 1.93$      $F = 4296$      $H_T = 0.033$

Included observations = 1993 – 2018    Sample (adjusted) = 26

Similarly, Regression Model 2 shows that economic growth in Ethiopia during the sample period was caused by an increase in disposable income (0.61%) and tax revenues (0.15%) as a result of 1 percent increase in each of the respective variables.

### Regression Model 2

Dependent Variable:  $(d(\log(Y_t))/d(d(Y_t^2)))$

Variable	Coefficient	t-statistic
$(d(\log(Yd_t))/d(d(Y_t^2)))$	0.609	15.35
$(d(\log(T_t))/d(d(Y_t^2)))$	0.145	18.05

$R^2 = 0.9779$      $DW = 1.92$      $F = 1109$      $H_T = 0.057$

Included observations = 1992 – 2018    Sample (adjusted) = 27

Regression Model 3 indicates that the increase in tax revenue had a positive and significant effect on economic growth during the sample period because a 1 percent increase in economic growth is associated with 0.93%, 0.30%, 0.03%, 0.15% and -0.09% increases respectively in household consumption, investment spending, exports and imports, *ceteris paribus*.

### Regression Model 3

Dependent Variable:  $(d(\log(Y_t))/d(d(X_t))/d(d((d(Y_t))^2))$

Variable	Coefficient	t-statistic
$(d(\log(C_{nt}))/d(d(X_t))/d(d((d(Y_t))^2))$	0.931	43.82
$(d(\log(I_t))/d(d(X_t))/d(d((d(Y_t))^2))$	0.297	35.55
$(d(\log(T_t))/d(d(X_t))/d(d((d(Y_t))^2))$	0.025	5.60
$(d(\log(X_t))/d(d(X_t))/d(d((d(Y_t))^2))$	0.152	8.51
$(d(\log(M_t))/d(d(X_t))/d(d((d(Y_t))^2))$	-0.087	-7.74

$R^2 = 0.9988$      $DW = 1.93$      $F = 4296$      $H_T = 0.033$

Included observations = 1993 – 2018    Sample (adjusted) = 26

According to Gabato (2017), the positive effect on economic growth rate can be influenced by taxation if economic growth is indirectly driven by tax revenues, especially when taxes are used to finance investments in public goods, particularly goods generating positive externalities (infrastructure, education and public health).

From Regression Model 4 it can be clearly seen that there is almost a one-to-one relationship between disposable household income growth and economic growth. During the sample period, the contribution of increased household disposable income (0.97%) to economic growth, following a 1% rise in household disposable income, was much more than the contributions from the growth in government spending (0.15%), exports (0.17%) and exports (-0.22%), following a 1% rise in each of the independent variables.

### Regression Model 4

Dependent Variable:  $(d(\log(Y_t))/d(S_t)/d(d(Y_t^2))$

Variable	Coefficient	t-statistic
$(d(\log(Y_{dt}))/d(S_t)/d(d(Y_t^2))$	0.969	27.32
$(d(\log(G_t))/d(S_t)/d(d(Y_t^2))$	0.152	37.75
$(d(\log(X_t))/d(S_t)/d(d(Y_t^2))$	0.167	4.39
$(d(\log(M_t))/d(S_t)/d(d(Y_t^2))$	-0.216	-10.35

$R^2 = 0.9976$      $DW = 1.97$      $F = 3137$      $H_T = 0.430$

Included observations = 1992 – 2018    Sample (adjusted) = 27

From Regression Model 5 it can be confirmed that an increase in tax revenue has the potential of generating economic growth. This result shows that a 1% increase in household consumption, gross savings and tax revenue during the sample period might have caused economic growth to increase by 0.68%, 0.17% and 0.02% respectively, *ceteris paribus*.

### Regression Model 5

Dependent Variable:  $(d(\log(Y_t))/d(\log(X_t)))/d(d(Y_t^2))$

Variable	Coefficient	t-statistic
$(d(\log(C_{nt}))/d(\log(X_t)))/d(d(Y_t^2))$	0.678	93.75
$(d(\log(S_t))/d(\log(X_t)))/d(d(Y_t^2))$	0.171	76.52
$(d(\log(T_t))/d(\log(X_t)))/d(d(Y_t^2))$	0.024	10.26
$R^2 = 0.9998 \quad DW = 1.89 \quad F = 48153 \quad H_T = 0.085$		
Included observations = 1992 – 2018      Sample (adjusted) = 27		

Some researchers have found a positive relationship between tax revenues and economic growth. For instance, Sekou (2015) and Babatunde et al. (2017) find significant and positive correlations between tax collection and economic growth in Mali and Africa respectively.

Similarly, Chigbu et al. (2012), Ogbonna and Appah (2012) and Ihenyen, and Ebipanipre (2014) find that that tax reform is positively and significantly related to economic growth in Nigeria.

They conclude that tax reforms would improve the government revenue capacity to undertake socially desirable expenditure to translate to economic growth in real output and per capita basis.

Regression Model 6 provides results that can be used for testing the significance of the respective variable coefficients. The results show that tax revenues and government deficits both have a positive influence on economic growth.

Thus, a 1% growth in government deficit, investment spending, tax revenues, household disposable income, exports or imports was responsible for respective rises of 0.12%, 0.23%, 0.10%, 0.83%, 0.10% or -0.27% in economic growth.

### Model 6

Dependent Variable:  $(d(\log(Y_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$

Variable	Coefficient	t-statistic
$(d(\log(C_{nt}))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.839	26.13
$(d(\log(I_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.231	20.85
$(d(\log(G_t/T_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.123	20.91
$(d(\log(T_{nt}))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.098	10.48
$(d(\log(X_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	0.096	5.16
$(d(\log(M_t))/d(\log(S_t)))/d(d((d(Y_t))^2))$	-0.272	-14.56
$R^2 = 0.99999 \quad DW = 2.17 \quad F = 363912 \quad H_T = 0.001$		
Included observations = 1993 – 2018      Sample (adjusted) = 26		

Regression Model 7 indicates that government deficit, export surplus and tax revenue have weaker potential to influence real income through household disposable income since the sum of income elasticity of these three variables is approximately more than those of household income elasticity given in Regression Models 6 and 8, *ceteris paribus*.

While Regression Model 6 accepts the hypothesis that government deficit has a positive influence on economic growth, Regression Model 8 tests and confirms the hypothesis that in the case of Ethiopia, the government deficit had a positive influence on economic during the sample period.

### Regression Model 7

Dependent Variable:  $\log(Y_t) / d(d(Y_t^2))$

Variable	Coefficient	t-statistic
$\log(G_{nt}/I_t) / d(d(Y_t^2))$	1.263	6.95
$\log(X_t/M_t) / d(d(Y_t^2))$	-1.906	-11.00
$\log(T_t) / d(d(Y_t^2))$	1.262	175.62

$R^2 = 0.99999$      $DW = 1.89$      $F = 985344$      $H_T = 0.228$

Included observations = 1992 – 2018    Sample (adjusted) = 27\_

During the sample period, a 1% increase in growth of household disposable income, government deficit, balance of payment surplus or tax revenues was accompanied by 0.91%, 0.18%, 0.19% or 0.15% rises respectively in economic growth, *ceteris paribus*.

### Regression Model 8

Dependent Variable:  $(d(\log(Y_t))/d(d(\log(Y))))/d(d(Y_t^2))$

Variable	Coefficient	t-statistic
$(d(\log(Y_{dt}))/d(d(\log(Y))))/d(d(Y_t^2))$	0.915	20.74
$(d(\log(G_t/T_t))/d(d(\log(Y))))/d(d(Y_t^2))$	0.179	6.35
$(d(\log(T_t))/d(d(\log(Y))))/d(d(Y_t^2))$	0.148	19.60
$(d(\log(X_t/M_t))/d(d(\log(Y))))/d(d(Y_t^2))$	0.188	2.87

$R^2 = 0.991$      $DW = 2.25$      $F = 807$      $H_T = 0.186$

Included observations = 1992 – 2018    Sample (adjusted) = 27\_

By contrast, Regression Model 9 tests and accepts the hypothesis that, in the case of Ethiopia, in regard to both government savings and the balance of payments deficit, the government deficit had the potential of having a negative impact on economic growth during the sample period.

Regression Model 9 shows that during the sample period a 1% increase in growth of household disposable income, investment spending, government savings, exports, imports, or tax revenues was associated with 0.84%, 0.23, -0.12%, 0.10, 0.27 or 0.10% rises respectively in economic growth, *ceteris paribus*.

### Regression Model 9

Dependent Variable:  $(d(\log(Y_t))/d(\log(S))/d(d((d(Y_t))^2))$

Variable	Coefficient	t-statistic
$(d(\log(C_{nt}))/d(\log(S))/d(d((d(Y_t))^2))$	0.839	26.14
$(d(\log(I_t))/d(\log(S))/d(d((d(Y_t))^2))$	0.231	20.85
$(d(\log(T_t/G_t))/d(\log(S))/d(d((d(Y_t))^2))$	-0.123	-20.91
$(d(\log(T_t))/d(\log(S))/d(d((d(Y_t))^2))$	0.098	10.48
$(d(\log(X_t))/d(\log(S))/d(d((d(Y_t))^2))$	0.094	5.16
$(d(\log(M_t))/d(\log(S))/d(d((d(Y_t))^2))$	-0.273	-4.56

$R^2 = 0.99999$      $DW = 2.17$      $F = 363912$      $H_T = 0.001$

Included observations = 1993 – 2018    Sample (adjusted) = 26\_

Regression Model 10 implies that an increase in gross saving enhances economic growth (Blanchard and Johnson, 2013, p.97). Thus, during the sample period a 1% increase in household consumption, gross saving, or tax revenue in Ethiopia is associated with 0.71%, 0.22, or 0.10% rise respectively in economic growth, *ceteris paribus*.

### Regression Model 10

Dependent Variable:  $\log(Y_t) / d(d(Y_t^2))$

Variable	Coefficient	t-statistic
$\log(C_{nt}) / d(d(Y_t^2))$	0.712	82.14
$\log(S_t) / d(d(Y_t^2))$	0.228	36.11
$\log(T_t) / d(d(Y_t^2))$	0.101	19.11

$R^2 = 1.0000$      $DW = 1.72$      $F = 3.61 \times 10^8$      $H_T = 0.960$

Included observations = 1992 – 2018    Sample (adjusted) = 27\_

In 1995, the share of total government debt to GDP ratio in Ethiopia increased by up to 150 percent. The major cause of this huge rise in debt was high government borrowing from external sources to implement the post-war social and economic reform program, the Structural Adjustment Program (SAP). By 2000, however, the total debt to GDP ratio had declined to 77 percent, and fell to only 23 percent in 2014 (Teshome, 2015).

Melese (2005) by using structural macroeconomic, Co integration and Error Correction Models as well as the Ordinary Least Squares (OLS) method, with data covering the period 1970 to 2002, found a significant and positive relationship between external debt and economic growth in Ethiopia (Mohanty, 2017). Regression Model 11 indicates that in Ethiopia, during the period 1992 to 2016, external debt had a significant and positive effect on economic growth, though in the sample period, external debt servicing had a significant and negative effect. The evidence provided by Regression Model 11 indicates that a 1% increase in household consumption, government spending, external debt, or external debt servicing during the sample period was responsible for 0.57%, 0.20%, 0.05% or -0.04% increases respectively in economic growth in Ethiopia, *ceteris paribus*.

### Regression Model 11

Dependent Variable:  $(d(\log(Y_t))/d(d((G_t)))/d(d(Y_t^2)))$

Variable	Coefficient	t-statistic
$(d(\log(C_{nt}))/d(d((G_t)))/d(d(Y_t^2)))$	0.574	6.48
$(d(\log(G_t))/d(d((G_t)))/d(d(Y_t^2)))$	0.198	6.48
$(d(\log(ED_t))/d(d((G_t)))/d(d(Y_t^2)))$	0.052	3.83
$(d(\log(EDS_t))/d(d((G_t)))/d(d(Y_t^2)))$	-0.041	-3.42

$R^2 = 0.98$   $DW = 1.85$   $F = 375$   $H_T = 0.033$

Included observations = 1992 – 2018 Sample (adjusted) = 27\_\_

Regression Model 12 indicates that government spending could have affected economic growth through the household disposable income channel because a 1% increase in tax revenues is accompanied with 0.93%, a 0.97% rise in economic growth following a 1% increase in household income as given in Regression Model 4.

### Regression Model 12

Dependent Variable:  $\log(Y_t) / d(d(Y_t^2))$

Variable	Coefficient	t-statistic
$\log(G_t) / d(d(Y_t^2))$	0.934	33.35
$\log(ED_t) / d(d(Y_t^2))$	0.711	7.83
$\log(EDS_t) / d(d(Y_t^2))$	-0.650	-4.82

$R^2 = 0.99999$   $DW = 2.02$   $F = 935672$   $H_T = 0.216$

Included observations = 1992 – 2018 Sample (adjusted) = 27

Regression Models 11, 12, and 13 indicate that in Ethiopia, during the sample period, growth in external debt had a significant and positive effect on

economic growth; whereas external debt servicing had a significant and negative effect on economic growth.

In addition, Regression Models 13, 5, 6 and 9 indicate that it is through disposable income, that household consumption could have influenced economic growth because in these four equations the coefficients of income elasticity of both household disposable income and household consumption are the nearly same nearly, i.e. 0.78, 0.68, 0.84, and 0.84 respectively.

### **Regression Model 13**

Dependent Variable:  $\log(Y_t/G_t) / d(d(Y_t^2))$

Variable	Coefficient	t-statistic
$\log(Y_{dt}/G_t) / d(d(Y_t^2))$	0.789	20.95
$\log(ED_t/G_t) / d(d(Y_t^2))$	0.173	7.02
$\log(EDS_t/G_t) / d(d(Y_t^2))$	-0.116	-4.82
$R^2 = 0.99995 \quad DW = 1.73 \quad F = 249349 \quad H_T = 0.095$		
Included observations = 1992 – 2018      Sample (adjusted) = 27_		

Theoretical intertemporal government budget constraint models which have failed to conform to empirical tests have been proposed by Antwi et al. (2013), Ayadi and Ayadi (2008), Barro (1979), Bianconi (2000), Blanchard et al. (2000, pp.437–439), Claey's, (2008), Curtasu (2011), Das (2016), Domar (1944), Landolfo (2001), Rode (2012, pp.151–152). However, these theoretical models do not entirely conform to the results in Regression Models 14 and 15 because the theoretical models proposed by these scholars are characterized as:  $G = T - ED + EDS$ ; and in logarithm form the theoretical government budget deficit models proposed by them is wrongly characterized as:  $\log(G/T) = -\log(ED) + \log(EDS)$ .

In this paper, the linear intertemporal government budget deficit model is characterized by  $T = G + ED - EDS$  and this characterization conforms to the empirical findings as depicted in Equation 5.14.

### **Regression Model 14**

Dependent Variable:  $(\log(T_t) / d(d(X_t))) / d(d(T_t^2))$

Variable	Coefficient	t-statistic
$(\log(G_t) / d(d(X_t))) / d(d(T_t^2))$	0.765	10.30
$(\log(ED_t) / d(d(X_t))) / d(d(T_t^2))$	0.466	7.91
$(\log(EDS_t) / d(d(X_t))) / d(d(T_t^2))$	-0.391	-4.21
$R^2 = 0.99999 \quad DW = 1.97 \quad F = 1249805 \quad H_T = 0.072$		
Included observations = 1992 – 2018      Sample (adjusted) = 27_		

In this present paper, the logarithm form reveals that the intertemporal government budget deficit is characterized by  $\log(T/G) = \log(ED) - \log(EDS)$  and this characterization conforms to the empirical findings depicted in Regression Model 15.

### **Regression Model 15**

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Dependent Variable:  $(\log(T_t) / d(d(X_t)) / d(d(T_t^2)))$

<b>Variable</b>	<b>Coefficient</b>	<b>t-statistic</b>
$(\log(ED_t) / d(d(X_t)) / d(d(T_t^2)))$	0.417	6.27
$(\log(EDS_t) / d(d(X_t)) / d(d(T_t^2)))$	-0.585	-7.10
$R^2 = 0.997$ $DW = 2.25$ $F = 8356$ $H_T = 0.389$		
Included observations = 1992 – 2018	Sample (adjusted) = 27	

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In other words, an increase in demand for external borrowing has positive consequences on real government spending; and it is the increase in demand for real government spending that has positive consequences on tax revenues at any given point in time. So, external debt servicing can clearly reduce demand for real government spending on goods and services and end up reducing demand for tax revenues at any given point in time.

Adopting the budget deficit model suggested by the scholars mentioned above gives results that are misleading, because it implies that reducing external borrowing leads to an increase in government spending, and also that an increase in external debt servicing leads to reduction in government spending. This is shown by Regression Model 16

### **Regression Model 16**

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Dependent Variable:  $(\log(G_t) / d(d(Y_t/P_t)) / d(d(G_t^2)))$

<b>Variable</b>	<b>Coefficient</b>	<b>t-statistic</b>
$(\log(T_t) / d(d(Y_t/P_t)) / d(d(G_t^2)))$	0.857	10.93
$(\log(ED_t) / d(d(Y_t/P_t)) / d(d(G_t^2)))$	-0.870	-14.66
$(\log(EDS_t) / d(d(Y_t/P_t)) / d(d(G_t^2)))$	1.278	9.33
$R^2 = 0.99999$ $DW = 1.90$ $F = 1548756$ $H_T = 0.086$		
Included observations = 1992 – 2018	Sample (adjusted) = 27	

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Adopting the budget deficit model suggested is also misleading as it implies that reducing external borrowing leads to an increase in government deficit financing, and an increase in external debt financing leads to a reduction in government deficit financing. This is made clear in Regression Model 17

### Regression Model 17

Dependent Variable:  $(\log(G_t/T_t) / d(\log(Y_{dt}))) / d(d((G_t/T_t)^2))$

Variable	Coefficient	t-statistic
$(\log(ED_t) / d(\log(Y_{dt}))) / d(d((G_t/T_t)^2))$	-0.132	-5.20
$(\log(EDS_t) / d(\log(Y_{dt}))) / d(d((G_t/T_t)^2))$	0.213	7.28
$R^2 = 0.996$ $DW = 2.23$ $F = 7056$ $H_T = 0.157$		
Included observations = 1992 – 2018    Sample (adjusted) = 27		

Regression Models 18 and 19 indicate that a 1% increase in population growth tends to raise tax revenues by as much it can raise government spending i.e. 1.13% and 1.11% respectively.

### Regression Model 18

Dependent Variable:  $(\log(T_t) / d(T_t)) / d(d(T_t^2))$

Variable	Coefficient	t-statistic
$(\log(G_t/T_t) / d(T_t)) / d(d(T_t^2))$	-0.572	-12.16
$(\log(P_t) / d(T_t)) / d(d(T_t^2))$	1.133	269.31
$R^2 = 1.0000$ $DW = 1.92$ $F = 99933545$ $H_T = 0.011$		
Included observations = 1992 – 2018    Sample (adjusted) = 27		

### Regression Model 19

Dependent Variable:  $(\log(G_t) / d(d(S_t))) / d(d(G_t^2))$

Variable	Coefficient	t-statistic
$(\log(G_t/T_t) / d(d(S_t))) / d(d(G_t^2))$	0.450	2.80
$(\log(P_t) / d(d(S_t))) / d(d(G_t^2))$	1.111	79.63
$R^2 = 0.99996$ $DW = 2.14$ $F = 607343$ $H_T = 0.728$		
Included observations = 1992 – 2018    Sample (adjusted) = 27		

So, equations 5.18 and 5.19 show that the government deficit in Ethiopia during the sample period affected tax revenues by as much as it affected government spending.

Regression Model 20 indicates that in the long run tax revenue collection is positively influenced by an increase in government spending (0.95%), investment spending (1.72%) and exports (1.33%), but is negatively affected by gross savings (-1.664%) and imports (-2.40%).

### Regression Model 20

Dependent Variable:  $(d(\log(T_t)) / d(\log(Y_t))) / d(d((d(T_t))^2))$

Variable	Coefficient	t-statistic
$(d(\log(G_t)) / d(\log(Y_t))) / d(d((d(T_t))^2))$	0.957	12.22
$(d(\log(I_t)) / d(\log(Y_t))) / d(d((d(T_t))^2))$	1.717	11.08
$(d(\log(S_t)) / d(\log(Y_t))) / d(d((d(T_t))^2))$	-1.663	-12.28
$(d(\log(X_t)) / d(\log(Y_t))) / d(d((d(T_t))^2))$	1.334	19.03
$(d(\log(M_t)) / d(\log(Y_t))) / d(d((d(T_t))^2))$	-2.400	-17.16
$R^2 = 0.9697$ $DW = 1.92$ $F = 168$ $H_T = 0.159$		
Included observations = 1993 – 2018    Sample (adjusted) = 26		

Regression Model 21 implies that in Ethiopia during the sample period growth in exports rather than growth in government spending had greater influence on economic growth. It underlines that an export growth strategy would be a better alternative for stimulation of economic growth and also shows that, as revealed by the coefficients of imports and exports on taxes, other things equal, imports and exports always tend to be at equilibrium.

### Regression Model 21

Dependent Variable:  $(\log(T_t) / d(S_t/P_t)) / d(d(T_t^2))$

Variable	Coefficient	t-statistic
$(\log(G_t) / d(S_t/P_t)) / d(d(T_t^2))$	0.908	3.65
$(\log(X_t) / d(S_t/P_t)) / d(d(T_t^2))$	2.843	5.59
$(\log(M_t) / d(S_t/P_t)) / d(d(T_t^2))$	-2.869	-4.64
$R^2 = 0.999999$ $DW = 1.75$ $F = 13125049$ $H_T = 0.016$		
Included observations = 1992 – 2018    Sample (adjusted) = 27		

Regression Models 22 and 23 indicate that in Ethiopia during the sample period economic growth and growth in household disposable income were equally affected by growth in investment spending. It can also be deduced from Regression Models 22 and 23, that disposable income was influenced more than household disposable income, by household consumption, most likely due to the influence of taxes on real income. Regression Model 22 implies that growth in both household consumption and investment spending could have influenced economic growth through household disposable income since the addition of coefficients 0.587, 0.095 and 0.131 almost equals 0.81 i.e. the value of the

coefficient of elasticity of disposable income on gross domestic product (0.79) as given in Regression Model 13.

### **Regression Model 22**

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Dependent Variable:  $(\log(Y_t) / d(d(\log(X_t)))) / d(d(Y_t^2))$

Variable	Coefficient	t-statistic
$(\log(C_{nt}) / d(d(\log(X_t)))) / d(d(Y_t^2))$	0.587	9.27
$(\log(I_t) / d(d(\log(X_t)))) / d(d(Y_t^2))$	0.095	7.55
$(\log(T_t) / d(d(\log(X_t)))) / d(d(Y_t^2))$	0.131	22.54
$R^2 = 0.999$ $DW = 2.10$ $F = 12789$ $H_T = 0.026$		Included
observations = 1992 – 2018      Sample (adjusted) = 27		

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From Regression Models 22 and 23, it is clear that while the increase in the growth of tax revenues during the sample period had positive consequences on overall economic growth, it had negative consequences on household disposable income.

Regression Model 24 shows that external debt enhanced economic growth faster than the rate at which external debt financing depressed it, although Alemayahu and Zerfu (1998) have confirmed that the level of debt in Ethiopia was beyond the capacity of the country to service it. Empirical results reveal that external debt servicing had a negative effect on economic growth as indicated by the negative correlation between external debt servicing and investment spending in Ethiopia during the 1992 to 2018 period.

### **Regression Model 23**

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Dependent Variable:  $(d(\log(Y_{at})) / d(d(Y_t))) / d(d(Y_{at}^2))$

Variable	Coefficient	t-statistic
$(d(\log(C_{nt})) / d(d(Y_t))) / d(d(Y_{at}^2))$	0.856	180.50
$(d(\log(I_t)) / d(d(Y_t))) / d(d(Y_{at}^2))$	0.097	37.41
$(d(\log(T_{t-1})) / d(d(Y_t))) / d(d(Y_{at}^2))$	0.027	6.04
$R^2 = 0.9998$ $DW = 2.20$ $F = 48815$ $H_T = 0.809$		
Included observations = 1992 – 2018      Sample (adjusted) = 27		

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However, external debt in Ethiopia had positive and significant effects on investment, indicating that a 1% increase in external debt in the case of Ethiopia contributed 0.74% increase to the level of investment as depicted by Regression Model 24. It also contributed -0.42% increase to the level of investment in the country during the given period *ceteris paribus*. Hence, external debt servicing crowded out investment in Ethiopia.

### Regression Model 24

Dependent Variable:  $(\log(I_t) / d(d(\log(S_t)))) / d(d(I_t^2))$

Variable	Coefficient	t-statistic	
$(\log(G_t) / d(d(\log(S_t)))) / d(d(I_t^2))$	0.569	6.61	
$(\log(ED_t) / d(d(\log(S_t)))) / d(d(I_t^2))$	0.741	69.92	
$(\log(EDS_t) / d(d(\log(S_t)))) / d(d(I_t^2))$	-0.421	-4.09	$R^2 =$
1.0000	$DW = 1.93$	$F = 73923796$	$H_T = 0.002$
observations = 1992 – 2018	Sample (adjusted) = 27		

## 4. Conclusions

Higher government spending and pro-poor resource allocation reduced absolute poverty in Ethiopia during the 1990 to 2018 period. Empirical evidence in this study indicates that increases in tax revenue, government revenue and the government deficit had positive and significant effects on economic growth during this period.

The empirical evidence in this study also shows that some other variables had positive and significant effects on economic growth in Ethiopia during the sample period. These included: household disposable income, investment spending, household consumption, private savings, and the potentials for balance of payments and external debt. However, the study also showed a number of variables had negative and significant effects on economic growth: levels of import, government savings, the balance of payments deficit, the savings investment ratio and external debt financing.

Theoretical intertemporal government budget constraint models which have failed to conform to empirical tests have been proposed by a number of scholars: Antwi et al. (2013), Ayadi and Ayadi (2008), Barro (1979), Bianconi (2000), Blanchard et al. (2000), pp.437–439), Claeys, (2008), Curtasu (2011), Das (2016), Domar (1944), Landolfo (2008), Rode (2012, pp.151–152). Adopting the intertemporal budget deficit model suggested by these scholars is therefore misleading.

It implies that reducing external borrowing leads to an increase in government deficit financing; that an increase in external debt financing leads to a reduction in government deficit financing; that reducing external debts leads to an increase in government spending; and that an increase in external debt financing leads to a reduction in government spending.

This study found that an increase in demand for external borrowing has positive consequences on real government spending, and that an increase in demand for real government spending has positive consequences on tax revenues at any given point in time. It is clear that external debt financing reduces demand for real government spending on goods and services and consequently always reduces demand for increased tax revenues.

It is also clear that in Ethiopia, during the sample period, growth in exports rather than growth in government spending had the greater influence on economic growth. The conclusion must be that an export growth strategy rather than increased external borrowing is the better alternative to stimulate economic growth in Ethiopia.

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# Poverty and Inequality in Ethiopia: How Long Would It Take to Exit Poverty?

Degye Goshu<sup>1</sup>

## *Abstract*

*Poverty alleviation and equitable distribution of benefits among citizens are the overriding welfare objectives of developing countries. Ethiopia has designed and implemented a number of development policies and interventions to attain such objectives, but poverty alleviation, of necessity, still remains the primary development agenda of the country. Indeed, the distribution of poverty and inequality across the country's regions and population sub-groups is becoming worrisome. In order to generate the latest, relevant and reliable empirical evidence on these welfare issues, the third wave (2015) of the Living Standards Measurement Study (LSMS) dataset on Ethiopia was utilized. A sample of 4954 households with 22,296 household members covering all regions and cities was employed for rigorous distributive analysis. Foster-Greer-Thorbecke (FGT) poverty indices and the time taken to exit poverty were estimated and decomposed by population sub-groups and expenditure components. A right-censored Tobit model of welfare ratio was used to identify the correlates of poverty and to predict the intensity and probability of poverty. The Gini index of inequality was estimated and decomposed by population sub-groups and expenditure components. The results of distributive analysis show that absolute poverty rate in Ethiopia was 22.1 percent with significant variation across regional states. Absolute poverty was also largely differentiated by gender, place of residence (rural-urban), and religion. Similarly, depth and severity of poverty (6% and 2.4%) were varied across regions. Based on different growth scenarios of consumption expenditure per capita assumed (14%, 11%, 8%, and 5), the poor in Ethiopia would take 9.4-26.4 years to exit poverty. The Tobit model outputs indicated that the expected welfare ratio of the poor was 0.783, which was 21.3 percent, far below the poverty line (ETB 14758). The likelihood of individuals to be poor was 22.0 percent, which is consistent with the FGT index (22.1%, about 22.1 million population). Poverty decomposition results show that the absolute poverty rate in Ethiopia was highly attributable to rural areas (24.1%) with relative contribution of 88.5 percent*

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*compared to their counterparts in urban centers (12.7%). Similarly, decomposition of poverty by expenditure components verify that the absolute contribution of food consumption expenditure in reducing total poverty was 65.3 percent, whereas non-food consumption expenditure contributed only 11.4 percent. Moreover, consumption inequality in Ethiopia was estimated to be 34.4 percent. The Gini decomposition of inequality shows that 58.9 percent of the total inequality was relatively attributable to rural areas; the relative contribution of urban areas was below three percent. The contributions of food and non-food consumption expenditures on total inequality were respectively 26.5 percent and 7.8 percent in absolute terms and 77.3 percent and 22.7 percent in relative terms. The regression-based decomposition of inequality indicates consistent results in that food consumption inequality was mainly attributable to food. The findings clearly suggest the need to design and implement relevant poverty reduction interventions for attaining the Sustainable Development Goals (SDG) of ending poverty and hunger in all its forms by 2030.*

## **1. Introduction**

Poverty, as a major indicator of welfare in a society, can be defined as a pronounced deprivation in well-being. With its multiple dimensions and approaches, poverty has been one of the primary research areas of development economics. The basic challenge in poverty analysis has been the approach and the methods of measuring poverty as a welfare indicator. Poverty measurement is the production of numbers suitable to assess the overall degree of poverty in a given society and to identify the poor and non-poor members of this society. To decide which measures of poverty to utilize, we need a theory about the object we want to measure and an appropriate poverty indicator.

There are different theories of poverty analysis, of which the dominant is the ‘welfarist’ school, the ‘basic-needs’ school, and the ‘capability’ school. The ‘welfarist’ school, the dominant approach, sees well-being or poverty as an issue of economic wellbeing. For this school, poverty is said to exist in a given society when one or more persons do not attain a level of economic well-being deemed to constitute a reasonable minimum by the standards of that society (Ravallion, 1994). This poverty concept derives from the assumption that individuals maximize their well-being essentially in preference ordering of goods representable by a utility function.

The ‘basic-needs’ approach, which is generally ranked second to the ‘welfarist’ approach in importance, considers “something” that is lacking in the lives of the poor as a small subset of goods and services identified and deemed to meet the basic needs of all human beings (Asselin and Dauphin, 2001). The focus of the basic-needs approach is not utility. Rather, it focuses on individual requirements relative to basic commodities including food, water, sanitation, shelter, clothing, basic education, health services, and public transportation.

In the third approach, the ‘capability’ school, the ‘something’ that is lacking refers to human abilities, or capabilities, not utility nor satisfaction of basic-needs. The ‘capability’ approach differs from ‘welfarist’ or utilitarian evaluation in considering a variety of doing and being as important in itself. The perspective of capabilities provides fuller recognition of the variety of ways in which people can be poor or non-poor (Sen, 1994; Asselin and Dauphin, 2001).

Poverty reduction is the overriding objective of developing countries including Ethiopia. Ethiopia has been designing and implementing various development policies and interventions to attain objectives of welfare and equity over many years. However, poverty alleviation remains the primary development problem of the country. The design and implementation of poverty reduction strategies requires new and reliable information on poverty and inequality, their spatial and sectoral distribution and the possible sources of poverty and inequality. To analyze the poverty and inequality situation in Ethiopia, consumption expenditure per capita and other attributes of 22,296 samples from all regions and cities were utilized in this study. In order to identify priority areas of intervention and the relative importance of findings for matching appropriate poverty reduction policy options and strategies, this paper employed different measures of poverty and inequality and decomposed them into their constituent parts.

## **2. Dataset and Analytical Framework**

### **2.1 Dataset**

This study has utilized the third wave of Living Standards Measurement Study (LSMS 2015) for Ethiopia. The LSMS is the country representative, multi-topic dataset collected at different levels (individual, households, farm plots, etc.) by Central Statistical Agency (CSA) of Ethiopia in collaboration with the World

Bank. The third wave covered the nine regional states and two administrative towns with 4954 households and more than 23,000 individuals across the country.

The Ethiopian Government monitors regional and national poverty situations by using the Foster-Greer-Thorbecke (FGT) decomposable measures of poverty (head count index, poverty gap index, and poverty severity index). However, the design and implementation of poverty reduction strategies requires adequate, reliable and detailed information on poverty and inequality and their spatial and sectoral distribution and the possible sources. To generate new and reliable information on various aspects of poverty and inequality in Ethiopia, this study has utilized 22,296 (29% urban residents) regionally distributed samples (Table 1).

**Table 2: Distribution of samples across regions and places of residence**

<b>Region</b>	<b>Rural</b>	<b>Small towns</b>	<b>Medium and large towns</b>	<b>Total</b>
Tigray	1,554	155	708	2,417
Afar	569	53	37	659
Amhara	2,927	405	643	3,975
Oromia	3,273	476	922	4,671
Somali	1,156	123	163	1,442
Benishangul Gumuz	538	58	0	596
SNNP*	4,083	475	696	5,254
Gambella	505	42	35	582
Harari	661	0	154	815
Addis Ababa	0	0	1,019	1,019
Dire Dawa	578	0	288	866
Country level	15,844	1,787	4,665	22,296

Note: \* SNNP denotes Southern Nations, Nationalities and Peoples Region.

## **2.2 Measuring Poverty**

Poverty can be measured through three steps. The first step is to define an indicator of welfare or poverty and the second is to establish a minimum acceptable standard of that indicator, called the poverty line, used to separate the poor from the non-poor. Finally, a summary statistic is generated to aggregate the information from the distribution of this welfare indicator relative to the poverty line (Ravallion, 1998).

### **2.2.1 Choice of poverty indicator**

Income and expenditure are two important indicators of welfare or poverty, both with their own advantages and disadvantages. Income (potential) as an indicator of welfare is to be preferred in some circumstances. It has ease of measurement, mainly due to the limited number of income sources, ability to measure the degree of control over resources, and relatively lower costs to collect it, and these are major merits of income as a poverty indicator. However, an income approach is more likely to be underreported, and it is also affected by short-term fluctuations, unobservable income sources, the uncertain link between income and welfare, and the failure of reporting periods to capture the average income of the household (Haughton and Khandker, 2009).

The expenditure (achievement) approach shows a current actual material standard of living, enabling irregularities (reflecting long-term average wellbeing) to be smoothed out, and is relatively less likely to be understated (due to the ease to recall). However, the use of expenditure as a poverty indicator also has various problems. Households may not be able to smooth out their consumption. Other issues can arise from making misleading consumption choices, the irregularity of some expenses incurred, which may lead to noisy data, and the difficulty to measure some components of consumption including durable goods.

If we choose to assess poverty based on household consumption or expenditure, it is helpful to think in terms of an expenditure function, to show the minimum expense required to meet a given level of utility derived from a vector of goods at their prices. While using income as a measure of welfare, there are many problems related to its definition (including timing of income whether over years or lifetime) and measurement (usually understated).

This paper has used consumption expenditure per capita as the measure of poverty and inequality in Ethiopia.

### **2.2.2 Setting the poverty line**

A poverty line<sup>2</sup> for a household,  $z_i$ , may be defined as the minimum expenditure needed to achieve at least the minimum utility level  $u_z$ , given the level of prices (p) and the demographic characteristics of the household (x) (Ravallion, 1998):

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<sup>2</sup> To measure poverty, we need to combine the poverty line with information on the distribution of consumption expenditure. In principle, there are two ways of doing this: (a) the welfare ratio method, and (b) the equivalent expenditure method. One can deflate

$$z_i = e(p, x, u_z),$$

Because utility,  $u_z$ , or expenditure,  $e(\cdot)$ , are difficult to measure, there are two practical approaches to determine a poverty line. One approach is to compute a poverty line for each household, adjusting and accounting for household differences, prices differences, and demographic composition. This gives a different poverty line for each household. A second and more widely used approach is to construct one per capita poverty line for all individuals, and adjust expenditure per capita for differences in prices and household composition. The adjusted per capita is then compared with the poverty line to determine if the individual is living below the poverty line. This approach allows us to talk of the poverty line and present it as a single figure.

Poverty has various forms, each of them measured differently. Extreme poverty, absolute poverty, or destitution, is defined as a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It refers to a condition where a person does not have the minimum amount of income needed to meet the minimum requirements for one or more basic living needs over an extended period of time. It relates to both income and access to services. When the World Bank set the global standard of an absolute poverty line in 1990 as living on less than \$1 a day, it refers to a standard which is the same in all countries and which does not change over time. This threshold was later revised to \$1.25/day (at 2005 prices). The current standard of absolute poverty threshold refers to earning below an international poverty line of \$1.90/day (2015 prices) (World Bank, 2013). The World Bank has set a new goal to end extreme poverty in a generation aiming to have no more than 3 percent of the world's population living on just \$1.90 a day by 2030. Currently the World Bank is using three poverty levels: \$1.90 a day for extreme poverty, \$3.20 a day for middle-income countries, and to \$21.70 a day for high-income countries. A national poverty line is the poverty line deemed appropriate for a country by its authorities. It is based on population-weighted sub-group estimates from household surveys.

Relative poverty, as opposed to absolute poverty, is a condition in which people lack the minimum amount of income needed in order to maintain an average standard of living in the society in which they live. It is considered the

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all money incomes by  $z$ , so that the indicator of welfare is simply  $y/z$  where  $y$  is total expenditure. The value of  $y/z$  is known as the welfare ratio.

easiest way to measure levels of poverty in an individual country. Relative poverty is defined in comparison to the members of a society and, therefore, differs across countries. Relative definitions of poverty see poverty in terms of minimum acceptable standards of living within the society which a particular person inhabits.

There are two main ways of estimating objective poverty lines<sup>3</sup>: food-energy intake and cost-of-basic-needs (CBN) methods. The consumption expenditure level at which food energy intake is just sufficient to meet pre-determined food energy requirements is used to determine an objective poverty line using the food energy-intake method. Because energy requirements vary across individuals, and by activity levels and over time for any given individual, adjustments need to be made accordingly. The purpose of the food-energy intake method is to find a monetary value for the poverty line at which basic needs are met.

If the expected value of food-energy intake is conditional on total consumption expenditure,  $E(k/y)$ , is strictly increasing in  $y$  over an interval which includes energy required, then there will exist a poverty line  $z$  such that (Ravallion, 1994)

$$E(k/z) = k'$$

where  $k$  is food-energy intake (random variable),  $k'$  is the food energy required (considered to be fixed), and  $E(k/z)$  is the expected value of food-energy intake conditional on the poverty line or food-energy requirement.

In the case of the cost-of-basic-needs (CBN) method, a consumption vector assumed to be consistent with choices actually made by a relevant reference group is chosen. Poverty is then measured by comparing actual expenditures with the CBN, which includes food and non-food components of measurement of the poverty line<sup>4</sup>.

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<sup>3</sup> The common practice of estimating poverty lines for measuring income poverty is the threshold of 50-60 percent of the median (national equalized) household income.

<sup>4</sup> The primary source of subjectivity in measuring poverty lines is the notion of "basic needs"; the distinction between necessities and luxuries remains largely subjective. There are two methods of measuring subjective poverty lines: the minimum income question and developing country setting.

## 2.3 Poverty Analysis

Two methods of measuring poverty were used in this study. The Foster-Greer-Thorbecke (FGT) index of poverty was used to analyze the incidence, depth and severity of consumption poverty. The method of time-taken to exit poverty was also used to estimate the speed at which the poor are expected to exit the poverty trap.

### 2.3.1 FGT poverty indices

There are various summary measures of welfare or poverty situations in a society. The FGT poverty index measures are additively decomposable. It is also possible to separate changes in the FGT measures into a component resulting from rising average incomes/expenditures, and a component resulting from changes in the distribution of income/expenditure. As one of the measures proposed by Foster, et al. (1984), it may generally be written as

$$P_a = \frac{1}{N} \sum_{i=1}^N \left( \frac{G_i}{z} \right)^a, \quad a \geq 0$$

where  $\alpha$  is a measure of the sensitivity of the index to poverty and the poverty line. When parameter  $\alpha = 0$ ,  $P_0$  is simply the headcount index. When  $\alpha = 1$ , the index is the poverty gap index  $P_1$ , and when  $\alpha$  is set equal to 2,  $P_2$  is the poverty severity index. For all  $\alpha > 0$ , the measure is strictly decreasing in the living standard of the poor (the higher the standard of living, the less poor one is).

The most widely used measure of FGT index of poverty is the headcount index, which measures the proportion of the population that is counted as poor, and  $P_0$  can specifically be computed by the formula

$$P_0 = \frac{N_p}{N}$$

where  $N_p$  is the number of households counted as poor in the sample, and  $N$  is the total number of households used for analysis.

If the interest is to compute the likelihood of households to be poor in the case of binary data, the head count index can be computed as follows:

$$P_0 = \frac{1}{N} \sum_{i=1}^N I(y_i < z)$$

where  $I(\cdot)$  is an indicator function that takes on a value of 1 if the expression in parenthesis is true, and 0 otherwise. So, if the welfare indicator  $y_i$  (e.g. expenditure) is less than the poverty line,  $z$ , then  $I(\cdot)$  equals 1 and the household would be counted as poor.

However, the head count index, as a measure of incidence of poverty, has three major weaknesses: it does not take the intensity of poverty into account; it does not change if people below the poverty line become poorer or better-off; and the poverty estimates are at household level, not at individual level, which is less relevant for policy interventions designed to address intra-household poverty.

The poverty gap index measures intensity of poverty. It measures depth or the extent to which individuals on average fall below the poverty line, and expresses it as a percentage of the poverty line. The poverty gap ( $G$ ) for household  $i$  and the poverty gap index ( $P_1$ ) may be specified as follows

$$G_i = (z - y_i) \times I(y_i < z)$$
$$P_1 = \frac{1}{N} \sum_{i=1}^N \frac{G_i}{z}$$

The poverty gap is defined as poverty line ( $z$ ) less actual income,  $y_i$ , for poor individuals; it is considered to be zero for the non-poor. It is the mean proportionate poverty gap in the population (where the non-poor have zero poverty gap). It indicates the minimum cost of eliminating poverty (relative to the poverty line), and the amount of income/expenditure which would have to be transferred to the poor to bring their incomes or expenditures up to the poverty line as a proportion of the poverty line.

The squared poverty gap index takes into account inequality among the poor. It measures a weighted sum of poverty gaps (as a proportion of the poverty line), where the weights are the proportionate poverty gaps themselves with different weights used. This contrasts to the poverty gap index, where the gaps are weighted equally. By squaring the poverty gap index, the measure puts more weight on observations that fall far below the poverty line.

The squared poverty gap index, also known as poverty severity index, can be computed by the following formula:

$$P_2 = \frac{1}{N} \sum_{i=1}^N \left( \frac{G_i}{z} \right)^2$$

The squared poverty gap index averages the squares of the poverty gaps relative to the poverty line. It is one of the FGT class of poverty measures that allow one to vary the amount of weight put on the income (or expenditure) levels of the poorest members in society.

### 2.3.2 Time-taken to exit

When thinking about poverty reduction strategies, it may be useful to show how long it would take, at different potential economic growth rates, for the average poor person to exit poverty. It is decomposable by population sub-groups and is sensitive to the distribution of a welfare indicator,  $x$ , among the poor. For the  $i^{th}$  person below the poverty line, the expected time to exit poverty (or to reach the poverty line), if consumption expenditure per capita grows at positive rate  $g$  per year, is (Morduch, 1998):

$$t = \frac{\ln(z) - \ln(y_j)}{g} = \frac{W}{g}$$

where W is Watts index.

The time taken to exit is the Watts index divided by the expected growth rate of expenditure of the poor. This measure of poverty indicates the negative relationship between economic growth rates and the speed at which the poor are exiting poverty.

### 2.3.3 Decomposition of poverty

The FGT poverty index (P) can be decomposed by population sub-groups as follows (Araar and Duclos, 2013):

$$\hat{P}(z, \alpha) = \sum_{g=1}^G \hat{\phi}(g) \hat{P}(z; a, g)$$

where G is the number of population sub-groups,  $\hat{P}(z, \alpha, g)$  is the estimated FGT index of sub-groups g,  $\hat{\phi}(g)$  is the estimated population share of sub-groups

$\sum_{g=1}^G \hat{\phi}(g) \hat{P}(z; a, g)$  is the estimated absolute contribution of sub-groups  $g$  to total poverty, and  $\sum_{g=1}^G \hat{\phi}(g) \hat{P}(z; a, g)$  is the estimated relative contribution of sub-groups  $g$  to total poverty.

The total alleviation of FGT poverty into a sum of the contributions generated by separate income/expenditure components can be decomposed. Total alleviation is maximal when all individuals have an income/expenditure greater than or equal to the poverty line. A negative sign on a decomposition term indicates that an income component reduces poverty.

Assume that there exists  $K$  income/expenditure sources and that  $s_k$  denotes source  $k$ . The FGT index is defined as (Araar and Duclos, 2013):

$$\hat{P}\left(z; a, y = \sum_{k=1}^K s_k\right) = \frac{\sum_{i=1}^n \left(1 - \frac{y_i}{z}\right)_+^a}{\sum_{i=1}^n w_i}$$

where  $w_i$  is the weight assigned to individual  $i$  and  $n$  is sample size.

This estimates the share in total income/expenditure of each source  $k$  and the absolute and relative contributions of each source  $k$  to the value of  $\left(\hat{P} - 1\right)$ .

#### 2.3.4 Correlates of poverty

One of the most important question in welfare analysis is the attempt to identify the major causes of poverty. A poverty profile describes the pattern of poverty, but is not principally concerned with explaining its causes. Haughton and Khandker (2009) have tried to identify the main potential determinants of poverty at different levels, national, sector-specific, community, household, or individual characteristics. Regression techniques can be used to determine the factors “causing” poverty or correlates of poverty. Household and individual level sources of poverty/welfare have been identified for empirical analysis in this paper (Table 2).

**Table 3: Definition of variable sand working hypotheses**

<b>Correlates of poverty (welfare ratio)</b>	<b>Measurement</b>	<b>Expected effect on welfare</b>
Family size	Counts	-
Number of meals served per day (counts)	Counts	+
Source of safe drinking water	Dummy (1 if safe, 0 otherwise)	+
Access to off-farm activities	Dummy (1 if accessed to)	+
Private ownership of telephone lines	Dummy (1 if owned)	+
Access to credit	Dummy (1 if accessed to credit)	+
Literacy status	Dummy (1 if literate)	+
Incidence of food shortage within last 7 days	Dummy (1 if yes)	-
Source of lighting	Dummy (1 if electricity)	+
Ownership of improved toilet facility	Dummy (1 if owned)	+
Type of house floor	Dummy (1 if clean)	+
Access to washing water	Dummy (1 if yes)	+
Consultation for medical assistance	Dummy (1 if yes)	+
Employment opportunity	Dummy (1 if yes)	+
Number of rooms in the house	Continuous	+
Place of residence	Dummy (1 if rural)	-

This paper employed the most common censored regression model, the Tobit model, which expresses the observed level of the outcome in terms of an underlying latent variable. The use of the Tobit model is intuitive because parameter estimates will be biased and inconsistent if a linear model is used in the presence of zero outcomes (failures or non-poor in this case); the bias will increase as the number of observations that take on the value of zero increases. The dependent variable measures the inverse relationship between poverty and welfare. Welfare ratios below 1 indicate poor individuals (below the poverty line) and those on or above 1 show non-poor individuals. Accordingly, higher values of the welfare ratio designate higher welfare (lower poverty). The dependent variable was censored from above to deal with the intensity and status of poverty situation in the society.

The Tobit model can be specified as (Cameron and Trivedi, 2009):

$$y_i = \mathbf{x}\boldsymbol{\beta} + \varepsilon_i$$

and the measurement model

$$y_i = \begin{cases} \mathbf{x}\boldsymbol{\beta} + \varepsilon_i, & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* < 0 \end{cases}$$

where  $y_i$ , the dependent variable (the welfare ratio, which is the ratio of real consumption per capita, divided by the poverty line,  $z$ ) and the  $x$ 's are vectors of covariates determining the intensity and status of the welfare ration, and  $\boldsymbol{\beta}$  is a vector of corresponding parameters to be estimated.

## **2.4 Analysis of Inequality**

### **2.4.1 Inequality indices**

The property of mean independence is considered a desirable feature of an inequality measure. Inequality measures are often calculated for their distributions. Other than expenditure, most inequality measures, income, land, assets, tax payments, and other continuous and cardinal variables, do not depend on the mean of the distribution. As a good measure of income and consumption inequality, the Gini coefficient has six desirable properties: mean independence, population size independence, symmetry, Pigou-Dalton transfer sensitivity, decomposability, and statistical testability (Haughton and Khandker, 2009).

The Gini coefficient is the most widely used single measure of inequality officially used by the World Bank to compare inequality among countries in the world. It is based on the Lorenz curve, a cumulative frequency curve that compares the distribution of a specific variable with the uniform distribution that represents perfect equality. To construct the Gini coefficient, we create a graph of the cumulative percentage of households (e.g. from poor to rich) on the horizontal axis and the cumulative percentage of expenditure (e.g. income) on the vertical axis.

The diagonal line in the Lorenz curve represents perfect equality. The Gini coefficient is defined as

$$G = \frac{A}{A + B} \\ = 1 - \sum_{i=1}^N (x_i - x_{i-1})(\gamma_i + \gamma_{i-1})$$

where A and B are the areas shown in the Lorenz curve<sup>5</sup>.  $x_i$  is a point on the x-axis, and  $y_i$  is a point on the y-axis.

When there are N equal intervals on the x-axis, the equation simplifies to the following

$$G = 1 - \frac{1}{N} \sum_{i=1}^N (\gamma_i + \gamma_{i-1}).$$

### 2.4.2 Decomposing inequality

This paper decomposes inequality indices by income/expenditure sources, population sub-groups and predicted components. There are two approaches to decompose inequality by income/expenditure sources: the analytical approach and the Shapley approach. The analytical approach decomposes the (usual) relative or the absolute Gini index by consumption components. The Shapley approach decomposes inequality indices into a sum of the contributions generated by separate expenditure components (Arrar and Duclos, 2013). The Shapley approach estimates the share in total consumption expenditure of each source k, the absolute contribution of each source k to the Gini index, and the relative contribution of each source k to the Gini index.

The relative or the absolute Gini index is also decomposed by population sub-groups. To determine the contribution of each sub-group to total population inequality, the Gini index was decomposed as follows (Araar and Duclos, 2013):

$$I = \underbrace{\sum_{g=1}^G \phi_g \varphi_g I_g}_{\text{Between}} + \underbrace{\bar{I}}_{\text{Within}} + \underbrace{R}_{\text{Overlap}}$$

where  $\phi_g$  is the population share of group g in G population sub-groups;  $\varphi_g$  is the expenditure share of group g;  $\bar{I}$  is the between-group inequality (when each individual is assigned the average income of his group); and  $R$  is the residue implied by group expenditure overlap.

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<sup>5</sup> If A = 0, the Gini coefficient becomes 0, which means perfect equality; if B = 0, the Gini coefficient becomes 1, which means complete inequality.

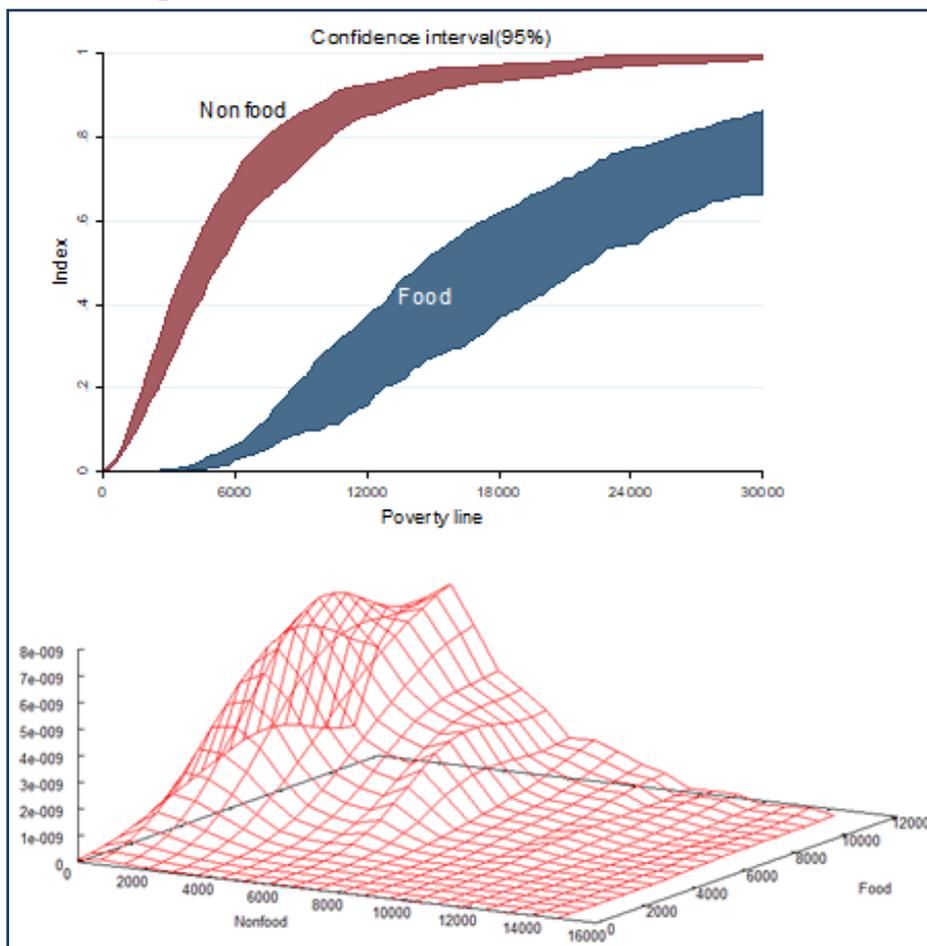
In the regression-based decomposition approach, inequality indices were decomposed by predicted components of the sources. Regression-based decomposition of inequality by predicted components estimates a model of total inequality as a function of covariates and predicts the contribution of each covariate, the constant, and of the residual to total inequality. The contribution of covariates to total consumption inequality is shown by decomposing the total inequality by the predicted contributions of covariates. There are two approaches for the decomposition of total inequality by expenditure: the Shapley approach based on the expected marginal contribution of consumption sources to total inequality, and the Analytical approach based on algebraic developments that express total inequality as a sum of the inequality contributions of income sources.

### **3. Results and Discussion**

#### **3.1 Consumption and Welfare Patterns**

The FGT poverty curves (with confidence intervals) for food and non-food consumption expenditure were plotted and compared. Food consumption expenditure had contributed higher proportion to total poverty. Non-food expenditure was relatively higher; increasing with an increasing rate for lower poverty thresholds and increasing with a decreasing rate for higher poverty thresholds (upper panel of Figure 1). On the other hand, food expenditure, as a necessity, was lower and increasing with a decreasing rate. The FGT poverty curves clearly depict how poverty of non-food expenditure was relatively more prevalent.

**Figure 1: FGT curves and joint density surfaces for food and non-food expenditure**



Source: Author’s computation from LSMS data (2019).

As illustrated by their joint probability density function, food and non-food expenditure were interdependent (lower panel of Figure 1). As expenditure for one type of consumption increases, the expenditure for the other increases but with different rates. However, food expenditure moves with lower values and remains inelastic for higher values of non-food expenditure because of the fact that food is a necessity good.

The number of meals served per day can be considered as an indicator of poverty situation (Table 3). The mean annual real consumption expenditure per capita was compared to the number of meals to verify if they are related. About

17.1 percent of the samples were served with two or less meals per day. This group of respondents spent the largest proportion (83.3%) of their expenditure on food. The majority of samples (77.4%) were served with three meals per day and spent 76 percent of their expenditure on food. However, only 5.5 percent of the respondents were served with more than three meals per day; they spent about 71.9 percent of their expenditure on food.

The results suggest people with low level of real consumption expenditure per capita are forced to eat a relatively lower number of meals per day and spend a greater proportion of their money on food. The variation in the number of meals served per day generally explains the relative difference in their mean annual consumption expenditure.

**Table 4: Real annual consumption expenditure per capita and meals served per day**

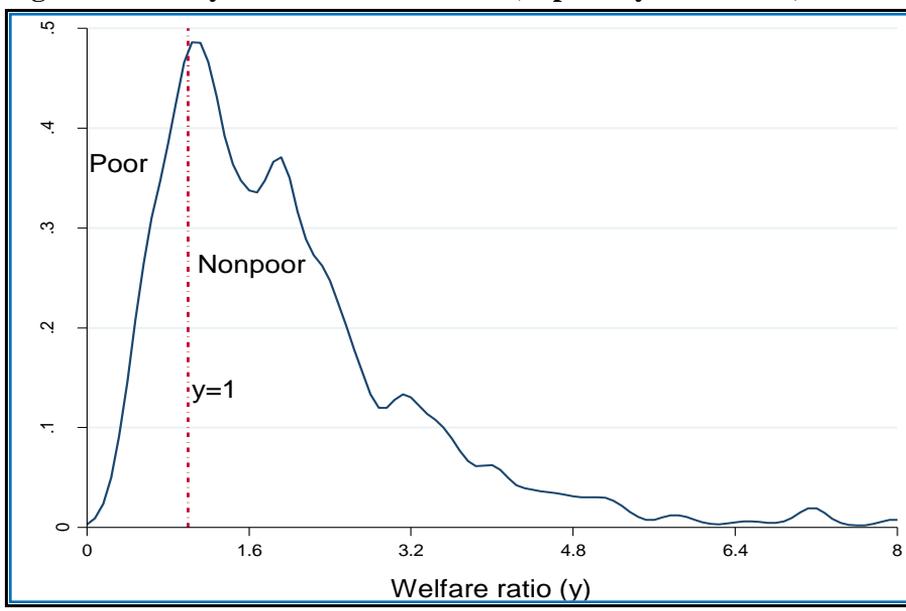
Number of meals served per day	Proportion of samples (%)	Expenditure share (%)	
		Food	Non-food
Twice or lower per day	17.1	83.3	16.7
Three times	77.4	76.0	24.0
Above 3	5.5	71.9	28.1
Total	1.00	76.7	23.3
Observations	22296		

Source: Author's computation from LSMS data (2019).

The median real annual expenditure per capita was about ETB 4177. People with two or lower number of meals per day (with annual mean food expenditure of ETB 3594) were constrained to spend below the median expenditure (only 86% of the median expenditure on food). However, individuals served with more than three meals per day were able to spend higher than the median expenditure per capita (ETB 5100). The results clearly imply that poor individuals with the small number of meals per day (17.1%) were forced to consume less.

The density curve of welfare ratio indicated in Figure 2 depicts the proportion of the samples above and below the poverty line (at a welfare ratio of 1) indicated by the vertical broken line. The density curve of the welfare ratio was right-skewed indicating the greatest majority of respondents were above the poverty line.

**Figure 2: Density curve of welfare ratio (at poverty line=14758)**



Source: Author's computation from LSMS data (2019).

## 3.2 Poverty Indices

### 3.2.1 Absolute Poverty

As reported below, the incidence or prevalence of an absolute<sup>6</sup> consumption poverty rate in Ethiopia in 2015/16 was 22.1 percent with significant difference across the regional states, equivalent to 22.1 million people (Table 4). This poverty rate was far lower than the Sub-Saharan Africa (SSA) average (41.1%) (at 2011 PPP) indicating the substantial change Ethiopia has achieved in poverty reduction. The poverty gap observed in Ethiopia was 6.0 percent, also better than the SSA average (15.8%). However, the spatial (regional) distribution of the poverty rate was relatively higher in Gambella region (41.9%) followed by Amhara (30.9%) and SNNP state (29.9%). Poverty rate in all the other regions and cities were below the national poverty rate (22.1%).

<sup>6</sup> The official national poverty lines in 2015/16 determined by the government of Ethiopia were ETB 7184 for overall poverty and ETB 3772 for food. This poverty threshold was seriously underestimated mainly due to the very low threshold used for 2015 - US\$ 1.25 per day. The international absolute poverty line in 2015, as revised by the World Bank, was USD 1.90 (ETB 40.43 per day). This offers an overall absolute poverty line of ETB 14758 per year (with an exchange rate of ETB 21.28 as of December 2015).

**Table 5: Spatial distribution of poverty in Ethiopia (poverty line =14758)**

<b>Region</b>	<b>Incidence (<math>\alpha=0</math>)</b>	<b>Depth (<math>\alpha=1</math>)</b>	<b>Severity (<math>\alpha=2</math>)</b>
Tigray	0.193	0.056	0.023
Afar	0.054	0.015	0.006
Amhara	0.309	0.085	0.033
Oromia	0.160	0.041	0.017
Somali	0.116	0.027	0.010
Beni-Shangul Gumuz	0.419	0.138	0.063
SNNP	0.299	0.082	0.035
Gambella	0.137	0.026	0.008
Harari	0.128	0.037	0.015
Addis Ababa	0.127	0.032	0.013
Dire Dawa	0.153	0.034	0.012
Population level	0.221	0.060	0.024

Source: Author's computation from LSMS data (2019).

Poverty incidence<sup>7</sup> also significantly varied according to the place of residence, gender of household heads, marital status, and religion (Table 5). The poverty rate ranged from 12.7 percent to 15.5 percent in small, medium and large towns to 24.1 percent in rural areas. The poverty rate in rural areas was 11.4 percent higher than the poverty rate observed in urban areas. The overall absolute poverty gap was 6.0 percent.

The poverty rate was also 12.1 percent higher among female-headed households compared to male counterparts. Similarly, the depth of poverty among female-headed households was nearly threefold higher than the intensity of poverty observed among male-headed households, suggesting that the gender differential is one of the major sources of poverty in Ethiopia.

The three major forms of marital status widely practiced in Ethiopia (single, married, and divorced) were investigated for their implications on the economic wellbeing of people. Single and married persons generally make up the greater proportion of marital status in the population in Ethiopia (47.8% single and 40.6% married). Divorce, although covering only a small proportion of the population (3.5%) was found to potentially create major social problems by

<sup>7</sup> The relative poverty line routinely computed at 60% of the median expenditure per capita is ETB 14884. The relative poverty rate estimated at this threshold is 22.4%, which is not significantly different from the absolute poverty rate (22.1%). The same thing is true for relative food poverty (22.3% at a poverty line of ETB 10980).

pushing people into poverty. The poverty rate for divorced persons was 15.1 percent higher in comparison with the national poverty rate (22.1%) and with the poverty rate observed in other forms of marital status (near or below the national average, 22.5% for married and 19.2% for single).

For reasons currently unidentified by the researcher, the incidence, depth and severity of poverty was substantially different in sub-populations following different religions<sup>8</sup>, the highest poverty rate being among Protestants (27.8%). Poverty was relatively less prevalent, indeed, below the national poverty rate among Orthodox Christians (19.9%) and Muslims (16.3%). These differences might be attributable to the proportion of population following the specific religion and the length of time since its introduction to Ethiopia. Religions with wider coverage and longer establishment in Ethiopia (Islam and Orthodox Christianity) could be better off in their resource endowments and social capital, leading to better welfare conditions for their followers.

**Table 6: Distribution of poverty by population sub-groups**

<b>Population sub-groups</b>	<b>Incidence (<math>\alpha=0</math>)</b>	<b>Depth (<math>\alpha=1</math>)</b>	<b>Severity (<math>\alpha=2</math>)</b>
<b>Place of residence</b>			
Rural	0.241	0.064	0.026
Small town	0.155	0.052	0.022
Medium and large towns	0.127	0.034	0.014
<b>Gender</b>			
Female	0.357	0.129	0.064
Male	0.236	0.066	0.027
<b>Marital status</b>			
Single	0.192	0.049	0.019
Married (monogamy)	0.225	0.061	0.025
Divorced	0.372	0.131	0.062
<b>Religion</b>			
Orthodox	0.199	0.055	0.022
Muslim	0.163	0.048	0.021
Protestant	0.278	0.070	0.029
Population level	0.221	0.060	0.024

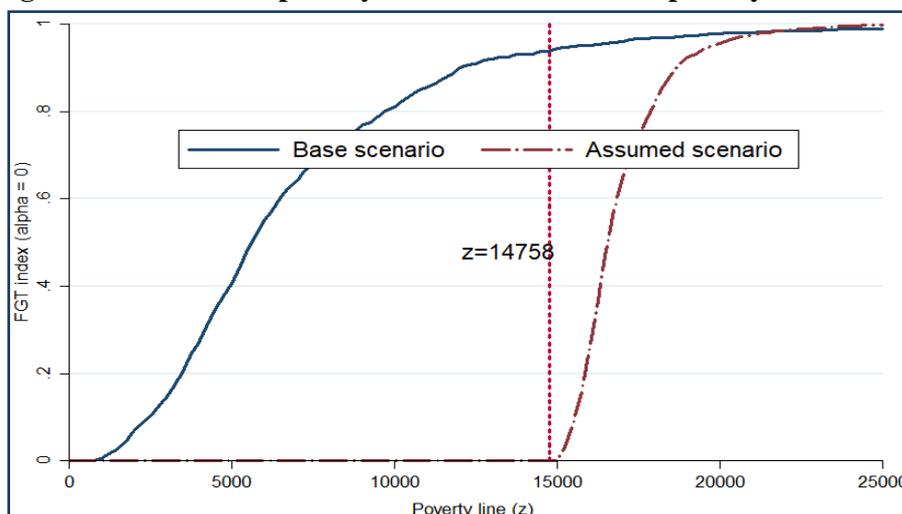
Source: Author's computation from LSMS data (2019).

<sup>8</sup> According to the LSMS (2015/16) dataset, the population figures for religions in Ethiopia were 46.5% (Orthodox), 31.4% (Muslims), 19.7% (Protestant), 1.2% (Catholic), and 1.1% other (including Traditional, Waketeta, Pagans, etc.).

### 3.2.2 Time-taken to exit poverty

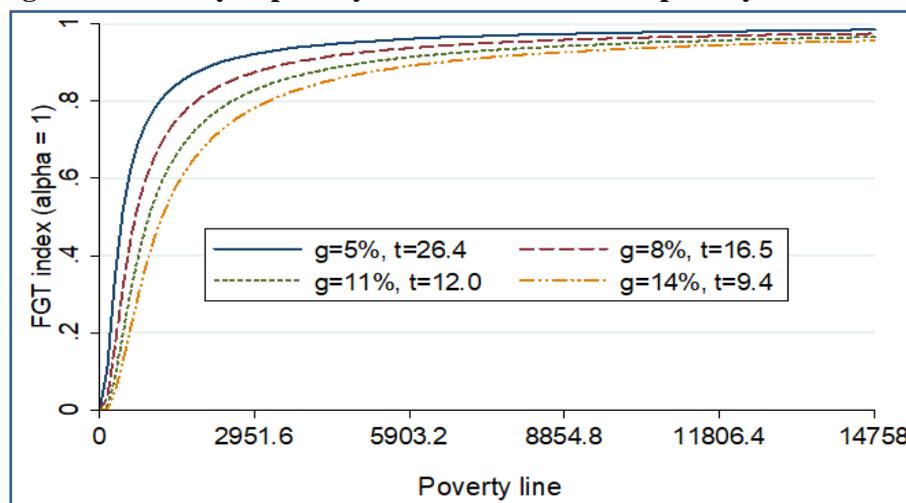
The length of time required, for the average poor person, to exit poverty with different potential expenditure per capita growth rates is important information for designing and implementing poverty reduction strategies. The real consumption expenditure per capita of people in the base scenario (2015) was considered to predict four different growth scenarios (5%, 8%, 11%, and 14%). Depending on the annual growth scenarios assumed, the time taken to exit poverty varies from nine to 26 years (Figure 3). The higher the annual growth rate (g) of expenditure per capita, the shorter time taken (t) to exit poverty.

**Figure 3: Incidence of poverty and time-taken to exit poverty**



The mean annual expenditure per capita of the poor at the given growth scenarios and predicted time-taken to exit poverty converge at ETB 16260 (Figure 4). If Ethiopia is able to achieve an annual growth of real expenditure per capita of eight percent, it will take 26.4 years to attain the first two Sustainable Development Goals (SDG) of the United Nations (UN), ending poverty and hunger, by 2032 (2 years late). If an 11 percent annual growth of expenditure per capita (ETB 519 per year) is attained, the average poor person requires about 12 years to exit the poverty trap by 2027. Lower annual growth rates of expenditure per capita (5% or below) would take the country longer than two and half decades to exit poverty.

**Figure 4: Intensity of poverty and time-taken to exit poverty**



### 3.3 Correlates of Poverty

As reported in Table 6, the Tobit model outputs were consistent with other non-parametric analytical results discussed in this paper. Out of 16 hypothesized correlates of poverty, 14 were identified as statistically significant sources of intensity of poverty and probability of being poor in Ethiopia.

Family size, number of meals served per day, source of safe drinking water, access to off-farm activities, private ownership of telephone lines, access to credit, literacy status, ownership of improved toilet facility, type of house floor, consultation for medical assistance, number of rooms in the house and place of residence were positively correlated with welfare and negatively related to intensity of poverty. Incidence of food shortage and source of light, however, were negatively correlated with welfare, aggravating poverty and depleting income which would have otherwise been allocated for other consumption items.

The overall marginal effect of these covariates on the ratio was 0.787, which is the expected welfare ratio of the poor. On average, poor individuals were expected to be 21.3 percent far below the poverty line<sup>9</sup>. The most important variables largely correlated to intensity of poverty were telephone ownership (5.1%), source of light (-3.7%), type of house floor (3.7%), and incidence of food shortage (-3.1%).

<sup>9</sup> The intensity of the welfare ratio for the poor (22.0%) is consistent with the FGT poverty index (22.1%) estimated above, confirming the explanatory power of the top-coded Tobit model.

The likelihood of people to be poor was 22.0 percent. The most important variables largely reducing the probability of being consumption poor were telephone ownership (by 17.9%), type of household floor (by 12.3%), and family size (by 5.9%). Their likelihood to be poor was largely and positively corrected with sources of lighting (by 13.0%) and incidence of food shortages (by 10.9%).

**Table 7: Correlates of poverty in Ethiopia**

Correlates	Coefficien t	Standard errors	Marginal effects	
			Intensi ty	Probability
Family size (counts)	0.074***	0.002	0.017	-0.059
Number of meals served per day	0.045***	0.008	0.010	-0.036
Source of safe drinking water	0.045 ***	0.008	0.010	-0.036
Access to off-farm activities	0.025*	0.013	0.006	-0.019
Private ownership of telephone lines	0.216***	0.008	0.051	-0.179
Access to credit	0.067***	0.009	0.015	-0.052
Literacy status	0.059***	0.008	0.014	-0.048
Incidence of food shortage	-0.127***	0.009	-0.031	0.109
Source of light	-0.153***	0.008	-0.037	0.130
Ownership of improved toilet facility	0.030***	0.008	0.007	-0.024
Type of house floor	0.176***	0.014	0.037	-0.123
Access to washing water	-0.011	0.018	-0.003	0.009
Consultation for medical assistance	0.018***	0.008	0.004	-0.014
Employment opportunity	0.016	0.064	0.004	-0.013
Number of rooms in the house	0.043***	0.004	0.010	-0.035
Place of residence	0.035***	0.011	0.008	-0.028
Constant	0.405***	0.027	-	-
Marginal effects: $E(y y<1)$ , $Pr(0<y<1)$	-	0.787	0.220	
Pseudo R2	0.2734			
LR chi2(16)	5515.14***			
Observations	19577			
Left-censored observations	0			
Uncensored observations	5194			
Right-censored observations	14383			

Note: \*\*\* and \*, respectively, denote strong (1%) and weak (10%) significance levels. Source: Author's computation from LSMS data (2019).

### 3.4 Decomposition of Poverty

#### 3.4.1 Rural-urban decomposition of poverty

The alleviation of FGT poverty was decomposed by population sub-groups (place of residence) and the results appear below (Table 7). The incidence, depth and severity of poverty in Ethiopia was mainly attributable to place of residence. The absolute effect of rural areas on the incidence of poverty was far higher (19.6% and above) than the other two areas of residence. About 88.5 percent of poverty incidence observed among persons was in rural areas of Ethiopia, and the relative contribution and depth and severity of poverty were very high (87.7% and 87.3%). In order to produce national poverty reduction targets for the country, the decomposition results clearly suggest the urgent need to reduce poverty in rural areas of Ethiopia.

**Table 8: Rural-urban decomposition of poverty**

Place of residence	FGT index	Absolute contribution	Relative contribution
<b>Incidence (<math>\alpha=0</math>)</b>			
Rural	0.241	0.196	0.885
Small towns	0.155	0.008	0.038
Medium and large towns	0.127	0.017	0.076
Country level	0.221	0.221	1.000
<b>Depth (<math>\alpha=1</math>)</b>			
Rural	0.064	0.052	0.877
Small towns	0.052	0.003	0.047
Medium and large towns	0.034	0.005	0.075
Country level	0.060	0.060	1.000
<b>Severity (<math>\alpha=2</math>)</b>			
Rural	0.026	0.021	0.873
Small towns	0.022	0.001	0.049
Medium and large towns	0.014	0.002	0.078
Population level	0.024	0.024	1.000

Source: Author's computation from LSMS data (2019).

#### 3.4.2 Poverty decomposition by expenditure components

FGT poverty indices were also decomposed by expenditure components (food and non-food) using the Shapley value (Table 8). As expected, the absolute contribution of each expenditure component had negative signs. Food

consumption expenditure had the largest absolute effect in reducing the incidence (65.3%), depth (71.3%) and severity (68.8%) of poverty

The relative contribution of food expenditure is also in line with the results of the absolute contribution. About 85.2 percent of the poverty incidence, 76.3 percent of the poverty gap, and 70.6 percent of the severity of poverty in Ethiopia, were attributable to food consumption expenditure.

**Table 9: Decomposition of poverty by expenditure components using the Shapley value**

<b>Expenditure components</b>	<b>Expenditure share</b>	<b>Absolute contribution</b>	<b>Relative contribution</b>
Incidence ( $\alpha=0$ )			
Food consumption	0.785	-0.653	0.852
Non-food consumption	0.215	-0.114	0.148
Total	1.00	-0.767	1.000
FGT index		0.233	
Depth ( $\alpha=1$ )	1.000		
Food consumption	0.785	-0.713	0.763
Non-food consumption	0.215	-0.222	0.237
Total	1.000	-0.936	1.000
FGT index		0.064	
Severity ( $\alpha=2$ )			
Food consumption	0.785	-0.688	0.706
Non-food consumption	0.215	-0.286	0.294
Total	1.000	-0.974	1.000
FGT index		0.026	
Poverty line	14758		

Source: Author's computation from LSMS data (2019).

### **3.5 Inequality Indices**

Most inequality measures do not depend on the mean of the distribution; this property of mean independence is considered to be a desirable feature of an inequality measure. Inequality measures are often calculated for distributions other than expenditure (e.g. income, land, assets, tax payments, and many other continuous and cardinal variables).

The consumption inequality in Ethiopia in 2015 was 34.4 percent with a maximum variation of 10.5 percent among regions (Table 9). Inequality was relatively higher in Amhara (35.3%), Dire Dawa (35%) and Tigray (33.7%).

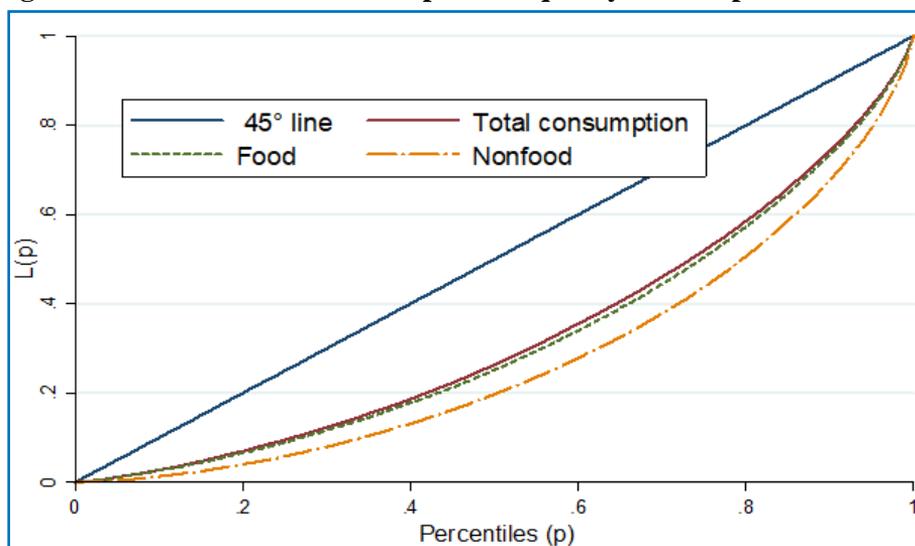
**Table 10: Regional distribution of inequality in Ethiopia**

<b>Regional distribution of inequality</b>	<b>Gini index</b>	<b>Standard errors</b>	<b>Lower bound</b>	<b>Upper bound</b>
Tigray	0.337	0.004	0.328	0.346
Afar	0.248	0.009	0.230	0.267
Amhara	0.353	0.051	0.247	0.458
Oromia	0.325	0.002	0.321	0.330
Somali	0.265	0.018	0.227	0.302
Beni-Shangul Gumuz	0.323	0.028	0.265	0.380
SNNP	0.347	0.036	0.272	0.422
Gambella	0.302	0.024	0.252	0.352
Harari	0.301	0.007	0.287	0.316
Addis Ababa	0.339	0.000	0.339	0.339
Dire Dawa	0.350	0.011	0.327	0.373
Population level	0.344	0.008	0.327	0.361

Source: Author's computation from LSMS data (2019).

The generalized Lorene curve depicted in Figure 5 enables comparison of the extent of inequality for the expenditure components (food, non-food, total). As expected, the inequality among people in relation to food consumption was relatively lower compared to the inequality prevalent in non-food consumption. The result clearly shows that total inequality was mainly attributable to food consumption inequality, whereas the role of non-food consumption expenditure was minimal due to lower share in total expenditure.

**Figure 5: Lorenz curve of consumption inequality in Ethiopia**



Source: Author's computation from LSMS data (2019).

### **3.6 Decomposing Inequality**

#### **3.6.1 Rural-urban decomposition of inequality**

In order to identify the contribution of constituent parts of inequality, the Gini index of total inequality was decomposed by socio-demographic groups or sectors (rural and urban). The decomposition results of total consumption inequality by area of residence (Table 10) was dominated by inequality among rural residents. About 75.4 percent of the national consumption expenditure was spent by 81.3 percent of the population residing in rural areas of the country. The absolute contribution of consumption expenditure to total consumption inequality was 20.3 percent while towns contributed only one percent. About 20.3 percent of the national absolute inequality and 58.9 percent of the relative inequality of real consumption expenditure was attributable to rural areas. The absolute and relative contribution of consumption inequality within rural and urban areas to total inequality was 21.3 percent and 61.8 percent, respectively. However, as expected, the variation in inequality between rural and urban residents to absolute inequality was smaller (6.2%) compared to the relative inequality observed between rural and urban residents (17.9%). The decomposition results clearly show how the sources of inequality determine the poverty reduction interventions needed to be identified and implemented in rural Ethiopia.

**Table 11: Rural-urban decomposition of inequality**

<b>Sector (place of residence)</b>	<b>Gini index</b>	<b>Populatio n share</b>	<b>Expenditur e share</b>	<b>Absolute contribution</b>	<b>Relative contributio n</b>
Rural	0.331	0.813	0.754	0.203	0.589
Small towns	0.316	0.055	0.059	0.001	0.003
Medium and large towns	0.355	0.133	0.188	0.009	0.026
Within	-	-	-	0.213	0.618
Between	-	-	-	0.062	0.179
Overlap	-	-	-	0.070	0.203
Country level	0.344	1.000	1.000	0.344	1.000

Source: Author’s computation from LSMS data (2019).

### 3.6.2 Decomposition of inequality by expenditure components

The Shapley approach of inequality decomposition by expenditure components decomposes inequality indices into the sum of the contributions generated by separate expenditure components (Araar and Duclos, 2013). It estimates the share in total expenditure of each consumption type k, the absolute contribution of each source k to the Gini index, and the relative contribution of each source k to the Gini index.

The share of food consumption expenditure to the Gini index was 78.5 percent and the remaining 21.5 percent was attributable to non-food consumption expenditure (Table 11). Accordingly, its contribution to absolute and relative inequality was higher (26.5% and 77.3%). As expected, the share and the contribution of non-food expenditure was lower (7.8% and 22.7%)

**Table 12: Decomposition of inequality by expenditure components using the Shapley value**

<b>Consumption expenditure</b>	<b>Expenditure share</b>	<b>Absolute contribution</b>	<b>Relative contribution</b>
Food consumption	0.785	0.265	0.773
Non-food consumption	0.215	0.078	0.227
Total	1.000	0.343	1.000
Inequality index	0.343		

Source: Author’s computation from LSMS data (2019).

### **3.6.3 Regression-based decomposition of inequality**

The consumption expenditure per capita was regressed to its components using a linear model. As shown in Table 12, 99.1 percent of the variation in annual real consumption expenditure was explained by the two expenditure components. The consumption shares of food and non-food expenditure were 76.6 percent and 23.6 percent respectively. The absolute and relative contribution of food expenditure to total consumption inequality was threefold (25.7% and 74.6%) compared to that of non-food expenditure (8.6% and 25%). The results suggest that consumption expenditure on food is the major source of inequality in Ethiopia.

**Table 13: Regression-based decomposition of inequality by predicted components (using the Shapley value)**

<b>Predicted components</b>	<b>Expenditure share</b>	<b>Absolute contribution</b>	<b>Relative contribution</b>
Real annual food expenditure	0.766	0.257	0.746
Real annual non-food expenditure	0.236	0.086	0.250
Constant	-0.002	-0.000	0.000
Residual	0.000	0.001	0.003
Total	0.000	0.344	1.000
Estimated inequality	0.344		
Observations	22296		
Adjusted R2 (linear model)	0.991		

Source: Author's computation from LSMS data (2019).

## **4. Concluding Remarks**

Ethiopia has designed some ambitious policies and undertaken several development interventions for alleviating poverty and inequality. These policies have brought substantial improvements in the welfare of the society but offered different implications. There are multiple controversies over poverty estimates mainly arising from inconsistent research findings. These controversies and inconsistent findings have mainly been related to the coverage and reliability of data, the poverty measures used and the methods of poverty estimation.

To work round these limitations and sources of controversy, this paper utilized a country-representative dataset of the LSMS, and generated poverty and inequality estimates using rigorous distributive analysis (with DASP software).

Real expenditure per capita of samples drawn from all over the country were used. Alternative indicators of poverty were estimated to check for the consistency and reliability of the findings. Poverty and inequality estimates were also decomposed into their constituent sources to identify possible options for alleviating poverty and inequality.

The findings indicate that poverty and inequality in Ethiopia were significantly differentiated across population sub-groups, including regional states, gender, and place of residence. These differences among population sub-groups require poverty reduction strategies to be differentiated across regions, contributing to the rural-urban transformation, and securing gender balance across all dimensions of poverty and inequality. Appropriate poverty alleviation policies and equitable allocation and the use of available resources between and among population sub-groups as well as a selection of relevant interventions. need to be the primary foci of policy makers and other stakeholders.

Alternative scenarios of real expenditure per capita growth rates were assumed and the corresponding time taken to exit poverty estimated. Estimates of these alternative scenarios suggest the need to accelerate the growth of disposable income to attain the SDGs of ending poverty and hunger in all its forms by 2030. In order to attain such United Nations' SDGs, Ethiopia should design and implement poverty alleviation policies and interventions enabling it to register eight to 11 percent annual growth rates of real expenditure per capita for its citizens.

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# Identifying, Explaining, and Solving Ethiopia's Development Puzzle: Some exploratory research

Amdissa Teshome<sup>1,2</sup>

## *Abstract*

*Puzzles are often associated with games. Children are given puzzles to solve and those who solve them in the shortest time possible are considered quick thinkers and potential future strategists. When used in a development context, puzzles demonstrate a complex relationship between various development issues and embody both opportunities and challenges.*

*The Ethiopian economy has often been described as a puzzle largely due to the inability to utilize its natural and human potential for the wellbeing of its people. However, problem elements have not been systematically identified, explained or solved. The purpose of this exploratory research is to identify and explain the most important puzzles systematically and seek solutions; demonstrate a methodology for building consensus around strategic issues; and to trigger a dialogue on key areas of the Ethiopian economy. Findings can be expected to inform policy makers.*

*For the purpose of this research, an initial list of 25 development puzzles was identified, based on a review and synthesis of the literature on the Ethiopian economy as well as engagement with different platforms. They were grouped into five blocks representing key sectors of the economy. A 5-point Likert scale questionnaire was distributed to researchers, academics, and development practitioners in government and NGOs. They were also asked to provide solutions. Mean scores and standard deviation were calculated for each puzzle and a pairwise technique was used to compare and identify the ten most important puzzles. Ranking and prioritising of the puzzles was not intended as an end in itself but as a means to generate solutions. A total of 690 solutions were proposed*

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<sup>2</sup> I must thank the Ethiopian Economics Association for giving me the platform to share my research ideas. The questionnaire designed for the research contained complex statements and was very demanding; my special thanks go to my respondents who devoted so much time to reply and share their wealth of knowledge and experience. I would also thank my key informants who shared their knowledge so generously. However, I remain fully responsible for the interpretation and conclusions presented in this paper.

*to solve these prioritised puzzles. The solutions were categorised under seven themes: policy and strategy; implementation capacity and institutions; research; extension; finance; education system; and appropriate technology. A second round of ranking based on the number of solutions generated a different order for the puzzles.*

*While the proposed solutions are based on high levels of knowledge and expertise, they remain 'usual' offerings, just 'more of the same'. The capacity to think 'outside the box' appears limited. Techniques for developing the capacity to think 'outside the box' are therefore proposed.*

*In terms of methodology, research based on expert opinion such as this should incorporate the Delphi Method which involves multiple rounds of consultation with a panel of experts until a consensus is reached. This requires special arrangements with the experts, time and resources.*

**Key words:** development puzzles, exploratory research, pairwise, policies, strategies

## **1. The Concept and Application of 'Development Puzzle'**

A 'puzzle' is a game or a problem that tests a person's ingenuity or knowledge. In a puzzle, the solver is expected to put pieces together in a logical way, in order to arrive at a correct solution.<sup>3</sup>

In Ethiopia, Inqoqlish (roughly equivalent to puzzle) is one of the many traditional games played in groups of 2 or more. Assume two players ('A' and 'B'); 'A' poses the puzzle and 'B' provides a solution. If the solution is correct, 'B' is rewarded. If 1, 'B' is penalized: 'A' demands that 'B' gives her a country. 'A' refuses to accept the country until she gets a bigger and richer country ... and the game goes on with each taking turns to challenge the other. In this simple illustration, the inability to solve the puzzle has a very high price, handing over a country!

While the Ethiopian puzzles are mainly verbal, in the form of question and answer, puzzles come in different modes in the modern world<sup>4</sup> often involving words, pictures, numbers or physical activity. Children are given

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<sup>3</sup> See <https://en.wikipedia.org/wiki/Puzzle> (accessed 21.8.19)

<sup>4</sup> Puzzles have a long history. The first wave of puzzles began emerging in the 18<sup>th</sup> century more or less coinciding with the industrial revolution. In the absence of little entertainment opportunities, labourers took to puzzles.

puzzles to solve and those who solve them in the shortest time are considered quick thinkers and potential future strategists. Examples of puzzles include jigsaw puzzles, in which the player pieces together shapes to make a picture of an animal, a landscape, a country; or the contestant enters a maze and works out a complex path to find the exit. In many puzzles, time is considered important; the quickest to solve crossword or mathematical puzzles is the winner.<sup>5</sup>

When used in the development context, the concept of ‘puzzle’ demonstrates the complex relationship between various development issues and embodies both opportunities and challenges. According to North (1997), they [puzzles] “go to the heart of the nature of economic change”.

The Ethiopian economy has indeed been described as a puzzle, a paradox, a dilemma by researchers, practitioners, and politicians alike.<sup>6</sup> For example, in 2009, the International Food Policy Research Institute (IFPRI) organized a workshop on Ethiopian agriculture where researchers described an increase in cereal production, considerably higher than Green Revolution yields, as “puzzling” since it occurred at a time when the sector exhibited none of the features of the Green Revolution, whether increased use of modern inputs (fertilizer and seeds) or an expanded irrigation system. Since then, more research has been done, indicating that rising crop yields have been the primary driver of increased agricultural GDP followed by land area expansion (Schmidt and Thomas, 2019:17). While this is encouraging, it is far from clear whether this indicates the puzzle has been resolved.

In his blog,<sup>7</sup> Samuel G/Selassie (2007) described a price hike in Ethiopia as a “puzzle” because it happened at a time when the country had a bumper harvest. The price hike led the government to take frantic actions to keep food prices low including reversing some measures, for example cash-based safety

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<sup>5</sup> In many parts of the world, there are puzzles for seasons (summer, winter, spring and autumn) as well as puzzles for events (New Year’s Day, religious holidays, Mother/Father Day). <https://www.activityvillage.co.uk/puzzles> (accessed 20.8.19)

<sup>6</sup> The inability to tap into natural and human resource endowments is often cited as the rationale for puzzles (Pingali, et. al 2019). However, Ethiopia is puzzling on a number of other fronts including but not limited to history, institutions, culture, politics, education, language and literature. The puzzles identified in this paper capture all of these aspects except perhaps language and literature. <sup>7</sup> See [users.ox.ac.uk/econstd/Ethiopia%20paper%203\\_v5.pdf](https://users.ox.ac.uk/econstd/Ethiopia%20paper%203_v5.pdf)

<sup>7</sup> The blog was written in 2007 but posted in 2010 <https://www.future-agricultures.org/blog/can-ethiopia-realise-a-better-agriculture-in-its-third-millennium-the-role-and-dilemma-of-farm-prices/>.

nets, introduced to stimulate the market. Rashid and Lemma (2014) also found the continued large scale commercial importation of wheat under conditions of foreign exchange rationing and low profitability as puzzling.

From a political point of view, Ethiopia had numerous opportunities to democratize since the 1960s but failed to do so. Levine (2007) considered this "An Ethiopian Dilemma" and hoped that his work might help Ethiopians get a better grip on their country's problems in the same way the book by Swedish sociologist Gunnar Myrdal, "An American Dilemma", played a signal role in helping Americans resolve their longstanding conflict of values regarding racial discrimination.<sup>8</sup>

## **2. Motivation and Objectives**

The motive of this research is to explore policies and strategies from a different and more provocative angle using the 'puzzle lens'. The specific objectives of the research are to:

- Demonstrate a methodology for identifying and reaching consensus on Ethiopia's development puzzles
- Provide indicative solutions to the identified puzzles
- Determine the adequacy of the solutions
- Trigger dialogue on policy and strategic issues among researchers, academic, and development practitioners<sup>9</sup>

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<sup>8</sup> The concept of puzzle has also been applied to larger sectors and geopolitical areas. For instance, North (1977) found it puzzling that despite being among the first human activities more than ten thousand years ago, the rate of change in agriculture has been slowest compared to other sectors. As a matter of fact, agriculture has stagnated in sub-Saharan Africa. Beegle, et. al. (2016) find it puzzling that in sub-Saharan Africa poverty responds to income growth and income distribution much less than anywhere else in the developing world. More recently, researchers are finding that Africa is not following the tried and tested Arthur Lewis 'transformation model' – adding to the list of puzzles. I will return to this later in this paper.

<sup>9</sup> The puzzles identified in this paper have already generated intense discussion among academics, researchers and development practitioners. Some lecturers have shown willingness to use them as essay topics for their students.

### **3. Typology of Research and Methodology**

#### **3.1 Typology of Research**

There are many ways of classifying academic research. For example, basic research (also known as pure research or fundamental research) has the aim to improve scientific theories for improved understanding or prediction of natural or other phenomena. Applied research is a methodology used to solve specific practical problems of society. Depending on the type of data predominantly used, research may be classified as quantitative or qualitative.<sup>10</sup>

Phillip and Pugh (1987) classify research into three broad categories:

- *Experimental research*: a set of variables are kept constant while other sets of variables are measured as the subject of experiment.
- *Hypothesis testing*: using statistics to determine the probability that a specific hypothesis is true or false.
- *Exploratory research*: to investigate a problem that has not yet been clearly defined. It is carried out to look for a better understanding of existing problems and provide indicative but not necessarily conclusive results.<sup>11</sup> These indicative results can then form the basis for formulating specific research questions or hypotheses to conduct in-depth research.

The current research is exploratory in that it attempts to identify, explain and seek solutions to Ethiopia's 'development puzzles', a phrase for which there is no standard definition.

#### **3.2 Defining the Research Domain**

The Ethiopian economy encompasses several sectors and subsectors. It is therefore important to define the focus of the research. To this end, the economy was divided into 5 blocks, each block covering more than one sector (see Table 1). An initial list of 25 development puzzles (see Annex for the full list) was constructed from three major sources. The first is the author's life-time

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<sup>10</sup> See <https://keydifferences.com/difference-between-basic-and-applied-research.html> (accessed 26.8.19)

<sup>11</sup> See for example Bhat, A. Exploratory Research: Definition, methods, types and examples, Global VP - Sales and Marketing at QuestionPro, <https://www.questionpro.com/blog/exploratory-research/> (accessed 21.1.19).

experience of working in development, agricultural development in particular; second, an extensive review of literature on the Ethiopian economy; and finally, participation in and facilitation of food and nutrition security platforms, task forces, gender networks and conferences in which many of these puzzles have been discussed explicitly or implicitly.

It is no accident that 60% of the puzzles are in Blocks 1 and 5 (shown in bold). In part, this reflects the professional background of the author but the puzzles itemized here are also the most discussed in many of the platforms that he is associated with.

**Table 1: Number of identified puzzles by economic sectors/blocks**

<b>Blocks</b>	<b>No. of puzzles</b>	<b>% of total</b>
Block 1: Agriculture, Livestock and Pastoralism	9	36
Block 2: DRR and Climate Resilience	3	12
Block 3: Industry and Infrastructure	3	12
Block 4: Business and Commerce	4	16
Block 5: Institutions, Capacity and Gender	6	24
Total	25	100

### **3.3 Profile of Respondents and Data Collection Tools**

The platforms, task forces, networks and conferences are multi-sectoral and include multi-agency experts advising the government and development partners on policy and strategy issues as well as designing, implementing, monitoring and evaluating programs and projects. Therefore, they formed an ideal sampling frame for this research. A total of 210 respondents were selected randomly from a list of 1300, male and female, using a statistical table<sup>12</sup> that suggested the sample size was sufficient to explain findings associated with this sample frame. The frame was stratified by different groups (e.g. Productive Safety Net Program group, a nutrition group, gender group, etc.) to give diverse experts the chance to be represented.

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<sup>12</sup> see <https://www.research-advisors.com/tools/SampleSize.htm>

A five-point Likert scale questionnaire was designed (see Figure 1) and distributed mainly by email.<sup>13</sup> Where emails bounced or respondents were unavailable, replacements were made from the frame. The current findings are based on a 35% response rate, representing some 75 respondents. In addition, about 40 key informants were interviewed to deepen understanding of the issues. Figure 2 shows the profile of the experts involved, the majority male; the balance of representation of experts based in Addis Ababa and in the regional states is satisfactory. Experts with a social science background and those employed in academic institutions, as might be expected, feature strongly.

A combination of basic descriptive statistics (mean and standard deviation) and text analysis have been used to summarize the data for each puzzle. Pairwise technique<sup>14</sup> was used to compare and identify the top ten puzzles. The prioritized puzzles are matched to their proposed solutions which were analyzed and grouped into seven categories/themes:

- Policy/strategy related solutions
- Implementation capacity and institutional related solutions
- Research related solutions
- Extension related solutions
- Finance related solutions
- Education system related solutions
- Appropriate technology for farming/livestock production related solutions

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<sup>13</sup> Prior to the distribution of the questionnaire, experts in the sample frame were introduced to the research through requests for expression of interest and cooperation. The questionnaire was then sent to email addresses of those who expressed interest.

<sup>14</sup> In a comparison of 'pairwise ranking' and 'individual score ranking', the former is found to be superior because when collecting pairwise comparisons from one or more people, there would be no ambiguity in the overall ranking of objects from largest to smallest (ranked in accordance with the outcomes of the pairwise comparisons). By contrast, when asking people to score individual objects on a scale of say 1-100, the ordered list generated according to the scores often does not agree with the correct ranking. This happens because people may forget that they gave a score of 10 to item 'A' by the time they are asked to score another larger/smaller object (e.g. Z) and mistakenly give the new object a smaller/larger score (Stewart et. al, 2005) cited in NEXT team (2015).

**Figure 1: Sample questionnaire and sample response**

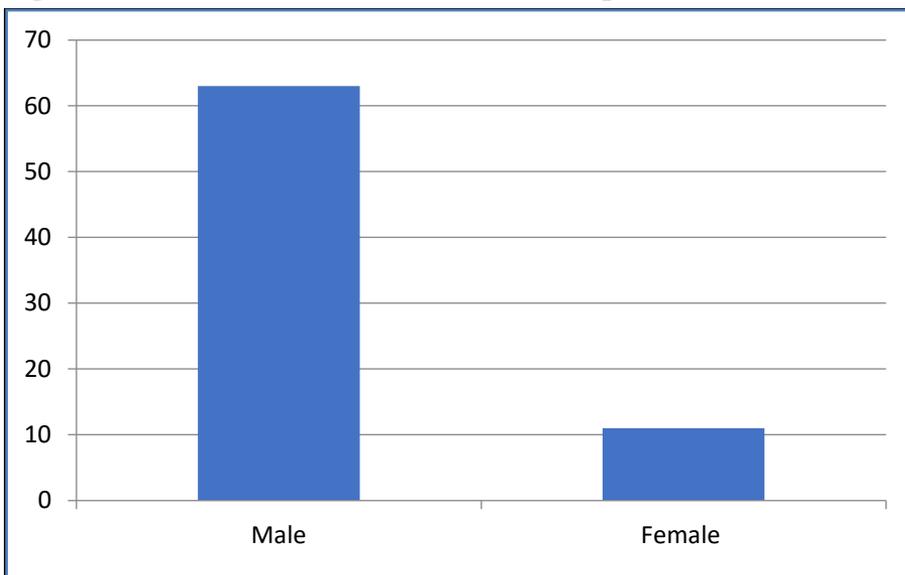
<b>BLOCK 1: AGRICULTURE, LIVESTOCK AND PASRTORALISM</b>	<b>SA</b>	<b>A</b>	<b>N</b>	<b>D</b>	<b>SD</b>
P2: The crop and livestock sectors are the major contributors to employment, GDP and export earnings. However, they receive the lowest capital investment. Agricultural machinery spare parts; irrigation and drainage equipment; and animal feed are either heavily taxed or not seen favourably by finance institutions.		X			

If you strongly agree or agree, please suggest HOW to solve this puzzle: I would like to organize Community Supported Agriculture (CSA): many people in urban areas are interested to have HIGH QUALITY FOOD – and we have a problem of knowing where our food is coming from, with which inputs used, and farmers don't have the initial capital to make appropriate investment to supply this. With the CSA mode, a group of consumers pay a farmer (or a group of farmers) at the beginning of the year so that the farmers have money up front for investment, and in return the buyers have a share of the good food. LETS START THIS!!! It solves the capital problem locally.

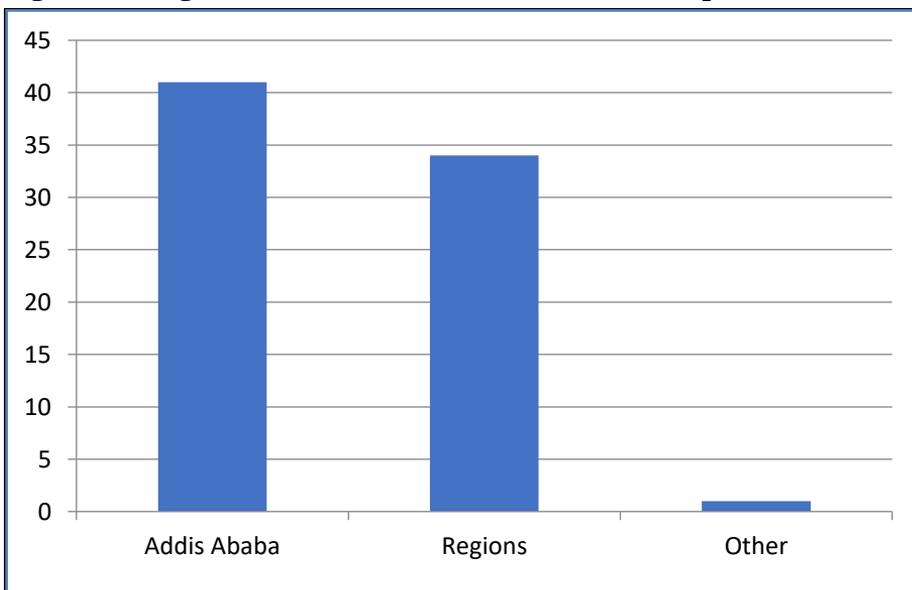
<b>BLOCK 2: DISASTER RISK REDUCTION &amp; CLIMATE RESILIENCE</b>	<b>SA</b>	<b>A</b>	<b>N</b>	<b>D</b>	<b>SD</b>
P10: Substantial investments have been made in drought prone areas and yet the returns in terms of environmental rehabilitation, ensuring food security and building resilience remain low. High potential areas are known for quick wins but there has not been sufficient investment in these areas which may have increased their vulnerability. Getting the right balances has become a puzzle.			X		
If you strongly agree or agree, please suggest HOW to solve this puzzle:					

**Figure 2: Profile of experts**

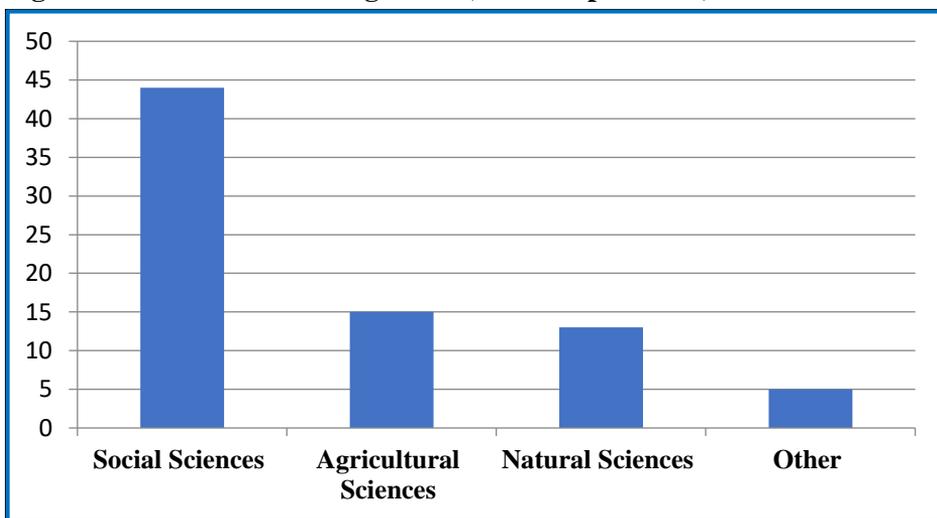
**Figure 2a: Female/Male distribution (No. of respondents)**



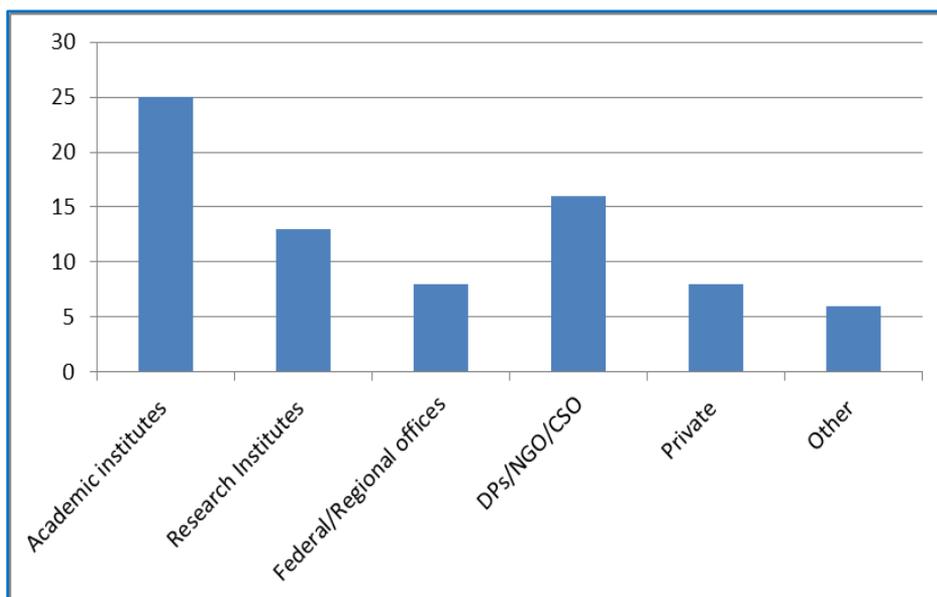
**Figure 2b: Region/Addis Ababa distribution (No. of respondents)**



**Figure 2c: Professional background (No of respondents)**



**Figure 2d: Organisational affiliation (No. of respondents)**



## 4. Findings

### 4.1 Top Ten Puzzles

The identified puzzles, shown in Figure 3, are listed both vertically and horizontally to facilitate comparison of one with another, using the mean score and standard deviation (SD). The mean score is the primary indicator for comparison. The SD comes into play only when two puzzles have the same mean score (e.g. P3 vs. P4) in which case the puzzle with the lowest SD is prioritized. The list of top ten puzzles together with the number of proposed solutions is given in Table 2.

Figure 3: Pairwise ranking

	Mean	STD	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	Count	Rank	
P1	12.8	3.3																										23	2	
P2	16	11.0																											24	1
P3	10.7	9.7																											15	10
P4	10.7	6.3																											16	9
P5	12.8	5.4																											22	3
P6	12.6	9.1																											19	6
P7	12.6	4.1																											21	4
P8	10.5	11.5																											14	11
P9	12.6	7.8																											20	5
P10	6.8	5.4																											3	22
P11	6.8	5.2																											4	21
P12	6.8	4.6																											6	19
P13	6.5	7.6																											0	25
P14	7.8	5.8																											10	15
P15	7.8	6.1																											9	16
P16	6.5	6.5																											1	24
P17	7.6	4.98																											5	20
P18	6.5	5.13																											2	23
P19	9.8	8.42																											13	12
P20	11.8	7.68																											18	7
P21	11.8	10.4																											17	8
P22	7.8	6.43																											8	17
P23	7.8	6.59																											7	18
P24	8	5.51																											11	14
P25	9.6	5.94																											12	13

**Table 2: Top ten puzzles**

<b>Code</b>	<b>Rank based overall score</b>	<b>Puzzle description</b>	<b># of proposed solutions</b>	<b>Rank based on # of proposed solutions (proxy for policy makers' choice)</b>
B1P2	1	The crop and livestock sectors are the major contributors to employment, GDP and export earnings. However, they receive the lowest capital investment. Agricultural machinery spare parts; irrigation and drainage equipment; and animal feed are either heavily taxed or not seen favourably by finance institutions.	37	10
B1P1	2	Generations of students have been taught that agriculture is the mainstay of the Ethiopian economy and that the country has the largest livestock population in Africa. And yet, we heavily rely on food aid and commercial import to meet our food needs. Per capita milk and meat consumption are the lowest even by Sub-Saharan Africa standards.	108	1
B1P5	3	Ethiopia's crop, fruit and vegetable diversity is among the highest in the world. This is a clear advantage in a world where three crops (wheat, rice, and maize) account for 60% of the world's food supply. Biodiversity is also a source of traditional medicine from which countries like China and Germany earn billions of dollars per annum. It is puzzling therefore to see Ethiopia's food and nutrition security does not reflect this diversity and traditional medicine gets little or no research support.	90	4

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<b>Code</b>	<b>Rank based overall score</b>	<b>Puzzle description</b>	<b># of proposed solutions</b>	<b>Rank based on # of proposed solutions (proxy for policy makers' choice)</b>
B1P7	4	Ethiopia is described as the “water tower” of East Africa but it has remarkably little irrigated agriculture. Besides, it is often said that the amount of rain the country gets, even in the driest of times, is much higher than the amount Israel gets in the wettest of times. Water harvesting schemes are given due emphasis in the Agriculture GTP but the practice on the ground does not match the intentions.	93	2
B1P9	5	Ethiopia is noted as a primary animal vaccine producer in Eastern Africa. However, its veterinary services are among the poorest and as a result, livestock diseases are rampant in both highland and lowland areas.	38	9
B1P6	6	Export products get more policy support (e.g. credit, tax, foreign exchange) than food crops and domestic markets. The cost of policy support to the export sector is either not calculated or too high. This is puzzling since food crops and domestic markets are key instruments of food security.	47	8
B5P20	7	Since the 1970s, participatory development has been the norm in many developing countries. Higher learning institutions are instrumental in promoting this approach. It is therefore puzzling that it has not received adequate attention in Ethiopia and as a result a top down approach continues to dominate economic policy making.	43	7

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Code	Rank based overall score	Puzzle description	# of proposed solutions	Rank based on # of proposed solutions (proxy for policy makers' choice)
B5P21	8	For the last 25 years, the civil service has been subjected to rigorous evaluation and testing ground for a number of management tools. And yet, it is puzzling to see that the civil service lacks motivation and innovativeness and operates in an environment of shifting priorities. Government and development partners invest in capacity building, but the work environment often does not allow application of the simplest tools and techniques learned.	65	6
B1P4	9	For the last 40 years, the land debate has not advanced. Considerable time and energy is spent on ownership issues. A great deal could be done on improving land use practices to increase productivity (e.g. zero grazing, conservation tillage (minimum/zero tillage), agro-forestry, etc.)	79	5
B1P3	10	In more than fifty years the research system has released several technologies; the public extension system has expanded into one of the largest in the world. Yet, researchers, extension officers and politicians have continued to speak of weak agricultural research-extension linkages.	91	3
<b>Total</b>			<b>691</b>	<b>-</b>

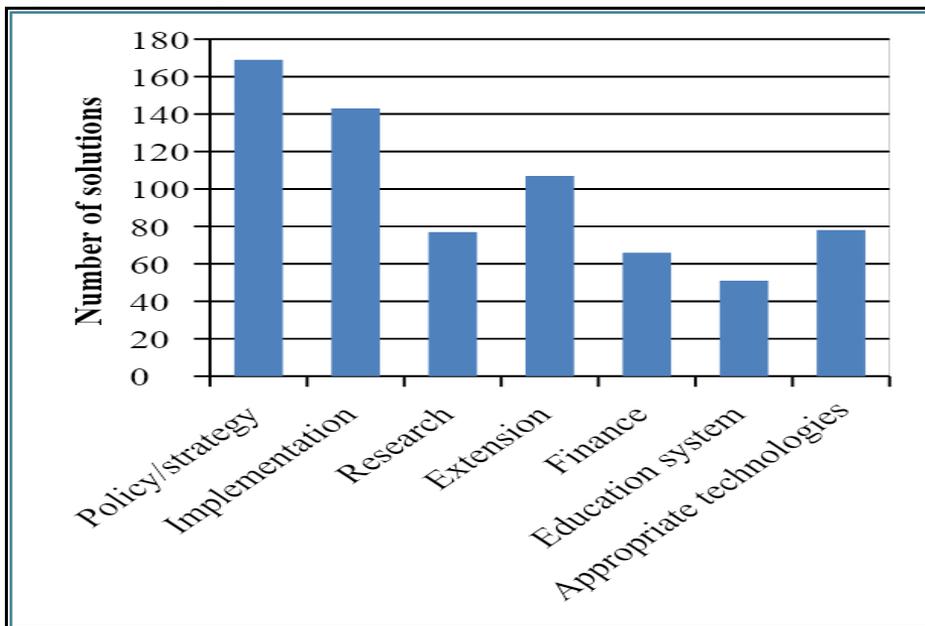
## 4.2 Solutions to the Puzzles

Puzzles must be solved. Ranking and prioritizing of the puzzles is not an end; it is a means for proposing solutions to the puzzles. As can be seen from Table 2, 690 solutions are proposed for the top ten puzzles - an average of 69 per puzzle. This is an indication of the vast knowledge and experience experts possess in the respective fields. These solutions are categorized into seven themes or focus areas where improvements are needed. During the text analysis, it was found that a single statement can respond to more than one theme (e.g. policy and finance).

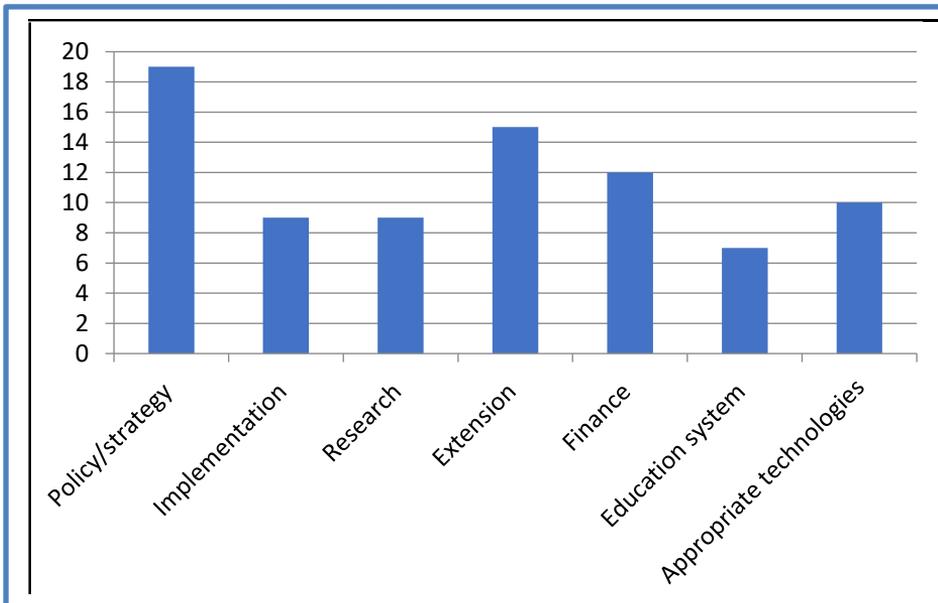
Figure 4a summarizes the responses by all experts (female and male) and Figure 4b by female experts alone. In both cases, improving policies and strategies are seen as critical to solving the puzzles but the response of female experts focused significantly more on improvements in extension, the need for finance and appropriate technology.

**Figure 4: The most important areas where improvements are needed**

**Figure 4a: All experts**



**Figure 4b: Female experts only**



## 5. Discussion and Policy Implications

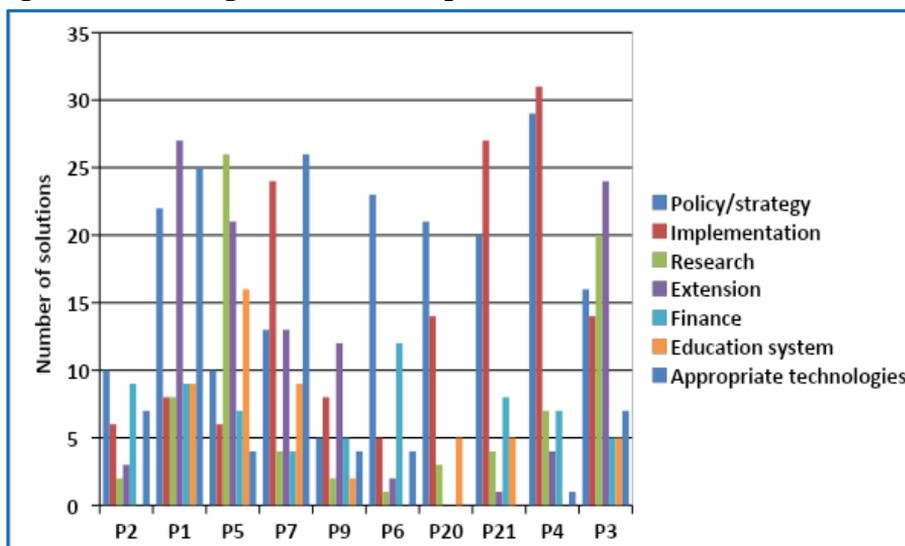
Two aspects of these findings need discussion. First, which puzzles will attract the attention of policy makers? Second, how adequate or ground-breaking are the suggested solutions?

### 5.1 Which Puzzles are More Likely to Attract the Attention of Policy Makers?

Figure 5 matches the solutions to the puzzles. Puzzle 2 (ranked 1) has the least number of solutions compared to the other puzzles; it dropped to No. 10 when ranked by the 'number of solutions' – proxy indicator for policy choice. Puzzle 1 (ranked 2) received the most solutions and jumped to No. 1 when ranked by this indicator. Similar changes occurred in the ranking of other puzzles. A better indicator of policy choice is "quality of solutions" than "quantity of solutions". The former requires an in-depth analysis of each solution against quality criteria such as SMART (Simple, Measurable, Achievable, Realistic, and Time-bound). This is important to policy makers as they are more likely to be interested in puzzles that have concrete solutions. However, this level of in-depth analysis

requires an iterative process that should be built into the research design and agreement reached with the panel of experts a priori. This, indeed, is one of the important findings of this exploratory research.

**Figure 5: Matching solutions to the puzzles (see Table 2 for definition of codes)**



Source: Based on survey data

## 5.2 How Adequate or Ground-breaking are the Solutions?

While the proposed solutions are based on high level knowledge and extensive experience, they are very ‘usual’, and must essentially be described as ‘more of the same’. The capacity to think ‘outside the box\*’ appears limited. How can experts think outside the box? There is no definitive formula or prescribed training for thinking ‘outside the box’ but the concept generally entails challenging “received wisdom” and “leaving the comfort zone or familiar territory”. Thinking ‘outside the box’ is not without risks. Challenging the status quo can lead to alienation, marginalization or delays in getting ideas implemented.

\* Having said this, there is no shortage of advice. There are numerous online messages in a form of, for instance, “10 ways” or “5 steps”, to think outside the box” (see for example <https://www.lifehack.org>; <https://www.wikihow.com>; [www.workberryafrica.com](http://www.workberryafrica.com); and <https://blog.kevineikenberry.com>)

The following three examples are generated from the responses.

### **Example 1: Rural Transformation Usual Solution**

A number of solutions have alluded to the need for rural transformation following the classic Arthur Lewis model (agriculture → industry). Arthur Lewis (1954), as cited in Hosseini, (2012), introduced a theoretical model of economic development premised on the twin assumptions that there was an unlimited supply of labor in the traditional agricultural sector of the less developed countries and that, as the modern industrial urban sector in these countries grew, this vast pool of surplus labor would be absorbed. A number of contemporary economists have used this theory as a basis to define rural transformation as a two-stage process.

- **Stage 1:** within a process of agriculture transformation in which increased labour (and land productivity) leads to surplus production sufficient enough to feed both the urban and rural population. During this stage, the demand for agricultural labour reduces; labour becomes less productive.
- **Stage 2:** the excess labour moves to the growing urban industrial centres that demands labour for various functions.

The key element for economic transformation is therefore when labour moves from the low productive sector (agriculture) to the high productive sector (industry).

### **Outside the box solution**

There is now overwhelming evidence that the 18th and 19th century rural transformation model is unlikely to happen in Ethiopia or the rest of Sub-Saharan Africa (Engel, et. al., 2017; McMillan, et.al. 2017; Rauch, et. al. 2016; Losch, et.al. 2012). Some would go as far as suggesting that the East Asian Economic Miracle, which was a manufacturing miracle, cannot be expected to play the same role for Africa; not, at least, to the same extent.

Globalization has opened our domestic markets to industrial/manufacturing products from China, India and other Asian countries and killed off our cottage industries. Our industry/manufacturing sector is unable to generate enough jobs to absorb the new job seekers. Policies and institutions put in place to control population growth have been ineffective. The emerging 'population dividend' has a long way to go before providing a pay-off.

Agriculture, therefore, will and should continue to be the source of employment for the foreseeable future. The current rural-urban migration is a

‘premature exodus’ since agriculture is not sufficiently mechanised to off-load excess labour. Migration is justified only if the labour remaining in agriculture could produce surplus food to: feed itself; feed the urban population; create a sufficient food reserve for emergency; and, if possible, export or support countries short of food.

Furthermore, land is frequently taken away from agriculture for urbanization and manufacturing. The productivity of the remaining land under agriculture should be doubled to produce enough food for the purposes listed above.

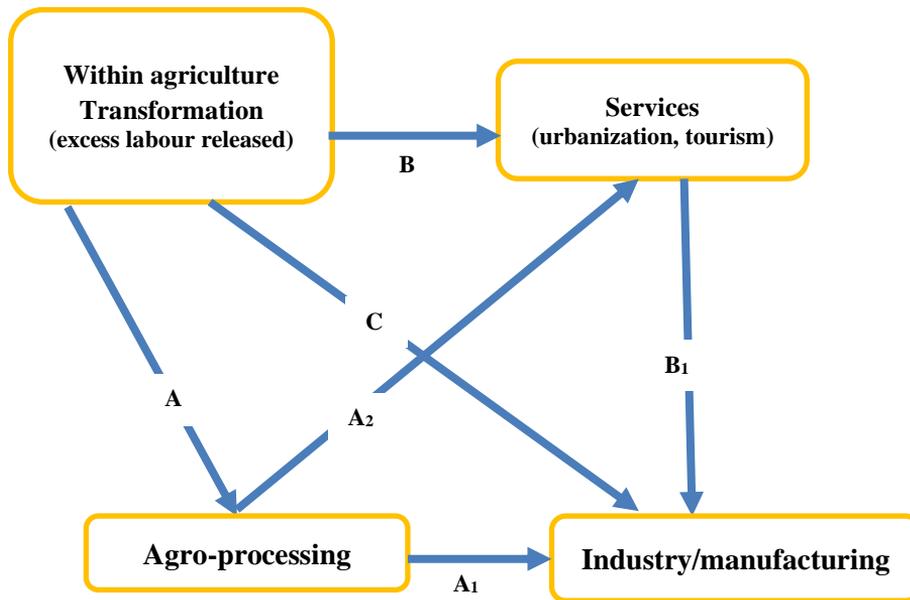
Once these conditions are fulfilled, excess labour has multiple routes to move out of agriculture (see Figure 6). The most immediate destination for excess labor should be nearby agro-industries (**Route A**); then to the service sector (urbanization/tourism/ICT) and/or industry manufacturing. **Route B** is from agriculture directly to the service sector (urbanization/tourism/ICT) and then to industry/manufacturing. These routes take into account the fact that agriculture labor starts from a low base in terms of skills needed for the modern economy. Moving from one sector to another gives the required experience and skills along the way. The third and presently less likely option (**Route C**) is from agriculture directly to industry manufacturing. ♦

**Risk:** Tensions between the ‘new thinking’ and the ‘hardliners/believers in the old model’.

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♦ In view of the barrier to enter the traditional industry and manufacturing sector, excess labour from agriculture could move to what are collectively referred to as “Industries Without Smokestacks” - a class of tradable services in agro-industry that are more similar to manufacturing than to traditional smallholder services in agriculture (e.g. horticultural enterprises, cut flowers, green beans), dealing in a global value chain with phytosanitary standards and highly demanding customers. The interesting thing about these “Industries Without Smokestacks” is that they share many characteristics with manufacturing and are therefore amenable to technological change and productivity growth (see <https://sdgacademy.org/course/industrial-policy-in-the-21st-century-the-challenge-for-africa/>).

**Figure 6: Multiple routes to rural transformation**



**Example 2: Research and extension linkage**

**Usual solution:**

The weak linkage between research and extension has been one of the talking points of the last 50 years and repeatedly reiterated in most recent publications (e.g. Berhane, et. al. 2019; Dawit Alemu, et.al. 2016). One of the most commonly proposed solutions is strengthening research and extension linkages through, for example, farmer–research-extension groups (FREG). Unfortunately, this mechanism has hardly gone beyond piloting projects. As Dawit et.al. (2016) observed it has long been recognized that agricultural research should involve the farmers. However, institutionalizing any such collaborative approach within government research institutions and extension services has lagged behind need.

**Solutions outside the box:**

Researchers and extension workers are not meant to be linked, they are meant to cooperate closely, to be together, working side-by-side, brainstorming, producing joint planning, implementing, monitoring and evaluating in concert.

Presently, research remains in an ‘ivory tower’\* while extension services wait for technologies to be disseminated. One way to strengthen the linkage is for the extension services to be more proactive and demand technologies from research without waiting for dissemination workshops.

**Risk:** There is a risk in shaking up the status-quo. If a system or structure is in an ivory tower, it is difficult to adapt to realities on the ground.

### **Example 3: The role of culture in institutional development**

#### **Usual solution:**

It is puzzling that despite being subjected to numerous management tools and techniques over the last 30 years, the Civil Service remains unstable and ineffective. It is not uncommon to hear at conferences and workshops and repeated in this survey that new techniques should take into account the culture and norms of Ethiopian society.

#### **Solution outside the box:**

An expert thinking outside the box would argue that these cultures and norms are the root causes of many of our problems (e.g. work ethics, spending cultures, feeding habits). It is received wisdom that Ethiopian labourers work hard and long hours in harsh conditions but our weak work ethic has been exposed as we move into manufacturing. Working hard is one thing; working smart/effectively is quite another. Similarly, little effort is made to improve our “spending culture”. Simple observations of television adverts during holidays

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\* Defined as “a state of privileged seclusion or separation from the facts and practicalities of the real world”

(<https://www.google.com/search?=what+is+the+meaning+of+ivory+tower/>). The present situation with extension and research more or less fits this description - there is a world of difference between the work environment of an extension office and a research office at all levels of administration.

• See for instance Meskerem Legesse and Andfetiya Ahmed (2019)

^ An article in Addis Fortune (December 2018) observed that organisational ethics has been an essential facet in the workplace in developed nations over the past decades. Ethiopia can learn from these countries where the level of professionalism and respect for work is high. Employees must constantly prove they are relevant to their employers to avoid replacement, continuously striving to keep supervisors satisfied (<https://addisfortune.net/columns/a-lesson-in-work-ethics-from-the-uk/>)

show that remittance beneficiaries are encouraged to spend their money on consumables and celebrations instead of promoting small businesses.

Our feeding habits are largely responsible for the prevailing high rate of stunting in the country. While the majority of families lack access to nutritious food, children in well-to-do families are not fed properly due to various cultural beliefs and norms. ‘Out of the box’ thinking suggests it is time for real and serious ‘cultural reform’ if policies and strategies are to be effective.

Risk: There is high risk that traditionalists will resist.

## **6. Conclusions and Recommendations**

This exploratory research has demonstrated a simple and systematic way of identifying, explaining, and proposing solutions to Ethiopia’s development puzzles. We have shown there is a wealth of knowledge and experience among the development experts and advisors who participated in this research. They are not short of solutions to the puzzles. However, their solutions are largely ‘more of the same’; the capacity to think ‘outside the box’ appeared limited. The box has become the comfort zone. This is a major concern.

Policy makers expect experts to generate smart solutions not just usual solutions. So, how do we develop the capacity to think outside the box? Experts on ‘thinking outside the box’ advise us to read widely outside our specialization. Solutions to our development puzzles may be found elsewhere; continue asking why, what, which, when until we get out of the box; experiment/pilot new ideas; do not dismiss them; and challenge received wisdom.♥

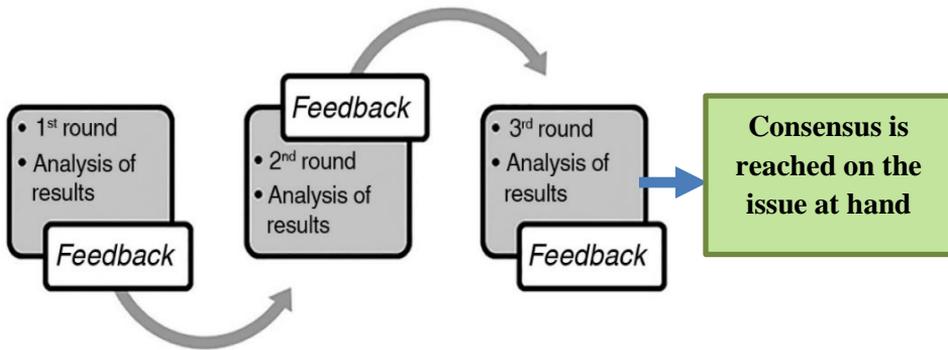
There are certainly risks associated with thinking ‘outside the box’ but these are worth taking if received wisdom is to be challenged, and it is certainly the only way to get untangled from the web of puzzles that are dragging the country backwards. Institutions must nurture an environment that encourages thinking ‘outside the box’ Two final recommendations for future research: First, in terms of methodology, research based on expert opinion such as this, should incorporate the Delphi Method, requiring continued involvement with the experts until a consensus is reached (see Figure 7). This requires particular arrangements with the experts and continued availability of resources. Secondly, “quantity of solutions” was used as a proxy indicator for policy choice. However, future

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♥ For example, see <https://www.youtube.com/watch?v=bEusrD8g-dM>

research should rather use “quality of solutions” which requires an in-depth analysis of each solution against quality criteria such as SMART (Simple, Measurable, Achievable, Realistic, and Time-bound). This is important for policy makers as they are always more interested in puzzles that have concrete solutions. It needs to be built into the research design and a priori agreement reached with any panel of experts.

**Figure 7: A simplified feedback chain in the Delphi Method**



Source: A Review by Alexander Twin in <https://expertprogrammanagement.com/2011/03/the-delphi-technique/> (accessed 25.8.19). Slightly modified to indicate the process should end with consensus.

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## **Annex: List of Ethiopia's Development Puzzles**

Each of the development puzzles listed here is a research topic in its own right. During data collection, some lecturers indicated that they were considering giving the list to their students for essay topics. The author would encourage researchers and students to explore each puzzle or group of puzzles further as topics for debate and as essay topics in schools, colleges and universities.

### **BLOCK 1: AGRICULTURE, LIVESTOCK AND PASRTORALISM**

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- P1 Generations of students have been told that agriculture is the mainstay of the Ethiopian economy and that the country has the largest livestock population in Africa. And yet, the country heavily relies on food aid and commercial imports to meet its food needs. Per capita milk and meat consumption are the lowest even by Sub-Saharan Africa standards.
- 
- P2 The crop and livestock sectors are the major contributors to employment, GDP and export earnings. However, they receive the lowest capital investment. Agricultural machinery spare parts; irrigation and drainage equipment; and animal feed are either heavily taxed or not seen favourably by finance institutions.
- 
- P3 For more than fifty years the research system has been releasing technologies; the public extension system has expanded into one of the largest in the world. Despite this, researchers, extension officers and politician continue to speak of weak agricultural research-extension linkage.
- 
- P4 For the last 40 years, the land debate has not advanced. Considerable time and energy is spent on ownership issues whereas a great deal could be done on improving land use practices that can increase productivity (e.g. zero grazing, conservation tillage (minimum/zero tillage), agro-forestry, etc.)
- 
- P5 Ethiopia's crop, fruits and vegetables diversity is among the highest in the world. This is a clear advantage in a world where three crops (wheat, rice, and maize) account for 60% of the world's food supply. Biodiversity is also a source of traditional medicine from which countries like China and Germany earn billions of dollars per annum. It is puzzling therefore to see Ethiopia's food and nutrition security does not reflect this diversity and traditional medicine gets little or no research support.
- 
- P6 Export products get more policy support (e.g. credit, tax, foreign exchange) than food crops and domestic markets. The cost of policy support to the export sector is either not calculated or too high. This is puzzling since food crops and domestic markets are key instruments of food security.
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- P7 Ethiopia is described as the “water tower” of East Africa but has the least irrigated agriculture in the world. It is often said that the amount of rain the country gets even in the driest of times is much higher than the amount Israel gets in the wettest of times. Water harvesting schemes are given due emphasis in the Agriculture Growth and Transformation Plan but the practice on the ground has not matched intentions.
- 
- P8 There is evidence suggesting that traditional pastoral systems (production, grazing) are more cost effective, sustainable, and resilient than new pastoral development programs including large-scale irrigation systems. It is puzzling that pastoral development programs are not informed by such evidence.
- 
- P9 Ethiopia is noted as the major animal vaccine producer in Eastern Africa. However, its veterinary services are among the poorest and as a result livestock diseases are rampant in both highland and lowland areas.
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## **BLOCK 2: DISASTER RISK REDUCTION AND CLIMATE RESILIENCE**

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- P10 Substantial investments have been made in drought prone areas and yet the returns in terms of environmental rehabilitation, ensuring food security and building resilience remain low. High potential areas are known for quick wins but there has been insufficient investment in these areas which may have increased their vulnerability. Getting the right balances has become a puzzle.
- 
- P11 In many parts of the world, small to medium scale and private-led interventions are more responsive to risk reduction and climate change than large scale interventions. It is puzzling therefore to see Ethiopia pursuing a number of large-scale public sector -led interventions.
- 
- P12 Both highlanders and lowlanders have suffered from climate change induced disasters (e.g. drought, floods, and crop and animal diseases) that have eroded their livelihoods. There is no evidence that a sedentary life is more resilient than pastoral livelihoods. It is therefore puzzling that sedentarization is aggressively pursued.
-

### **BLOCK 3: INDUSTRIAL AND INFRASTRUCTURE SECTORS**

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- P13 Investment in industrial and agro-processing parks may have attracted domestic and foreign investors. However, the fundamental problems of supply constraint remain - inconsistency, insufficient supply and poor quality of raw materials, seasonality of crops and high losses during transport.
- 
- P14 Ethiopia faces a dilemma of agro-processing. On the one hand, agro-processing adds value to raw materials thereby generating employment and higher incomes. On the other hand, there is a growing body of evidence highlighting the dangers posed by the myriad of chemicals in our food, colouring, preservatives, flavour enhancers or artificial sweeteners. Many countries have policies and regulations to protect citizens.
- 
- P15 Rural electrification is key to rural transformation. It drives small scale irrigation and on-farm and off-farm activities depend on it. This has been given due attention in the 5-year plan. However, alternatives to the national grid are not being sufficiently explored.
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### **BLOCK 4: BUSINESS AND COMMERCE**

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- P16 Ethiopians are born entrepreneurs. Some of the oldest trade routes passed through Ethiopia. Ethiopians have long traditions of owning and managing small and medium businesses. The Ethiopian Chamber of Commerce was established in 1947. However, it is puzzling to see that this sector is still the least developed. Successful family businesses that pass from generation to generation are few and far between.
- 
- P17 Private traders move about 90% of the goods from the surplus to the deficit areas and cooperatives move only 10%. In spite of this, cooperatives continue to enjoy substantial support from the government. In principle, the support should level the playing field for all traders, individual or collective.
- 
- P18 The role of free markets in ensuring food security is overrated. If the poor are left to the mercy of markets, they will not be able to meet their food basket. Alternative marketing channels driven by the public sector are not sustainable. In many countries, consumer cooperatives have proven successful but they have not been nurtured in Ethiopia.
- 
- P19 From “Thirteen Months of Sunshine” to “Land of Origins”, tourism remains the largest untapped development potential of Ethiopia. In spite of the relative peace and security, it is puzzling that the number of visitors is still far behind neighbouring countries.
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## **BLOCK 5: INSTITUTIONS, CAPACITY AND GENDER**

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- P20 Since the 1970s, participatory development has been the norm in many developing countries. Higher learning institutions are instrumental in promoting this approach. It is therefore puzzling that it has not received adequate attention in Ethiopia and as a result a top-down approach continues to dominate economic policy making.
- 
- P21 For the last 25 years, the civil service has been subjected to rigorous evaluation and been a testing ground for a number of management tools. And yet, it is puzzling to see that the civil service lacks motivation or innovativeness and operates in an environment of shifting priorities. Government and development partners invest in capacity building but the work environment often does not allow the application of the simplest tools and techniques learned.
- 
- P22 In many countries, non-state actors (e.g. NGOs, CSOs, professional and industrial associations) contribute to a vibrant society and add value to public sector efforts. In view of this, the government has supported their mushrooming (one study has established that more than 86% of the non-state actors have been formed since 1991). It is therefore puzzling to see most restrictive regulations in place constraining the sector. In a situation in which multi-stakeholder platforms have been established, there is an overriding concern of agendas being captured by interest groups.
- 
- P23 Economic policy making in Ethiopia is largely based on evidence generated by the public sector. Many countries have both public and independent systems for triangulation and value addition. The dominance of public sector in Ethiopia is therefore puzzling.
- 
- P24 Considerable efforts have been made to ensure gender equity over the last 25 years. Representations in federal and regional parliaments have reached respectable levels and the same is true for leadership positions. In economic participation, women have joint land certification and benefit from various food security programs. However, a number of areas of inequality remain. Women's records in loan repayment have been exemplary but their access to credit does not match their creditworthiness. There are differences in access to other inputs; women's productivity remains about 23% below that of male farmers.
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- P25 The Government has adopted scaling up best practices as one of its strategies. However, in all sectors of the economy, making progress in this remains a fundamental problem.
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# **Youth Economic Empowerment for Sustainable Development: Insights from Urban Ethiopia**

**Sindu W. Kebede<sup>1\*</sup>, Negussie Shiferaw, Netsanet Teklehaymanot, Atlaw Alemu, and Getaneh Gobezie**

## **1. Introduction**

The 2030 Sustainable Development Agenda puts emphasis on quality education, productive employment and decent work for youth as the center of a new development vision. In particular, targets under Sustainable Development Goals (SDGs) 4 and 8 place special focus on technical and vocational skills; youth employment challenges; and pathways for consistent and focalized action to provide decent jobs for youth (UN, 2015). Irrespective of these global initiatives, youth unemployment remains one of the most pressing challenge for sustainable development in developing countries (ILO, 2017). Youth empowerment, indeed, is central for sustainable development helping to avert major threats and challenges, including the impact of both unemployment and migration. More, if provided with an enabling environment and opportunities, youth can be key agents for social change, economic development and technological innovations. Youth bring with them boundless energy, imagination, creativity, ideas, and a limitless vision for their future and the societies in which they live.

With an estimated population of 105 million in 2017, Ethiopia stands as the second most-populous county in Africa with annual population growth rate of 2.4% (ILO and MOLSA, 2018). Given that more than 28% of the population is aged 15-29, the country has a critical task of creating jobs to absorb this growing population. Youth unemployment in Ethiopia is estimated at 19.1% in 2018 much higher than the sub-Sahara African average of 11.2% (ILO, 2017). The high level of unemployment is typically associated with the migration of youth from rural to urban areas (Abebe, 2020; Assefa and Yismaw YG, 2018; Eshetu and Beshir, 2017; Bezu and Holden, 2014; Gibson and Gurmu, 2012). Unemployment in

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Ethiopia is largely an urban phenomenon (World Bank Group, 2016). In particular, high youth unemployment is observed in the capital city, Addis Ababa, where 23.5% of households report an unemployed adult, versus 11% of households in other urban areas. The youth are facing unemployment challenges although their engagement in the economic process is crucial to achieving sustainable development; and most urban youth are living with prolonged periods of unemployment and poverty. Consequently, all-too-often some are forced to accept poorly paid jobs that fall outside the protection of the law.

Technical and Vocational Education and Training (TVET) is one of the initiatives most commonly used in developing countries to tackle youth unemployment, but even though the education system in Ethiopia produces a large number of University and TVET graduates, the absorption capacity of the economy is limited. The labor force continues to grow at a faster rate than job creation and it is common to see graduates unemployed for at least the first year after graduation (Tegenu, 2013; CBMS, 2018).

This study aims to contribute to the current literature on employment in general and urban youth employment in particular. Major research questions include:

1. What are the major challenges and opportunities of youth employment in urban setting of Ethiopia?
2. How does TVET improve employability of the youth in urban Ethiopia?
3. What are the key sectors that could be tapped into to reduce youth unemployment?

Section two of this paper discusses the conceptual framework for employability of TVET graduates, followed by a literature review in section three. The methodology used to address the research questions is outlined in section four; section five provides discussion of the results, followed by a conclusion.

## **2. Conceptual Framework for Employability of TVET Graduates**

This conceptual framework focuses on the challenges and opportunities for TVET youth graduates to access employment and to empower unemployed urban youth. This helps to contribute to the understanding the urban youth unemployment problems in Ethiopia and the study area in particular. It has particular importance for both scientific research practice and recommendations.

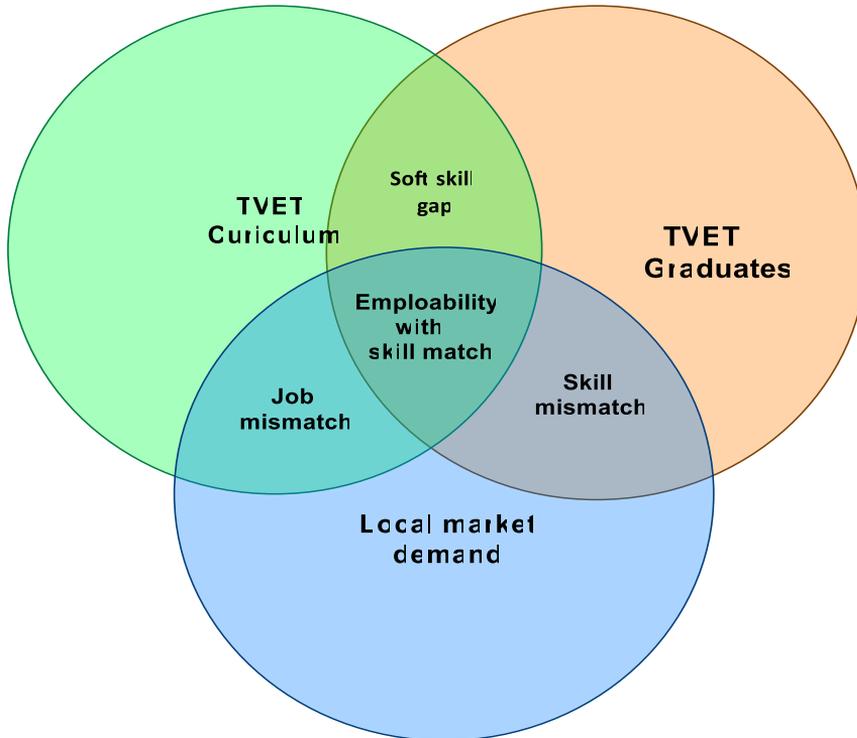
In Ethiopia, the TVET program is mainly supply driven and the strategy has decentralized the preparation of curricular materials to TVET institutions at the local level where there is often a lack of knowledge and experience of curriculum development. This decentralization, along with demands for particular specialization and fields of study being decided by local TVET institutions, means the intended objectives of the overall TVET program are not always properly addressed. TVET curriculum and employability skills' development are the most important factors in equipping TVET trainees with the skills to achieve the intended objectives of the TVET programs. The best need to be developed in coordination with private sector employers, as this approach ensures alignment with market needs and makes employers aware of the training and its value. Conversely, its lack results in jobs' mismatch.

TVET institutions, as suppliers of labor, should focus on employability skills in accordance with the requirements demanded by industry. Employability skills can be obtained through engaging prospective employers in curriculum development, sector-specific training, and creating linkages between employers and TVET graduates through apprenticeships. In this regard, integrating employability skills with learning can be expected to produce graduates ready to be recruited by a company. Employability skills are work skills that make an individual able to get a job and become successful in his preferred trade (Hari et al., 2020). Employability skills also provide a guide on how to get jobs according to professional field qualifications, thereby increasing the possibility of being recruited (Cavanagh et al., 2015). Beside employability skills, soft skills, including communication skills, critical problem solving, teamwork and leadership skills (Amiruddin et al., 2016), are important tools for TVET graduate employment. Integrating these into TVET programs is an effective instrument to ensure that trainees are equipped with the necessary proficiencies, as well as technical skills needed to deal with a complex and challenging workplace. However, the unique nature of TVET training programs, along with the diversity of soft skills to be developed and the difficulty in assessing them, can result in soft skill gaps for TVET graduates.

TVET programs that couple training with work experience, including short-term apprenticeships, facilitate job placement with employability skills' match for TVET graduates. By contrast, the absence of employability skills and lack of apprenticeships can lead to skills' mismatch, offering a key challenge for TVET graduate employment. The schematic conceptual framework, is depicted

in Figure 1 in a simplified manner.

**Figure 1: Conceptual Framework for TVET Graduates Employability**



### 3. Literature Review

While the literature on employment is extensive, focus on youth employment in urban areas is only slowly emerging in the context of developing countries. In particular, studies on the employability of TVET graduates and related challenges and opportunities are scarce. We first assess briefly existing literature on the determinants of youth employment in the urban locations of Ethiopia and then examine studies that touch upon TVET's contribution to enhance youth employment, considering experiences from Ethiopia and other African countries.

Broussard and Tekleselassie (2012) analysed the characteristics of youth labor market in Ethiopia using 1999/2000 and 2004/2005 labor force surveys, and 2009 and 2011 urban employment and unemployment surveys. Focusing on

youth in the age group 15-29, their study indicated that Ethiopian youth, both in urban and rural areas, had lower labor force participation and employment rates and higher unemployment and informal sector employment rates, than the national average. Broussard and Tekleselassie also made a regional comparison, and found that in 2005, Gambella (45 percent), Addis Ababa (51 percent), and Dire Dawa (61 percent) had the lowest employment-to-population ratios. They also had the highest unemployment rates with Dire-Dawa (18 percent), Gambella (26 percent), and Addis Ababa (29 percent). The trend analysis between 1999 and 2011, however, indicated a declining average urban unemployment.

The study also made a gender analysis, finding higher labor force participation for men than for women. The difference was more pronounced in employment and unemployment rates. In 2005, male youth had an employment to population ratio of 83 percent and an unemployment rate of 4 percent; the employment to population ratio for female youth was 71 percent with an unemployment rate of 11 percent. The study attributed the difference in labor market outcomes to the lack of women's access to education, formal sector employment, social security, and government employment programs, resulting in less employment opportunities compared to men. Broussard and Tekleselassie also found there was a positive relationship between educational attainment and unemployment, though this was less pronounced amongst women. Often referred to as the educated unemployment problem, they found youth with higher education was less likely to be unemployed in 1999 than in 2011, suggesting the labor demand had been unable to keep pace with the increases in educational attainment, particular for jobs which demanded highly skilled labor.

Kassa (2012) on the bases of the 2004 Ethiopian Urban Socio-Economic Survey investigated the determinants of unemployment in urban Ethiopia and the impact on household welfare. He found the education level of the household head and unemployment were positively correlated up to secondary school level, and that living in Addis Ababa was to be associated with the high probability of being unemployed. He attributed this to the congestion caused by the absolute number of people living in the metropolitan area and looking for better opportunities. Kassa also identified a negative association between being married and unemployment. He analyzed the impact of unemployment on household welfare, measured by real consumption expenditure, finding that larger household size, the number of unemployed members of the household and higher dependency ratios were associated with lower household welfare status. Kassa said education

was strongly and positively associated with household welfare and attributed this to the income effect of education. His findings indicate that having an employer as household head associated with higher welfare possibilities when compared to a casual worker household head, and he concluded that unemployment had a negative impact on household welfare.

Nganwa et al. (2015) assessed the nature and determinants of urban youth unemployment in Ethiopia using urban employment-unemployment surveys conducted between 2006 and 2011. Their study revealed that urban youth unemployment was high in comparison to total unemployment although the trend of urban youth unemployment decreased in those five years. Consistent with previous studies, Nganwa et al. found that young women suffered higher unemployment rates than young men in urban areas over the study period. They also found that place of residence (region), gender, age, and marital status significantly affected urban youth unemployment and the study indicated that education did not guarantee employability of youth in urban areas. This was in line with the references to the educated unemployment challenge by Broussard and Tekleselassie (2012).

Batu (2016) on the bases of the 2015 Urban Employment-Unemployment Survey also identified factors responsible for youth unemployment. His analysis indicated the unemployment rate was more pronounced amongst female (28.1 percent) than males (15.1 percent). He also established a positive association between education and being employed, with an unemployment rate of 17.2 percent for institute or college graduates compared to 24.6 percent amongst non-graduates. His geographical analysis of unemployment found unemployment to be more pronounced in relatively developed regions. The highest level of unemployment was recorded in Addis Ababa (27.4 percent) followed by Amhara (25.3 percent) and Tigray (24.2 percent) regions. Regional states like Gambella (12.04 percent), Benishangul-Gumuz (12.9 percent) and Afar (17.1 percent) had lowest rate of unemployment. Batu's analysis of the preference of employment type showed that more than half were willing to take any available job. About 27 percent of the unemployed youth indicated they would prefer to be self-employed, though they were challenged by shortage of finance and lack of working space to start their own business.

As noted, Technical and Vocational Education and Training (TVET) is one of the key initiatives used to tackle the challenge of youth unemployment in developing countries. However, only few studies have been conducted to assess

the challenges and opportunities of TVET in addressing urban youth unemployment in developing countries.

Alhasan and Tyabo (2013) assessed the contribution of TVET on youth empowerment in Nigeria, examining issues in relation to integrating TVET in the education curricula and promoting entrepreneurial activities aimed at creating jobs. The study recommended that priority should be given to revitalizing TVET with sufficient funding allocated to TVET to fulfil the demands of youth. In addition, TVET should be accessible to women and the disabled and be properly equipped to accommodate these segments of the population. The study also recommended ensuring TVET had a flexible learning environment and framework.

A study by Tripney and Hombrados (2013) conducted a systematic review and meta-analysis to evaluate the impact of TVET interventions for young people in low- and middle-income countries, predominantly from Latin America and the Caribbean. They considered five categories, paid employment, formal employment, monthly earnings, self-employment earnings and weekly hours worked in paid employment. They found that the overall mean effect of TVET interventions on paid employment, formal employment and monthly earnings was positive and significant although small and significantly heterogeneous. The effect of TVET interventions on self-employment earnings and weekly hours worked in paid employment was not, however, found significant. The authors underlined the results should be taken with considerable caution indicating that the findings could be either over- or under-estimating the effects of TVET on the outcome variables. They note more research was needed to strengthen the evidence base on TVET.

A study by Ogbuanya and Michael (2015) linked youth employment to national security in Nigeria, claiming that the development of a workable TVET program could be the needed panacea to create job opportunities for youth. They assessed the various ways adopted by other countries to enhance poor perception of TVET, examining youth employment programs in Nigeria and recommending ways to boost employment creation. The study suggested establishing strong linkages between TVET schools and industries through internships or apprenticeships was crucial. In addition, it underlined the importance of providing start-up capital through loans and grants for TVET graduates to start and expand business ideas, enabling TVET graduates to be directly engaged in productive activities instead of unproductive or disruptive ventures.

Buli and Yesuf (2015) examined the factors that could explain differences in entrepreneurial intention (EI) among Ethio-Italy TVET College students in Dire Dawa city in Ethiopia. Their findings indicated that personal attitudes towards entrepreneurship was the main factor of EI. The study suggested that proper care should be taken in designing curricula and running programs so that TVET students' individual attitudes towards job creation was enhanced. Buli and Yesuf recommended that TVET educational practice needed to be adjusted to include different areas such as decision-making, effective communication, entrepreneurial negotiation, leadership, creativity and critical thinking.

This brief summary of the literature shows that although research to identify determinants of urban youth unemployment in Ethiopia is expanding, there remains an overall scarcity of information on TVET and its challenges and opportunities. There is a clear knowledge gap in terms of identifying the deep-rooted challenges of youth unemployment in urban areas, especially among TVET graduates. It is clear that identifying the major entry points through categorizing priority sectors that have the potential to absorb the TVET graduates could provide tangible intervention targets that could be implemented to tackle urban youth unemployment. This would have a long-term effect on securing better livelihoods at the household level in the short-term as well as ensure sustainable development of society and the nation at large.

## **4. Methodology**

### **4.1 Description of Study Area**

Unemployment in Ethiopia in general can mainly be attributed to the rate of employment, which is lower than the growth rate of the working population, the mismatch between available jobs and the skills on offer, and the high cost involved in looking for jobs. Population growth generates young workers at around the same rate as its own growth rate. The fact that 41% of the population is under 15 years of age creates a high level of demographic pressure as well as a future demographic dividend, which, if it is well managed, could lead to an accelerated rate of economic growth and the expansion of the country's markets. The problem has been identified and various interventions measures have been taken by government, NGOs and donors, at various times, but without reducing unemployment to acceptable levels. The persistence of the problem calls for

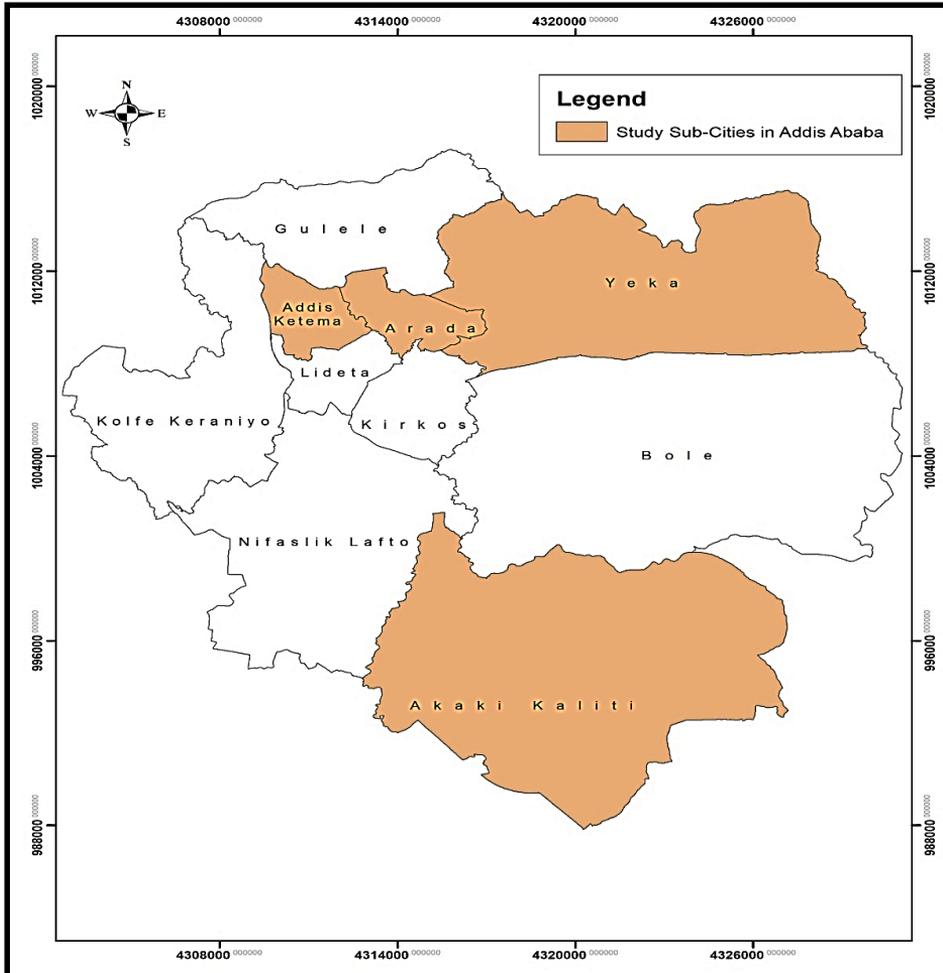
efforts to introduce either new methods of addressing the problem or revisiting the reasons why attempted efforts did not work.

Certainly, for the moment, youth unemployment remains a chronic social and economic problem for Ethiopia. Addis Ababa, as the capital city with all its attractions for migrants, reflects the problem at more magnified level. Lercari et al. (2017) claimed that there is an incredibly high level of frictional unemployment in the city, accounting for 20% of the unemployment with spatial and informational components, driven by high transportation costs and low connectivity of the internet. The chronic nature of unemployment in Addis Ababa is reflected in the persistent high unemployment rates reported by various studies and the statistical reports of the Central Statistical Agency in its National Labor Force Surveys of 1999, 2005, and 2013 and Urban Employment-Unemployment Surveys of 2003 to 2018. 23.5 percent of households report an unemployed adult, versus 11 percent of households in other urban areas (CSA, 2018a). An earlier study cited in the MYSC's Youth Policy paper has also indicated that some 60% of beggars in Addis Ababa are below the age of 30. This suggests significant numbers of youth spend their most active years in activities that expose them to health problems and criminal offences rather than in engagements that would be useful for their own development.

The youth generally suffer from severe unemployment due to poor educational status, lack of vocational skills, or of initial capital to start some sort of business activity. The lack of safe and empowering youth development spaces to enhance employment opportunities and help provide a positive outlook for their future as well as appropriate facilities in the sub-cities, compels youth to engage in risky behaviors. *Arada* and *Addis Ketema* sub cities, situated in the center of Addis, are particularly fragile areas for youth, where young people are mostly engaged in petty crime, robbery, smoking and other non-productive acts including violence. Young people in these localities are mostly marginalized and neglected unable to get equal access to opportunities. This is especially true for women. Indeed, *Addis Ketema* sub-city is one of the most densely populated areas of the city, and one in which most of the inhabitants are migrants from different parts of the country. According to the existing population and housing census, *Addis Ketema* sub-city hosts 16.8% migrants to Addis Ababa (CSA, 2007). The largest bus terminal in the country and the largest African open market, *Merkato*, are located in this sub city which has a significant number of rural-urban migrant, out-of-school youths engaged in different informal street businesses and contributing to theft and other criminal activities. The area is also known for a

high concentration of alcohol outlets and commercial sex work activities, especially around the *Sebategna* and *Merkato* market area.

**Figure 2. Youth unemployment study: Sub-cities in Addis Ababa**



#### 4.1. Methods and Data Sources

This study employs qualitative research techniques, which enable us to describe the complex situation of youth unemployment and its underlying factors in the study areas. Key Informant Interviews (KIIs) were conducted with key stakeholders: Federal TVET, Business incubation centres (Ice Addis) and representatives of the Ministry of Women, Children and Youth Affairs. Eight

Focus Group Discussions (FGDs) were conducted with unemployed TVET graduates, female and male groups separately. They were held in four sub-cities in Addis Ababa, *Arada*, *Akaki-Kaliti*, and *Yeka*, selected because of their high concentration of unemployed youth and migration from rural areas. The composition of the focus groups of unemployed TVET graduates, totalled 26 males in four groups, and 28 females, also in four groups. The FDGs were particularly helpful in gaining useful insights on the existing situation of youth unemployment in Addis Ababa.

**Table 1: Research participants of FGD and KII on Youth Employment in Addis Ababa**

<b>Key Informant Interview (KII)</b>	<b>Federal TVET institute</b>	<b>ICE Addis</b>	<b>Representative of Ministry of Women Children and Youth Affairs</b>	
<b>Focus Group Discussion (FGD)</b>	<i>Akaki-Kaliti</i> sub-city <i>woreda 9</i>	<i>Akaki-Kaliti</i> Sub-city <i>woreda 3</i>	<i>Yeka</i> sub-city <i>woreda 4</i>	<i>Arada</i> sub-city <i>Woreda 3</i>
<b>Female FGD</b>	6 participants	8 participants	6 participants	8 participants
<b>Male FGD</b>	7 participants	6 participants	7 participants	6 participants

## 5. Discussion of Results

Based on the focus group discussions and the interviews with key informants, we have compiled a list of the major challenges and opportunities in youth unemployment in Addis Ababa. These findings are summarized in Table 2. We find that youth unemployment has widespread and multidimensional challenges, but the major ones, revolve around the lower rate of job creation and the high growth of the labor force in urban areas. The natural population growth rate is also one contributor to the high growth of the labor force along with rural-urban migration.

**Table 2: Challenges and opportunities for urban youth employment in Addis Ababa: Findings from KII and FGD**

<b>Challenges</b>	<b>Opportunities/potential solutions</b>
Rate of job creation lower than growth of labor force	Develop and encourage expansion of private sector involvement in job creation. Identify and make use of public sector to absorb young work force in urban areas.
Mismatch between available jobs and skills	Provide refresher training to graduates, internship experience to students and entry level employment opportunities
High job search and informational costs	Create linkage mechanism for job seekers to job advertisers
Mismatch between TVET curriculum programs and local market demand.	There are more than 600 TVET institutions in the country, and TVET has enabled training of millions of youth. The training curriculum should be market-oriented.
TVET curriculum development is decentralized taking into account the individual institutions' capacity to develop curricula.	Centralize curriculum development at a federal level, or in regions to develop regional level TVET curricula.
Youth lack of motivation to work; failure to utilize their full potential	Identify means to motivate the youth for self-employed and possibility of formal employment.

The mismatch between available jobs and skills was repeatedly raised during discussions of both FGD and KII, described as TVET graduates lacking the required skills and practical experience to be directly integrated into their respective employment positions. Challenges in relation to high job search costs were also underlined as critical for young fresh graduates from Universities and TVETs. In addition, costs of job searches are high where the internet is not easily accessible and huge transportation costs can be incurred. These are discussed in our detailed findings from KII, FGD and priority sector data collection.

## **5.1 Summary of KII Data Findings**

To gather primary input for the study, three Key Informant Interviews (KIIs) with relevant government and private institutions were held. Various actors, government, private companies and Non-Governmental Organization (NGOs), provide Technical and Vocational Education and Training (TVET) in Ethiopia and there are more than 600 TVET institutions throughout the country. As indicated in the National Strategy one of the guiding principles of the national TVET system is demand orientation, with all TVET institutes responding to competence needs and qualification requirements in the labor market (MoE, 2008). The strategy explains that public TVET institutions should focus on producing middle level technical graduates. KII participants agreed, in principle, TVET curricula should be market-oriented; however, the evidence shows that the TVET program in Ethiopia is primarily supply driven (Krishnan and Shaorshadze, 2013).

There is no doubt that TVET institutes have contributed significantly to the effort in reducing youth unemployment and in enabling thousands, if not millions, of youth to acquire skills. It is, however, often claimed that there is a mismatch in the labor market, as TVET institutes are not market-oriented, and have limited capacity compromising the quality of training delivered, leading to post-graduation challenges in employment opportunities. Indeed, the National Strategy acknowledged the challenges in the sector and emphasized that all available efforts and resources should be directed towards a massive quantitative expansion of the public TVET supply. The consequence, however, was that programs, by-and-large, did not address actual competence economic requirements. Most programs proved to be of low quality and theory-driven due to resource constraints and a lack of skilled TVET teachers. This view is supported by the Ministry of Education (MoE) which made it clear that a systematic integration of TVET with the world of work had not yet been achieved (MoE, 2008).

To alleviate these problems, a series of reform measures were undertaken. One, based on international best practices, was to move from a curriculum-centered approach towards an occupational standard-based approach (MoE, 2008). This describes the level of competence that a person has to achieve in order to be considered “qualified” in a certain field. Occupational standards are developed at a national level by a panel of experts drawn from relevant industries

with knowledge of workplace requirements and in collaboration with TVET institutes (MoE, 2008). The respective ministries then have to approve the occupational standards. However, our research participants indicated that some of the industrial representatives involved in the development of occupational standards failed to understand the demands from industries and lacked adequate capacity. There are no external professional associations or chambers to provide a check and control mechanism on capability. The result was that some of the industries even questioned and criticized the occupational standards as they were developed and approved, leading to frequent revisions of curricula in some sectors.

Despite this, given the approved occupation standards, TVET institutes were able to develop their respective curricula. However, decentralization of curriculum development did not take into account the capacity of individual institutions for curriculum development. KII participants explained that studies indicated that institutes with strong human resource capacity and experience, developed good quality curricula; institutes, without the necessary human resources or which were newly established, had challenges. This affected the quality of the education delivered. The option being considered to resolve this is centralizing curriculum development at a federal or at least a regional level.

KII participants also indicated that institute programs are insufficiently market-oriented, failing to take into account local market demand. This has contributed to the mismatch between the programs offered by the institutes and the demands of the labor market. This mismatch is not limited to any region, but can be observed all over the country. In addition, KII participants noted that there were a number of skills, including communication and business skills, which were in demand by employers but not provided by TVET institutes.

KII participants indicated that TVET institutions' inability to adequately follow-up labor market demand dynamics and their failure to respond in a timely fashion, contributed significantly to the market mismatch. One example was when the Hawassa Industrial Park started operation in 2016, it demanded a large work force, especially for textile producers. However, the TVET institutions could not supply adequate numbers and the Industrial Park was forced to take individuals with no training and train them<sup>2</sup>. KII participants emphasized that TVET training in general is focused on core competency, and as a result, TVET

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<sup>2</sup> Further research is needed on this to identify which specific types of trained labor were scarce at Hawassa Industrial Park.

graduates have gaps in basic mathematics, business and communication skills. They suggested this should be taken into account in a revision of the occupational standards, which they claim are outdated and need to be revised.

Another major issue KII interviewees considered contributed to TVET graduates' unemployment, was the employers' lack of adequate knowledge of the more than 700 programs and training areas covered by TVET institutes. Employers' jobs advertisements often focused mainly on the fields/professions provided by universities. TVET institutes need to make extra efforts to ensure employers and the public at large are familiar with their programs and training levels. KII participants do, however, claim that despite the challenges, TVET graduates can acquire adequate skills, especially in handicraft, and the Certificate of Competency (COC) that TVET graduates have to go through is a quality assurance mechanism.

KII participants suggested various measures to address the unemployment challenges that TVET graduates encounter. These included:

- a. Improve the quality of training. TVET institutes must consider the quality of training they deliver, and this involves enhancing proficiency of staff, curriculum changes and the provision of adequate inputs, including machineries and tools.
- b. Strengthen the quality of entrepreneurship training provided by TVET institutes to enable graduates to start-up their own business.
- c. Take into account market demand when opening new programs to eliminate mismatches
- d. Closely monitor the dynamics of labor market demand and respond timely and efficiently.
- e. Provide a Career Development Service. Currently, there is no structure within TVET institutes to offer or provide counselling services to students, whether on career development or choice of programs. It is a major missing element.
- f. Establish platforms to provide labor market information to job seekers.
- g. Create a link between TVET institutes and potential employers.
- h. The government alone cannot resolve the youth unemployment challenge. A concerted effort is required which will need to develop the private sector as part of a long-term solution. This may, however, require policy adjustment.

- i. The formal sector does not have the capacity to absorb thousands of graduates coming from TVET institutions every year. The ones that are expected to join the formal sector are higher-level graduates (levels 3, 4 and 5), and thus it is important to increase the number of highly qualified trainees. This needs to be done with caution to avoid any increased mismatch.
- j. The Federal TVET institute has identified eight priority sectors including: Agriculture, Industry, Economic Infrastructure, Health and Mining sectors, among others. All TVET institutions should consider the priority sectors when they launch new programs.
- k. Gender related opportunities and challenges remain. Our Key Informants indicated that there was no gender disparity in TVET enrolment, with female enrolment standing at 51 percent. However, there are disparities between different professions and levels. Females are engaged in both hard skill (e.g. construction and automotive) and soft skill (e.g., garment, hotel and tourism) professions. The number is high in the soft skill professions though the participation of women as teachers in TVET institutions (25%) or in administration (4-6%)\_ remains very limited. Participants indicated that they did not expect women to face specific challenges due to their gender when joining the formal sector; however, there could be contextual differences. For instance, most TVET trainees are from rural areas and have to move to a nearby town to get TVET training where they often live in rented accommodation and face economic challenges. This can affect women more than men, often forcing them to quit training at level 1 or 2 and seek employment. This in turn affects their opportunity to accept or find formal employment opportunities.

## **5.2 Summary of FGD Findings**

A total of 8 Focus Group Discussions (FGD) were conducted with four male and four female unemployed TVET graduate groups in *Addis Ketema, Yeka and Akaki Kaliti* sub-cities. The findings of the focus group discussions are summarized here under thirteen topics: Root causes of youth unemployment; Suggested solutions for youth unemployment; Relevance of TVET Training in getting formal employment opportunity; Apprenticeship and internship; Priority sectors for TVET graduates; Availability of training institutions within a locality;

Mismatch between TVET graduates' qualification and employers' needs; Gender related problems in the recruitment system; Disability related problems in the recruitment system; Job search mechanisms used by the youth; CV, job application and interview skills; Type of support that should be availed to unemployed youth; and Business start-ups.

A. **Root causes of youth unemployment:** The FGD participants identified eight root causes for youth unemployment:

- The Gap in the labor market between supply and demand: Thousands of students graduate from universities and TVET institutions every year, but the rate of job creation has consistently failed to catch up with the numbers, creating an imbalance between supply and demand.
- Motivation of youth to be engaged in productive activities: University students and TVET trainees have limited opportunity to study in their areas of interest as officials of these institutions assign students to fields of studies. All-too-often students are forced to study topics in which they have no interest, affecting their motivation to pursue a career in their field of study. At another level affecting motivation, the youth often refuse to take up low paying jobs or jobs unrelated to their field of study even though this may be beneficial in acquiring experience.
- Gap in linking the trained youth with employers: the government has been providing short-term vocational and technical training for the unemployed, but follow-up support to link those trained with employers or to start-up their own businesses is almost non-existent, leading to disappointment and fatigue.
- Rural-urban migration: Addis Ababa with all its attraction has been the main destination for youth migrating from nearby towns and rural areas and other regions in search of employment opportunities. This has put extra pressure on the effort to address youth unemployment in the capital. Some research participants suggested the regional governments should take specific measures to address youth unemployment in their respective regions.
- Requirement for experience and social networking: Experience is often one of the requirements for employment, making it difficult for fresh graduates from universities and TVET institutions to find employment opportunities. Social networking is another challenge and research participants claim that even though job vacancies are officially advertised, they are often filled or handed out behind closed doors.

- Lack of finance and working space: Lack of finance and of working spaces are challenges facing youth who aspire to start-up their own businesses. The requirement for collateral by formal financial institutions and the high interest demanded by the informal financial sector restrict access to credit. Research participants indicated that the lack of working space meant they were unable to start-up their own businesses and therefore remained unemployed.
  - Market linkages: Youth who have been organized through different government schemes and started businesses find these are challenged by lack of access to market their products.
  - Lack of internship and other opportunities: Internship and apprenticeship opportunities remain very limited though they are crucial in acquiring experience, especially for fresh university and TVET graduates. Research participants suggested TVET institutions should take a lead role in arranging internship and apprenticeships for graduating classes in collaboration with government and employers.
- B. ***Suggested solutions for youth unemployment:*** Research participants also suggested six specific remedial measures in addition to those mentioned above.
- Accepting the government alone cannot resolve the youth unemployment, participants called for a coordinated effort by every stakeholder involved including the government, the private sectors and NGOs to resolve the issue of youth unemployment.
  - Employment should be on the basis of merit, and the government should establish checks and balances across the recruitment process to avoid current problems of social network and corruption.
  - The industrial parks absorb large labor forces and contribute significantly in addressing the youth unemployment challenge. More emphasis should be given for their expansion.
  - The government should address access to finance and working space for TVET graduates as a matter of urgency
  - The government should do more to strengthen market linkages.
  - Efforts must be made to develop schemes to allow fresh graduates from universities and TVET institutions with no experience to get employment opportunities or to provide internships and apprenticeship opportunities.

- C. **Relevance of TVET Training in getting formal employment opportunity:** Participants expressed diverse views regarding the relevance of TVET training for obtaining formal employment opportunities. Their views expressed are summarized in Box 1.

**Box 1. Participants views about relevance of TVET training**

<p><b>In support of TVET training:</b>                  Most FGD participants agree that TVET training was relevant in acquiring skills and qualifications. Some claimed that there were circumstances in which TVET graduates were preferred over university graduates. They also indicated that TVET institutions lacked materials for practical sessions and focused more on theories. Practical work environment, however, is quite different from theory. Participants indicated that TVET institutions do not provide training in some fields demanded by employers such as Peachtree. Participants accepted there was no educational system that could make students one hundred percent qualified and agreed what mattered most, and made people qualified and stand out in the labor market, was hard work and diligence.</p>	<p><b>Questioning TVET training relevance:</b>                  Some research participants claimed TVET training was only acceptable in the absence of other alternatives. They argued the quality of training delivered by TVET institutions was not up to the expectation of employers; society did not value TVET training and certificates; and employers were not willing to hire TVET graduates.</p>
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- D. **Apprenticeship and internship:** All FGD participants suggested an apprenticeship should be mandatory for every TVET graduating student and part of evaluation for graduation; only four research participants preferred an internship. The opportunity to develop skills during apprenticeships depended upon the organization where it was taking place. Most accounting

students would go to banks, which often provided a better opportunity for skills development, had follow-up systems and good evaluations. In other cases, however, the organizations providing apprenticeships assigned tasks unrelated to fields of study or, even worse, just filled out evaluation paperwork without providing any opportunity for skill development.

The FGD participants indicated that the current practice was for graduating students themselves, to look t for apprenticeships. The role of TVET institution was merely limited to writing a support letter. It all made finding an apprenticeship very difficult. They would therefore like to see TVET institutions taking a lead role in obtaining apprenticeships for their graduating students.

- E. ***Priority sectors for TVET graduates:*** Most FGD participants identified management, accounting, food preparation, human resources, construction, finishing, metalwork, woodwork, hairdressing, and electricity as priority sectors for TVET graduates.
- F. ***Availability of training institutions within a locality:*** Some participants identified specific institutions that provided training in their localities. These included *Abebech Gobena* Children’s Care and Development Association, Plan International Ethiopia, SMART UP, CC; Reach up, and Amanuel Integrated Community Development Organization and Youth Centers. The training they delivered included life skills, leadership, business skills, entrepreneurship, IT, food preparation, design, saving and driving. Some *Woredas* and *kebeles* also provided training for specific groups under their “*Kesidet Temelashoch/returnee migrants*” and “*Yelimat Teneshiwoch/those displaced dwellers for urbanization*” programs. Some participants noted that training provided through *kebeles* and NGOs were often filled through social networking and they were unable to access such opportunities. In other cases, there were no institutions that provided training in their locality.
- G. ***Mismatch between TVET graduates’ qualification and employers’ needs:*** Most of the research participants indicated that employers often demanded additional skills on top of a graduates’ main field of study and experience. For instance, for a job in accounting, a qualification in Peachtree, passing the COC exam, engagement in voluntary activities, or similar additional qualifications were required. In order to address the skill-mismatch research participants suggested:

- TVET institutions should identify employers' needs and adjust their training accordingly;
- TVET institutions should provide due emphasis of the quality of the training they deliver;
- TVET institutions should take the lead in looking for apprenticeship and internship opportunities;
- The Government should establish checks and balances for the recruitment process; and,
- Employers should have confidence in hiring fresh graduates without experience, or at the least provide them with the opportunity for a trial period and decide to hire or not depending on their performance.

H. ***Gender related problems in the recruitment system:*** According to most research participants, females are given priority in employment opportunities. Job advertisements often include the phrase “female applicants are encouraged”. There were also claims that some employers were only looking for good looking female employees. Participants also noted some professions were considered as gender-specific so even if a candidate had the necessary qualification, employers were reluctant to hire.

I. ***Disability related problems in the recruitment system:*** Research participants said most people believed that persons with disabilities were not efficient making it even harder to get employment opportunities. One example was when an employer claimed a person with an eye problem was denied an employment opportunity as they would be in danger from a machine. Another research participant detailed a case where his teacher was fired due to his disabilities. Participants explained working environments were usually not conducive for persons with disabilities, and infrastructure was not well developed to accommodate their condition.

J. ***Job search mechanisms used by the youth:*** According to FGD participants, job search mechanisms mostly involved job advertisement boards, newspapers (e.g. The Reporter and *Addis Zemen*), the internet, radio, Facebook, social networks, visits to potential employers, and information from peers. Some participants said they used agencies (brokers), but registration fees, of around ETB 500, prevented most from using them.

- K. ***CV, job application and interview skills***: Some research participants indicated that TVET institutions provided training on how to write a CV and handle an interview. Others noted they got training from *Abebech Gobena* Children's Care and Development Association on how to write CV. Participants also resorted to friends to get help in writing a CV and an application cover letter.
- L. ***Type of support that should be availed to unemployed youth***: Participants indicated the need for financial help, working space, technical skill-enhancing training, material and market linkage support. They also said:
- Every stakeholder should do a lot more in resolving the youth unemployment challenge;
  - The government should make every effort to eliminate corruption in the labor market;
  - A linkage between TVET institutions and potential employers should be created to enhance the employability of TVET graduates;
  - Requirements for experience, especially for entry-level jobs, are too challenging to be met. Employers should reconsider the necessity for this.
  - The government should establish controls within both *woredas* and *kebeles* to ensure that obtaining unemployed identification cards is made easy; and that political party members were not given priority- every citizen should be treated equally. In addition, youth group formation to access microfinance should be based on individuals who have similar interest and groups should be kept to manageable levels. Overall, firm support should be given to build up the confidence and motivation of youth before and after group formation.
- M. ***Business start-ups***: almost all FGD participants indicated that they believed they had the skills and qualifications to start-up their own businesses or be engaged in formal employment; but they also emphasized they were challenged by lack of finance, working space, market linkage and experience.

### **5.3 Sectors with Substantial Employment Potential in Addis Ababa**

Developing the private sector to absorb the urban labor force and identifying the public sectors that have the potential to absorb the young workforce is vital to design interventions and target these sectors. The sectors that contribute most to employment in urban areas, particularly in Addis Ababa, are the service and construction sectors (CSA, 2018a; WB Group, 2016). Among the

service subsectors, the hospitality subsector attracts the most job seekers, while the manufacturing sector (especially light manufacturing including garments and textiles) comes in as the third largest employer. This sector is, however, underdeveloped and it has not been used to its potential. ILO and MOLSA (2018) share this view acknowledging the prevalence of unemployment and underemployment is "mainly a result of rapid population and labor force growth and the limited employment generation capacity of the modern industrial sector of the economy." The low level of development of domestic manufacturing, largely concentrated in Addis Ababa, has led the service sector linking to imports and agriculture. Wholesale and retail trade is largely based on imports and agricultural products rather than on manufactured outputs. The result is that the low level of inter-sectoral linkage has contributed to limited job creation in the country.

A study by Addis Ababa City Government (Bureau of Labor and Social Affairs/ and Addis Ababa University) (2016) conducted in two sub-cities of Addis Ababa identified six priority sub-sectors for absorbing the unemployed. The wholesale and retail trade, metal and metal products, and hotel and restaurant sub-sectors stand out as the first three in terms of employment, while the non-metallic products, food and beverage, and leather and leather products sub-sectors led in terms of employment growth rate. A study by EDC (2018), identified mainly the construction, light manufacturing and service sectors particularly tourism and hospitality, and transport sub sectors as potential employers. Overall, there is a consensus that the priority sectors that absorb the majority of job seekers in urban areas are the light manufacturing (textile and garment), construction (metal, woodwork and finishing; and services (hotels and restaurants, tourism, wholesale and retail trade) sectors.

On this basis, we discuss in more detail the potential contribution and capacity of the clothing and textile, tourism and hospitality and construction sectors to absorb young labor force in Addis Ababa.

- i. **The clothing and textile sector** has grown by around 50% in the last ten years. It contributes almost 1.5% to Gross Domestic Product (GDP), making up 9.01% of the country's industrial production (Khurana, 2018). This sector is known for its uptake of women employees, which make up more than 80 percent of its employees in Ethiopia. In addition, employees in the clothing and textile factories tend to be younger than other domestic companies and a

smaller percentage of them have vocational training certificates. We would assess the sector to have the potential to absorb a high volume of young workers. Out of a total of 9,830 trainees and apprentices in Addis Ababa in 2013, 2,908 or 29.6% were engaged in clothing and textile-related programs. Nevertheless, the sector also shows evidence of a considerable mismatch between the needs of companies (demand side) and the skills and qualifications that the training establishments (supply side) believed they were providing to employees (Yamada et al, 2018). Given the potential of the sector, it is important to identify these gaps further and in detail. It is also imperative to provide close communication and information exchanges between the institutions that are concerned with supplying trained employees and the factories and establishments which hire them.

- ii. The tourism and hospitality sector** (including hotels, restaurants and food preparation) is one of the sectors that has been showing steady growth in Ethiopia. Even though the sector contributes 1.2% of Gross Domestic Product (GDP), it is predicted that this will increase to 9.0% by 2024. Similar to the clothing and textile sector, women occupy 74% of the jobs in the tourism sector and are the most appealing employees for the hospitality sector. Many employers in the sector are interested in hiring unskilled or semi-skilled young workers, creating substantial employment opportunities for young people who want to get a foot in the industry and have a positive attitude. The sector is classified as one with high interaction with customers, necessitating values such as communication skills and readiness to work hard as key factors. To ensure appropriateness of the service provided, vocational training graduates who have specialist soft skills, attitude and social skills, are the main employees in this sector.
- iii. The construction sector (metal and wood processing)** is a sector with increasing value creation stimulated by the expansion of public infrastructure and favourable government policies. The sector continues to absorb a large proportion of workers. Between 2005 and 2013, the number of jobs in the construction industry tripled from 229,000 to 825,000, with the percentage of the entire workforce accounted for by the construction industry increasing from 0.9% to 1.9% (Oqubay, 2018). The fast-growing housing sector offers the greatest opportunities in terms of employment, providing for increased opportunities for a young labor force in metal and woodwork. It is, however, important not only to look into the overall labor absorption capacity of the

sector, but also at the creation of jobs offering adequate salary, sick leave, and annual leave, and at the level of casual labourers.

## **6. Conclusion**

Youth unemployment has remained one of the major social and economic problems of Addis Ababa. The chronic nature of unemployment is reflected in the persistent high unemployment rates reported by various studies and statistical reports of National Labor Force Surveys (CSA, 1999; 2005; 2013; 2015) and Urban Employment-Unemployment Survey (CSA, 2018b). While the problem has been identified and various intervention measures have been, and are being, implemented by Government, NGOs and donors, it has not yet been addressed at an acceptable level. Among the major challenges emphasized by our key informants and Focus Group discussants (FGD) were the continuing imbalance between demand and supply of labor, and the mismatch between skills required and TVET training provided for unemployed youth for available jobs in the labor market.

This mismatch between jobs and skills could be reduced by providing refresher training to graduates as well as internship opportunities and apprenticeships for students to give on-the-job training and experiences. In addition, employers could be sensitized to the benefit of providing on-the-job trainings for students as well as for employers for entry-level employment opportunities. At the same time, priority should be given to address assistance to deal with the difficulties of job searches for fresh graduates from Universities and TVETs with systematic coaching of graduates for CV development, self-expression and presentation, and identification of job advertisements. To deal with the high costs of job searches/applications where internet is not easily accessible and heavy transportation costs are incurred, a system to link job seekers to job advertisers should be set up to provide information related to jobs for graduates at University or TVET centers.

This paper has attempted to dig deeper in terms of identifying the deep-rooted challenges of youth unemployment in urban areas with the aim of identifying the major entry points, categorizing priority sectors that have potential to absorb the unemployed youth in urban areas. This has provided tangible intervention policy targets that could be implemented to tackle urban youth unemployment, as well as producing a long-term effect in helping secure better

livelihoods at the household level in the short-run and sustainable development of society and the nation in the longer-term.

We have identified the sectors that contribute most in urban areas, particularly in Addis Ababa, are the clothing and textile, tourism and hospitality, and construction sectors. Given these sectors have a huge potential to absorb young graduates in urban areas, it is important to target these while designing mechanisms to linking potential employers to the young and unemployed. Equally important, while these sectors have high labor absorption capacity, is ensuring the creation of decent jobs with adequate salary, sick leave, and annual leave as well as carefully assessing and promoting the level of casual labourers.

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# **Rural-urban Differentials in Under-Five Child Mortality: Empirical Evidence from Ethiopia**

**Yibrah Hagos Gebresilassie, Phocenah Nyatanga and Mekonen  
Aregai Gebresilassie<sup>1</sup>**

*In Ethiopia, child mortality rate under the age of five is higher in rural areas than in urban areas. However, there has been little study of the factors that explain these rural-urban differentials in the child mortality rate. The main objective of the paper is to examine the factors affecting rural-urban differentials in under-five child mortality in Ethiopia. Data from the three Demographic and Health Surveys conducted in 2005, 2011, and 2016 in Ethiopia was analysed using a binary logistic regression to examine the association between the different factors and under-five child mortality. Also, Fairlie's decomposition technique was applied to identify the relative contribution of individual factors to rural-urban differentials in under-five child mortality. The rural-urban gap in child under-five mortality was explained by the distribution of the covariates between rural and urban areas. The child's birth weight, maternal education, household size, and mothers' exposure to mass media all contributed to narrowing the disparities in child mortality rates. Antenatal healthcare services and the numbers of women using modern contraceptives also contributed to widening the rural-urban differentials. The paper also found that although under-five child mortality has been reduced in Ethiopia, profound variations have persisted between rural and urban areas. It is clear that in addition to strengthening the health extension programme in rural areas, substantial efforts must also be made to improve the child's birth weight, women's education, and women's antenatal healthcare services.*

**Keywords:** Decomposition, differential, mortality, Oaxaca-Blinder, under-five child

**JEL Classification:** D24, I14, J13, R23, R58

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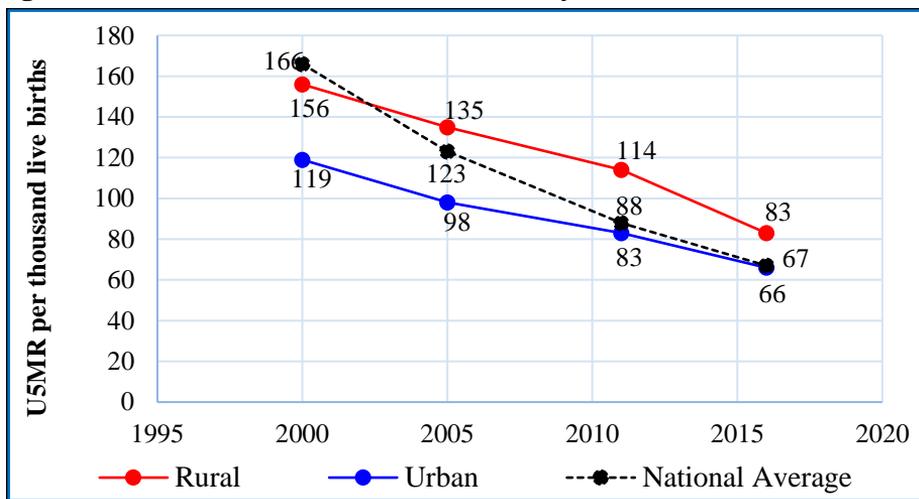
## 1. Introduction

The variations in child mortality between rich and poor countries are wide and growing, and evidence indicates growing inequity within countries (Victora *et al.*, 2003; Mulholland *et al.*, 2008). While remarkable progress made globally in reducing child mortality, the rate of reduction remains disproportionate between developed and developing countries. The highest rates of under-five child mortality continue to be found in sub-Saharan Africa, with the region accounting for half of the 8.8 million under-five year-olds' deaths globally in 2008 (UNICEF, 2010).

Ethiopia is one of the countries in the region that has made remarkable progress in reducing the overall under-five child mortality rate (U5MR), but significant variations persist between rural and urban areas. Rural under-five children in Ethiopia faced higher mortality risks than their urban counterparts, irrespective of the national average mortality rate (Figure 1) (CSA, & ORC Macro, 2000; 2006; CSA & IFC International, 2012; and 2016). According to the 2005 Ethiopia Demographic and Health Survey, the country's under-five mortality rate reduced from 205 in 1990 to 123 deaths per thousand births in 2005, but the disaggregated data revealed a significantly higher mortality rate in rural (135 deaths per thousand births) compared to urban areas (98 deaths per thousand births) (CSA & ORC Macro, 2006; UNIGME, 2015). Similarly, in 2011, the country's under-five child mortality was 88 deaths per thousand births while the disaggregated data revealed child mortality under the age of five to be significantly higher in rural areas (114 deaths per thousand births) compared to urban areas (83 deaths per thousand births) (CSA & IFC International, 2012). Moreover, findings of the latest 2016 Ethiopia Demographic and Health Survey indicated that while the under-five mortality rate declined substantially to 67 deaths per thousand births in 2016, the figure for urban areas was 66 deaths per thousand and for rural areas 83 deaths per thousand births (Figure 1) (CSA & IFC International, 2016). Indeed, the Ethiopian U5MR trend shows that there has been a sustained and significant difference between rural and urban areas in under-five child mortality rates. Although there have been several studies that have examined the impact of various factors on infant and/or under-five child mortality in Ethiopia (Amouzou *et al.*, 2014; Assefa *et al.*, 2013; Dejene & Girma, 2013; Gizaw, 2015; Regassa, 2012, among others), none of these studies has addressed the issue of rural-urban differentials in infant and/or under-five child mortality,

and the reasons for it have remained unclear. Given the lack of empirical evidence, this study aims to explore the factors explaining rural-urban differentials in under-five child mortality in Ethiopia.

**Figure 1: Trends of under-five child mortality across rural and urban areas**



Source: Authors' computation (CSA, & ORC Macro, 2000; 2006; CSA & IFC International, 2012; and 2016)

Section two discusses the methodology, section three presents empirical findings followed by discussion and the conclusion of the study in sections four and five.

## **2. Methods**

### **2.1 Data Sources**

The data is derived from the three Ethiopia Demographic and Health Surveys (EDHS) conducted in 2005, 2011, and 2016 (EDHS-2005, EDHS-2011, and EDHS-2016). The EDHS is a cross-sectional large-scale data and multi-round survey conducted on a nationally representative basis, with data collected both from urban and rural sample households throughout Ethiopia. The data were collected from under-five children through women's questionnaires in which they were asked to provide information about childbirth history; improved infant feeding practices and breastfeeding; delivery, antenatal, and postnatal

healthcare services and mortality, as well as fertility preferences; family planning; and mothers' and husbands' background characteristics.

The EDHS-2005 interviewed 14,645 households and 14,070 women of child-bearing age (15-49 years) and their respective children covering a total of 9,861 under-five children (9,002 from rural areas and 859 from urban areas). EDHS-2011 interviewed 16,702 households and of these, 16,515 were women respondents of age 15-49 years across the nine regional states with a total 11,232 under-five children (3,819 from rural areas and 7,413 from urban areas). EDHS-2016 interviewed a total of 16,650 households. Of these, 15,583 were women respondents of age 15-49 years for a total of 41,392 under-five children (36,473 from rural areas and 4,919 from urban areas). The three EDHS surveys applied standardised questionnaires, sample design, and field procedures to collect data. A detailed description of the survey design of the three EDHS is available in the respective national reports (CSA, & ORC Macro, 2000; 2006; CSA & IFC International, 2012; and 2016).

## **2.1. Description of Variables**

The outcome variable of interest employed in this study was under-five child death, which was assigned a value of 1 if the child died before age 59 months and 0 otherwise. Many studies have highlighted the role of proximate and socio-economic factors in explaining child mortality in various countries (Trussell & Hammerslough, 1983; Mosley & Chen, 1984; Sastry, 1997; Rutstein, 2000; Kuate-Defo and Diallo 2002; Hosseinpoor *et al.*, 2006; among others). Among the proximate factors included in the model were child's age, the gender of the child, child's birth order, child's birth spacing (interval), child's size at birth, and maternal age at first birth. The socio-economic factors included in the model were mother's education, mother's exposure to media, antenatal healthcare services, mother's working status, mother's exposure to mass media, place of delivery, and religion.

## **2.2. Estimation Technique**

Using the three rounds of EDHS data sets, we conducted a binary logistic regression to examine the association between under-five child mortality and independent variables. One of the most common techniques employed to identify

and quantify group differences in labour market, health, and other outcomes is the Oaxaca-Blinder decomposition (Blinder, 1973; Oaxaca, 1973). Thus, we employed the extension of the Oaxaca-Blinder decomposition technique that is appropriate for binary models to decompose the rural-urban gap in under-five child mortality into contributions that can be attributed to different determinant factors (Fairlie, 2005). Statistical computation was made by a STATA statistical software package version using the *fairlie* user-command available in Stata. Thus, the rural-urban differentials in the average value of under-five child mortality using the Oaxaca-Blinder decomposition technique proposed by the Fairlie (2005) can be described as:

$$\overline{U5MR}^{Rural} - \overline{U5MR}^{Urban} = [(\bar{X}^{Rural} - \bar{X}^{Urban})\bar{\alpha}^{Rural}] + [\bar{X}^{Urban}(\bar{\alpha}^{Rural} - \bar{\alpha}^{Urban})] \quad [1]$$

Where  $\bar{X}^j$  is a row vector of average values of independent variables and  $\bar{\alpha}^j$  represents the vector of coefficient estimates for the type of residence (rural vs urban). An extension of this Oaxaca-Blinder decomposition to a non-linear equation,  $U5MR = (X\bar{\alpha}^j)$  can be described as:

$$\begin{aligned} \overline{U5MR}^{Rural} - \overline{U5MR}^{Urban} = & \left[ \sum_{i=1}^{N^{Rural}} F \frac{X_i^{Rural} \bar{\alpha}^{Rural}}{N^{Rural}} - \right. \\ & \left. \sum_{i=1}^{N^{Urban}} F \frac{X_i^{Urban} \bar{\alpha}^{Rural}}{N^{Urban}} \right] + \\ & \left[ \sum_{i=1}^{N^{Urban}} F \frac{X_i^{Urban} \bar{\alpha}^{Rural}}{N^{Urban}} - \right. \\ & \left. \sum_{i=1}^{N^{Urban}} F \frac{X_i^{Urban} \bar{\alpha}^{Urban}}{N^{Urban}} \right] \quad [2] \end{aligned}$$

We defined  $\overline{U5MR}^j$  as the average probability of the binary outcome of interest group  $j$  and  $F$  is the cumulative distribution function from the logistic distribution. 'N' stands for the sample size of rural and urban areas. The first term in the left-hand side of equation [01] and [02] provide an estimate of the contribution of rural-urban gaps in the entire set of independent variables to the rural-urban variations in under-five child mortality.

According to Fairlie (2005), using the coefficient estimates from the logit regression for the pooled sample,  $\hat{\alpha}^*$ , the individual independent

contribution of  $X_1$  to the rural-urban gaps in under-five child mortality can be described as:

$$\overline{U5MR}^{Rural} - \overline{U5MR}^{Urban} = \frac{1}{N^{Urban}} \sum_{i=1}^{Urban} F(\hat{\alpha}^* + X_{1i}^{Rural} \hat{\alpha}_1^* + X_{2i}^{Rural} \hat{\alpha}_2^*) - F(\hat{\alpha}^* + X_{1i}^{Urban} \hat{\alpha}_1^* + X_{2i}^{Urban} \hat{\alpha}_2^*) \quad [3]$$

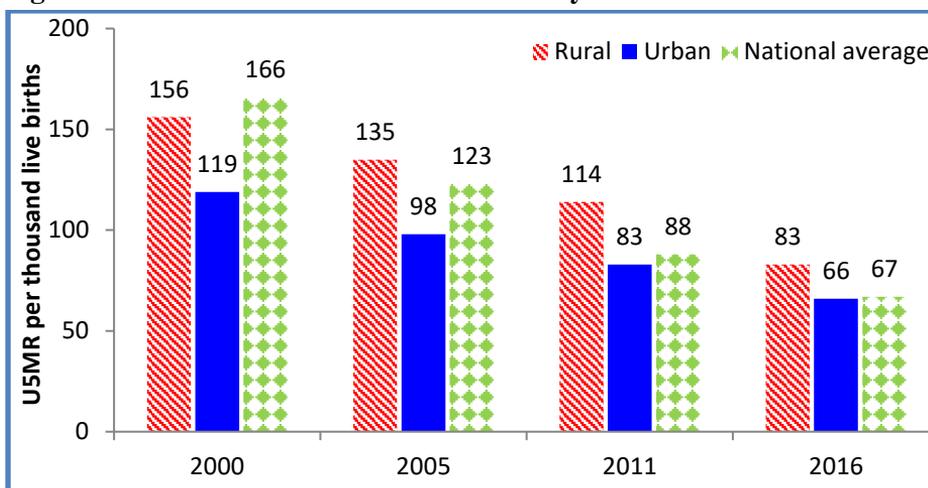
The contribution of each covariate to rural-urban gaps in under-five child mortality is thus equal to the changes in the average predicted probability from replacing urban distribution with rural distributions, while holding the distribution of all other factors constant.

### 3. Empirical Results

#### 3.1 Trends in the Rural–urban Gaps in Under-five Child Mortality in Ethiopia

A trend of comparison between rural and urban areas indicates that there has been narrowing of the gap for under-five child mortality (Figure 2), with the rural-urban ratio of under-five child mortality rate reversing in favour of the rural areas. Overall, childhood mortality reduced in both rural and urban areas, but the rate of reduction was more rapid in rural areas. The under-five child mortality rates were always higher in rural than urban areas. As indicated in Figure 2, there was a significant rural disadvantage in under-five child survival at the national level. The trend in the rural-urban variations in under-five child mortality revealed that the gap has been reduced significantly over the last fifteen years. While the rural under-five mortality decreased from 156 deaths per thousand births in 2000 to 135 deaths in 2005 and 83 deaths per thousand births in 2016, urban under-five mortality decreased from 119 deaths in 2000 to 98 deaths in 2005 and to 66 deaths per thousand births in 2016. Hence, although the absolute gap in rural-urban in under-five child mortality decreased over time, the relative gap concerning total under-five child mortality in Ethiopia has not significantly reduced. Analysis of rural-urban differentials in under-five child mortality using the three rounds of EDHS also yields a similar picture of rural disadvantage over the urban areas counterpart in terms of survival.

**Figure 2: Trends in under-five child mortality**



Source: Authors' computation (CSA, & ORC Macro, 2000; 2006; CSA & IFC International, 2012; and 2016)

### 3.2 Factors Explaining Rural–urban Gap in Under-five Child Mortality

Table 1 presents the findings of the detailed decomposition of the rural-urban gap in under-five child mortality by the independent variables. While the negative contribution of a covariate indicates that particular covariate contributed to reducing rural-urban gap in under-five child mortality, the positive contribution of a covariate indicates a widening rural-urban gaps in under-five child mortality. Overall, findings revealed that about 69-86 percent of the rural-urban gaps in under-five child mortality were explained by differences in the distribution of decomposed factors (covariates effect). Although the magnitude of the contribution of these factors differed over the three EDHS surveys, the direction of contribution remained the same for most covariates. Findings of the analysis indicated that the contribution of the proportional differences in under-five children who had an average or less than average size at birth contributed 60 percent to rural-urban gaps in under-five child mortality in EDHS-2005, though this contribution was reduced to 31 percent in EDHS-2011. The contribution of the proportion of maternal education reduced rural-urban gaps in under-five child mortality by 53 percent in EDHS-2005 and by two percent each in EDHS-2011 and EDHS-2016.

**Table 1: Detailed decomposition of the rural-urban gaps in under-five child mortality, EDHS-2005, EDHS-2011, and EDHS-2016**

Determinants	EDHS-2005		EDHS-2011		EDHS-2016	
	Estimates	Share	Estimates	Share	Estimates	Share
Child's age	-0.45	2.09	-0.23	0.62	-0.65	2.87
Child's sex (=female)	-0.05	0.23	-0.13	0.35	-0.25	1.11
Child's birth order>4	0.23	1.07	-0.12	0.32	-0.36	1.59
Short birth interval	-0.24	1.12	0.19	0.51	0.06	0.26
Maternal age at first birth	-0.08	0.37	-0.05	0.14	-0.03	0.13
Child's birth size	-12.98***	60.23	-11.47**	30.95	-21.15*	93.37
Maternal education	-11.45*	53.18	-0.87**	2.35	-0.54***	2.38
Antenatal healthcare services	12.65**	58.76	9.11	24.58	6.38**	28.17
Mothers using modern contraceptive	13.75*	63.86	5.67**	15.30	14.53***	64.15
Mothers' working status	4.53	21.04	7.27	19.62	8.35	36.86
Household size	-20.25*	94.05	-12.19**	32.89	-16.23***	71.66
Mothers' exposure to mass media	-15.45*	71.76	-13.45	36.29	-19.27***	2.38
Place of delivery	-10.11***	46.96	-6.98*	18.83	-22.23***	98.15
Religion (=Christian)	-13.65	63.40	12.99	35.05	0.28	1.24
Total gap	21.53	100	37.06	100	22.65	100
Explained gap	16.67	77.43	25.76	69.51	19.37	85.52
Number of observations		9,861		11,232		41,392

Sources: Authors' computation (CSA, & ORC Macro, 2006; CSA & IFC International, 2012; and 2016)

Note: The share is expressed as percentage of the total explained gap.

The findings further indicated that the contribution of household size in reducing the rural-urban gaps in under-five child mortality risk was overwhelming. Thus, the differences in proportional distribution of household size reduced rural-urban gaps in under-five child mortality by 94 percent in EDHS-2005, 33 percent in EDHS-2011, and 72 percent in EDHS-2016. The proportional distribution differences for mothers who had exposure to mass media between the rural and urban areas reduced the gaps in under-five child mortality by 72, 36, and 2 percent in EDHS-2005, EDHS-2011, and EDHS-2016, respectively. The differences in proportional distribution of place of delivery between rural and urban areas reduced the gaps by 46, 19, and 98 percent in EDHS-2005, EDHS-2011, and EDHS-2016, respectively. However, the

contribution of proportional differences in antenatal healthcare service visits widened rural-urban gaps in under-five child mortality by approximately 13 percent in EDHS-2005 and 25 percent in EDHS-2016. The proportional differences in the distribution of mothers who used modern contraceptive widened rural-urban gaps in under-five child mortality by 64, 15, and 64 percent in EDHS-2005, EDHS-2011, and EDHS-2016, respectively (Table 1).

#### **4. Discussion**

Although under-five child mortality gaps between rural and urban areas have been reduced, the rate of reduction has not been consistent over the time periods for rural and urban areas. The narrowing of rural-urban gaps seems to be mainly due to a relative decline in under-five child mortality in rural areas, but the considerably higher under-five child mortality in rural areas indicates an unequal proportional distribution and use of resources, mainly healthcare services by type of residence.

To the authors' knowledge, this study is the first of its kind in the Ethiopian context to examine factors affecting the rural-urban gap in under-five child mortality. It has identified some important factors that explain rural-urban gaps in under-five child mortality. Considerable rural-urban differentials in under-five child mortality persist with substantial mortality disadvantages in rural areas. Findings indicate that maternal education significantly reduced the rural-urban gaps in under-five child mortality. This study also confirms the findings of Ellen et al (2009) about the unequal proportional distribution of maternal education by rural-urban residences. It also suggests household size has played an important role in reducing rural-urban gap in under-five child mortality in the last decade and a half. This corrects the findings of some previous studies (Nandita et al., 2013).

The results of the present study indicated that the proportional distribution differences in mothers who had exposure to mass media between rural and urban areas reduced gaps in under-five child mortality. Yi et al. (2011) reported similar results. The proportional differences in the distribution of women who used modern contraceptives also reduced the rural-urban gaps in under-five child mortality. These findings, however, are inconsistent with Nandita et al. (2013), which indicated that the differences in the distribution of women who used modern contraceptives widened the gaps between rural and urban areas in

infant mortality. Modern contraceptive use by currently married Ethiopian women has steadily increased over the last 15 years, jumping from 6 percent of usage in 2000 to 35 percent in 2016 (CSA & IFC International, 2016).

In Ethiopia, the proportion of women of age 15-49 years who received antenatal healthcare services from a skilled healthcare services provider increased from 27 percent in 2000 to 34 percent in 2011, and 62 percent in 2016. Some 32 percent of women had at least four *antenatal healthcare service* visits during their last pregnancy. *Urban women are more likely than rural women to receive any antenatal healthcare service from a skilled provider (90 and 58 percent, respectively) (CSA, and IFC International, 2016).*

The findings of this study revealed that mothers' age at first birth was the major determinant factor in explaining or reducing rural-urban gaps in under-five child mortality. Here we are in complete agreement with the findings of the study by Njagi (2011). *The age at which a mother commences childbearing is an important determinant factor affecting the health and well-being of the mother and her child. Rural women age 25-49 began childbearing 2.7 years earlier than their peers in urban areas (CSA, and IFC International, 2016).* Furthermore, an under-five child whose birth size is less than average has significant higher mortality risk than an average *or heavier birth*. The findings of the present study agreed with Njagi (2011) that birth size affected the rural-urban gaps in child mortality. Ellen (2009) also found that a child's size at birth helped explain the rural-urban differentials in child mortality.

Finally, we found that the effect of institutional delivery reduced rural-urban gaps in under-five child mortality. Compared to home delivery, the differences in proportional distribution of institutional deliveries narrowed the gaps between rural and urban areas in under-five child mortality. This study's findings are in line with previous studies who reported similar results on the effect of institutional deliveries in explaining rural-urban gaps in under-five child mortality (Yi et al., 2011). In Ethiopia, although institutional deliveries that took place in health facilities increased from 10 percent in 2011 to 26 percent in 2016, *home delivery is still common, primarily in hard-to-reach rural areas.*

This study's findings have important policy implications. First, the persistence of considerable rural-urban under-five child mortality differentials at the national level suggest the failure of social and health policies to ensure sustainable health progress across all population groups. The results suggest that in addition to strengthening antenatal healthcare service visits during pregnancy

in rural areas, substantial efforts must also be made to improve mothers' exposure to mass media, institutional delivery, use of modern contraceptives, the issue of early marriage, enhancing children's birth intervals, and female education. It should be noted, however, that despite an overall health advantage, enormous differences exist between urban poor women and better off women in accessing maternal and child healthcare services (Tymicki, 2009). Policy actions directed towards the improvement of the health of the rural population should not be performed at the expense of other disadvantaged groups.

## **5. Conclusion**

In Ethiopia, although child mortality rate under the age of five declined during 2000-2016, considerable disparities persisted between the rural and urban areas of the country. Findings indicate that this rural-urban gap in under-five child mortality can be explained mainly by differences in the distributions of factors that determine under-five child mortality and by differences in the effects of those determinant factors in rural and urban areas. It is interesting to note that while the relative contribution of child's birth size, maternal education, household size, mothers' exposure to mass media, and place of delivery reduced rural-urban gaps in under-five child mortality, the contribution of antenatal healthcare service visits and mothers' use of modern contraceptives widened the gaps between rural and urban areas between 2005 and 2016. The reduction of disparities in under-five child mortality between rural and urban areas needs to be placed at the top of the agenda to reduce overall national child mortality in Ethiopia.

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# **Impact of Credit Constraints and Climate Variability on Agricultural Productivity: Panel Data Evidence from Rural Ethiopia**

**Hailu Elias<sup>1</sup>**

## *Abstract*

*Increasing agricultural productivity is a major step towards transforming the rural economy and ensuring food security. This paper uses household level panel data linked with climate data to examine the impact of different credit constraint conditions on agricultural productivity under changing climatic conditions. A propensity score matching (PSM) and a difference-in-differences (diff-in-diff) methods were employed to provide unbiased estimates of the production impacts of credit constraints on crop productivity. After controlling for potential selection bias, it found that relaxing credit constraints increases agricultural productivity by Ethiopian Birr 169 per hectare, while the real crop revenue for discouraged and quantity constrained farmers declined by Ethiopian Birr 443 and 275 per hectare respectively. These results suggest that relaxing credit constraints by improving performance of the rural credit market could significantly increase agricultural productivity in rural Ethiopia.*

**Key words:** Credit constraints, agricultural productivity, PSM, Climate variability, Ethiopia.

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## 1. Introduction

African agriculture is characterized by low productivity and harsh weather conditions including erratic rainfall and high average temperatures (Di Falco et al, 2011). Among African countries, Ethiopia is the most vulnerable country to climate change with the least adaptive capacity (Thornton *et al.*, 2008). This is mainly because rain-fed subsistence agriculture is the primary source of food and income for more than 80 percent of Ethiopians. Climatic factors present a great risk to agricultural productivity and food security. This calls for the adoption of effective climate adaptation strategies and agricultural technologies to improve productivity and achieve food security. Agricultural production involves a time lag between planting and harvesting, leading to uneven timing between agricultural income and expenditure; access to an affordable source of credit could be expected to relax the liquidity constraints of farmers.

However, performance of the rural credit market in developing countries is generally poor due to imperfections including weak contract enforcement, underdeveloped information systems, imperfect property rights, and unstable political institutions (Andersen, 2012). Contract challenges and problems related to information asymmetries about borrower type and behavior leave poor households in a credit constraint condition (Jack, 2011). Lenders often use collateral as a strategy to offset problems related to asymmetric information and moral hazards. Farmers however, lack required loan collateral and face credit constraints during crucial periods such as peak planting seasons. The result is they are forced to use minimal amounts of productivity-enhancing technologies, leading to lower yields (Morduch, 1995).

In countries where the credit market is weak, the impact of natural disasters on the aggregate output will also be more severe. For instance, Raddatz (2007) showed that climatic shocks have long term negative effects on the GDP in poor countries where the credit market is fragile. Thus, governments of some developing countries do now give due attention to the performance of the rural credit market given its role in improving productivity, household food security and reducing vulnerability to climate change. In Brazil, for instance, the official rural credit portfolio covers about a third of the annual financial needs of the agricultural sector (Assunção et al., 2013).

Micro-level studies from different countries also show that household welfare is significantly reduced when credit constraints are intertwined with

climatic shocks. Rosenzweig and Wolpin (1993) and Jacoby and Skoufias (1997) found that credit constraints caused by imperfections in the credit market have long-term welfare effects when climatic shocks also hit households. The effect is most severe on poorer households because such shocks can destroy their lifetime wealth directly and also reduce their current and future agricultural income. It may also reduce their earning potential through forced dispersal of productive assets.

Despite the immense literature on the links between climate change and choice of different adaptation strategies in the African context (see: Kurukulasuriya, 2008; Hassan and Nhemachena, 2008; Deressa et al, 2008; Di Falco *et al.*, 2011; Bezabih and Di Falco, 2012), the effect of different credit constraint conditions on agricultural productivity under changing climatic conditions has not been studied in depth, especially within a panel framework. Previous studies did not assess this link in the context of rural Ethiopia in general, or use household level panel data particularly from this study area.

In filling this gap, the current study is set out to examine the agricultural productivity trend in the study area; identify key variables which determine the probability of a household to fall into a given credit constraint category; evaluate the impact of multiple credit constraints on agricultural productivity under changing climatic condition; and generate policy-relevant information on approaches to enhance agricultural productivity by improving performance of the rural credit market.

Section 2 of this paper describes the data and variables used in the analysis and the methodological approach consisting of a theoretical model on the productivity effects of credit constraints. The econometric strategy is presented in section 3 and discussion of the results is provided in section 4. Section 5 concludes with some policy implications.

## **2. The Dataset and Variables used in the Study**

The data used for this study was drawn from two waves of panel survey conducted by the Ethiopian Project on Interlinking Insurance and Credit in Agriculture (EPIICA) designed by the Ethiopian Economics Association/Ethiopian Economic Policy Research Institute (EEA/EEPRI) and implemented jointly by the Ethiopian Economics Association, the University of California San Diego, the University of Athens, Greece, Dashen Bank and the

Nyala Insurance Company. While the first survey was conducted in 2011, the second round was conducted two years later in 2013. This study is based on the data drawn from both rounds.

The farm households were selected from four zones (north Shewa, south Wollo, north Wollo and west Gojjam) of the Amhara National Regional State located in the northern and central highlands of Ethiopia (Figure 2). About 33 percent of the 1,200 sampled households resided in north Shewa zone, 31 percent in west Gojjam, 23 percent in south Wollo, and the remaining 13 percent in north Wollo zone.

This unique panel data contains quantitative information on agricultural production, agricultural input use, access to credit, consumption expenditure and household's socio-economic characteristics. The household socio-economic characteristics contain demographic information (e.g. age, education, and marital status), household borrowing and lending behaviour, food consumption items, consumption and non-consumption expenditure, income from different sources, risk, food security, and asset holdings of farm households. The agricultural production section contains detailed information on crop production, cultivated land area, the types of inputs used, the type of crops produced, the amount produced and the amount sold, as well as livestock production and marketing of farm households.

## **2.1 Constructing the Panel Data Set and Linking it with Climate Data**

Even though the measurement for most of the variables used in the analysis was straight forward, the data cleaning process required explanation for some of the variables. Farmers reported their cultivated land by using different local units of measurement, so plots cultivated by households measured by local units were converted into a standard measure of hectares, using standard conversion units from EPIICA conversion factors collected during the survey period. The plot level information was aggregated into household level. Quantity of crop produced was also converted into standard units (kg) using local unit conversion factors prepared during the data collection. The quantity of production (cereal crops and root crops or fruits) was converted into value in ETB. The nominal value of production was converted into real values using CSA's production price data, using 2011 as a base year. Finally, a balanced panel of

1,189 households consisting of 2,378 observations over the two rounds of data collection was created.

Monthly rainfall data were obtained from the National Meteorological Agency of Ethiopia, from eight stations close to the study districts (*woredas*) for the years between 1983 and 2013. The rainfall measure was constructed by taking the sum of monthly rainfall for each year and averaging it over 30 years. The temperature average was also calculated as the monthly temperature average, also averaged over 30 years. The coefficient of variation (CV) for rainfall was calculated as the standard deviation divided by the mean for the respective periods. These climate variables were linked with the household survey data using the latitude, longitude and other relevant geographic information such as the zone and district of the households (Wahba, 1990; Wood, 2003).

## **2.2 Dependent Variable: Agricultural Productivity**

The outcome variable of interest in this study is real crop revenue per hectare, since crop production is the major agricultural activity in the study area and provides the largest share of agricultural production. Various annual crops (cereals, pulses, oil seeds, fibers, cotton and root crops) and perennials are grown in different parts of the Amhara region based on the suitability of agro-ecological conditions. Because farmers in the study area are engaged in the production of several different types of crops, monetary values were used instead of quantities to measure productivity and make it comparable across households. Productivity was measured as real crop revenue per hectare accounting for inflation.

## **2.3 Explanatory Variables and Hypothesis**

Variables explaining agricultural productivity were categorized into measures of climate variability; indicators of credit constraint status; household demographic characteristics; ownership of physical assets, and social capital.

### **2.3.1 Credit constraint categories**

Farm households were classified into four credit constraint categories based on responses to the specific questions raised in relation to willingness to participate in the rural credit market. The first category included unconstrained borrowers who applied for credit and received the amount they requested and did

not want to borrow more. The other three categories, quantity-constrained, risk-rationed and discouraged borrowers, were identified using a direct (survey-based) elicitation strategy. Quantity-constrained borrowers are characterized by an excess effective demand for credit and they face a credit limit due to supply-side problems. It means that these households have applied for additional funds, but given the available contract terms, their request is partially or completely rejected. The risk-rationed sub category includes those who do not want to participate in the credit market even if the market is available because they do not want to risk their assets and hence are not willing to provide the necessary collateral, or simply do not want to incur debt. The discouraged households are those who do not want to borrow because of the high transaction cost of borrowing. These costs include, among others, the cost of preparing the loan application, evaluating viability of the project and value of the loan collateral, and monitoring the periodic loan repayment. These costs are independent of the loan amount and discourage farmers who apply for smaller amounts of loan (Kon and Storey, 2003; Guirkingner, 2008; Ayalew and Deininger, 2014).

### **2.3.2 A measure for climatic factors**

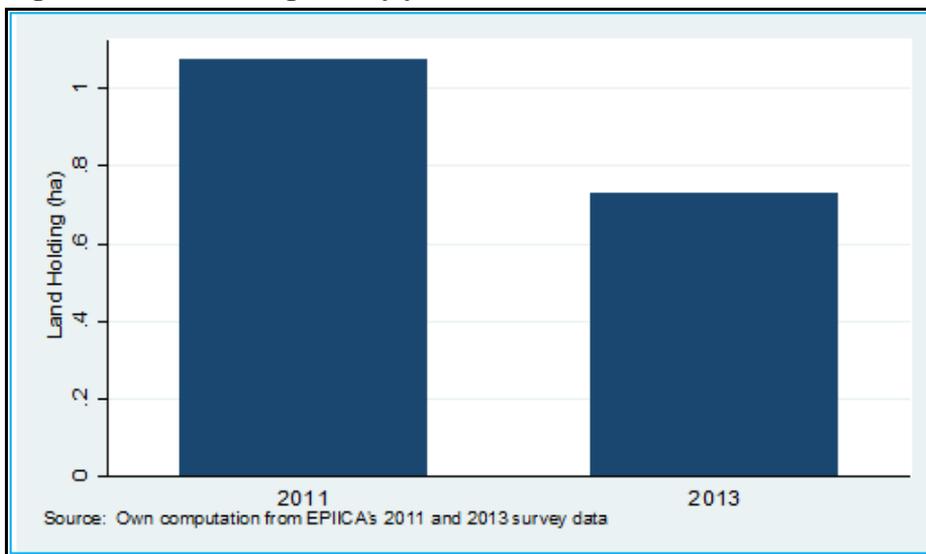
Climatic factors were captured using rainfall variability and the incidence of drought. Monthly rainfall data were obtained from the National Meteorological Agency of Ethiopia, from eight stations close to the study districts (*woredas*) for the years between 1983 and 2013. About 39 percent of the households in the sample reported they had faced drought shocks during the two survey years.

### **2.3.3 Ownership of physical assets and social capital**

Land holding is the major productive physical asset that determines the social and economic status of farmers in the study area. The data reveals that the mean land holding was about 1.07 hectares (ha) in 2011 and it had declined to about 0.73 in 2013 (Figure 1). A major reason for this might have been fast population growth in the country in general, and that of the region in particular. As the population grows, the demand for farm land increases while the land size is fixed. Among the farming communities surveyed, farmers in west Gojjam owned relatively larger amounts of land in 2011 followed by north Shewa and south Wollo. Estimates indicate that an average household with 5 members would require about one hectare of land for subsistence production (Alemneh, 1990), and the decline in land holdings observed in the study area is a major cause of

concern in terms of feeding an ever-increasing population, especially given the low levels of productivity.

**Figure 1: Land holding (ha) by year**



The social capital variables included in the analysis as explanatory variables are trust and participation in farmers' primary cooperatives, and membership in a rotating saving and credit association (ROSCA). These are important social assets enjoyed for their own sake, used for material gain, and called upon in times of shock or crisis (Woolcock and Narayan, 2000). Trust in cooperatives is represented by a dummy variable with a value of 1 if respondents trust their cooperatives and 0 otherwise.

#### **2.3.4 Socio-economic characteristics**

Household socio-economic characteristics such as age, gender, marital status, and level of education of the household head were included in the analysis as control variables. The average age of household heads in the sampled zones was about 50 years, with heads in west Gojjam zone being relatively younger than those in the other three zones. The average household size was approximately five. About nine percent of the households in the study sites were headed by females in 2011, with this figure increasing to twelve percent by 2013. About 22 percent of the household heads have around 5 years of formal education; 27 percent had attended some informal education in 2011 and 24 percent in 2013.

### 3. Methodology

#### 3.1 Quantifying the Productivity Effects of Credit Constraints and Climatic Factors: A Theoretical Framework

To increase crop production and to cope with the changing climatic conditions, rural farm households use both modern and traditional technologies including multiple cropping on one field, mixed farming of crops and livestock, using improved seeds (e.g. drought resistant crop varieties), irrigation, selling valuable assets, reducing household consumption, and other related mechanisms (Teklewold *et al.*, 2013). However, credit constraints have an adverse impact on the adoption of strategies to deal with a multitude of agricultural production constraints. This implies that useful information can be obtained by analyzing the link between financial constraints and agricultural productivity, both theoretically and empirically.

##### 3.1.1 The set up

Following the theoretical literature on producer-consumer models (e.g. Singh *et al.*, 1986; Sadoulet and De Janvry, 1995; Petrick, 2004; and Briggeman *et al.*, 2009), the impact of credit constraints on agricultural productivity under changing climatic conditions was conceptualized as below.

Assume a farm household which maximizes its utility by consuming  $C_0$  and  $C_1$  amounts of goods and services in periods 0 and 1, given a set of household characteristics  $z^h$ . The utility function is assumed to be inter-temporally additive, twice differentiable and quasi-concave such that:

$$u = (c_0, c_1; z^h) \quad [3.1]$$

Agricultural production in period 0 requires purchase of variable inputs ( $x$ ) such as seeds and fertilizer at a given price  $p$  and harvest occurs in period 1. These inputs can be purchased either with own resources ( $w$ ) or with a borrowed capital ( $k$ ) that will be repaid back with  $k(1 + r)$  in period 1 where  $r$  is the loan interest rate.

Let the agricultural production follow a twice differentiable and concave function:

$$y = f(x, z^y) \quad [3.2]$$

where  $z^y$  represents fixed and exogenous production inputs such as land and major farm tools.

Under this setup, a farm household tries to maximize the following utility function:

$\max u(c_0, c_1; z^h)$  subject to:

$$w + k - c_0 - px = 0 \quad [3.3]$$

$$f(x, z^y) - c_1 - (1+r)k = 0 \quad [3.4]$$

$$\bar{k}(z^h, z^y) - k \geq 0 \quad [3.5]$$

where equations (3.3) and (3.4) state the household budget constraints in periods 0 and 1, while equation (3.5) describes the credit<sup>2</sup> constraint condition in period 0 where  $\bar{k}(z^h, z^y)$  denotes the upper bound of credit that the household can obtain. In the rural areas of developing countries like Ethiopia, this constraint is compulsory due to a number of reasons. These include: the problem of adverse selection, moral hazard, and costly state verification due to information asymmetries as discussed in Stiglitz and Weiss (1981); screening, monitoring, and enforcement problems in under developed rural credit markets (Hoff and Stiglitz, 1996; and the problem of a lack of collateral. Lenders usually consider collateral an important means of reducing default risk and hesitate to grant credit to the poor who lack the required collateral. This makes credit constraints binding for the poor (Ghosh *et al.*, 2001).

To solve the above utility maximization problem, set the Lagrangian as:

$$L = u(c_0, c_1; z^h) + \psi(w + k - c_0 - px) + \zeta[f(x; z^y) - c_1 - (1+r)k] + \gamma[\bar{k}(z^h, z^y) - k] \quad [3.6]$$

The first order conditions (FOCs) of the optimal solution can be expressed as:

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<sup>2</sup> We took the Kuhn-Tucker conditions for equation (3.5) because it is an inequality constraint

$$\frac{\delta L}{\delta c_0} = \frac{\delta u(.)}{\delta c_0} - \psi = 0 \quad [3.7]$$

$$\frac{\delta L}{\delta c_1} = \frac{\delta u(.)}{\delta c_1} - \zeta = 0 \quad [3.8]$$

$$\frac{\delta L}{\delta x} = -\psi p + \zeta \frac{\delta f(.)}{\delta x} = 0 \quad [3.9]$$

$$\frac{\delta L}{\delta k} = \psi - \zeta(1+r) - \gamma = 0 \quad [3.10]$$

$$\frac{\delta L}{\delta \gamma} = k(z^h, z^y) - k \geq 0, \gamma \geq 0, \gamma \frac{\delta L}{\delta \gamma} = 0 \quad [3.11]$$

where equation (3.9) represents optimal production, while equations (3.7) and (3.8) represent optimal consumption. Equations (3.3), (3.4) and (3.11), on the other hand, are conditions which must be satisfied by an optimal solution, while  $\psi$ ,  $\zeta$  and  $\gamma$  are the lagrangian multipliers.

The subsequent section discusses how credit constraints affect household's production decisions under changing climatic conditions, first, by finding an optimal production decision when credit constraints are not binding<sup>3</sup>. Inserting equation (3.10) in to (3.9) given that  $\gamma = 0$  yields<sup>4</sup>:

$$\frac{\delta f(.)}{\delta x} = p(1+r) \quad [3.12]$$

This shows that the household production function does not depend on the utility function or on any of the household characteristics and this implies that household production and consumption decisions are now, separable. Hence, removing credit constraints by allowing farm households to have access to credit can ensure separability of production decisions from consumption decisions, allowing standard recursive household models to work. This in turn means that household resource allocation decisions will be efficient as the standard neo-classical household models predict (e.g. Singh *et al.*, 1986; Sadoulet and De Janvry, 1995).

<sup>3</sup> In the above setting, it is clear that credit constraints are not binding when gamma ( $\gamma$ ) = 0

<sup>4</sup> Given that  $\gamma = 0$  in equation (3.10) means that  $\psi = \zeta(1+r)$  and inserting it in equation (3.9) gives equation (3.12).

Equation (3.12) is similar to the standard resource allocation rule. However, it was assumed that household production and input purchase decisions are made in period zero, while income is earned in period one and hence input prices are inflated by the interest rate ( $r$ ).

On the other hand, when credit constraints are binding, equation (3.5) will hold with equality and hence  $\gamma > 0$  in equation (3.11) above. To show the effect of this constraint on input use, it is possible to rewrite equation (3.10) as:

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$$(1+r) = \frac{\psi - \gamma}{\zeta} \text{ . Solving for } \psi \text{ and substituting this expression in equation (3.9) yields:}$$

---


$$\frac{\delta f(.)}{\delta x} = [(1+r) + \frac{\gamma}{\zeta}]p \quad [3.13]$$

If the optimal input and agricultural technology demand which can be derived from equation (3.12) for credit unconstrained (cuc) households be denoted by  $x_{cuc}^*$  and the optimal input and agricultural technology demand for credit constrained (cc) households (which can be derived from equation (3.13)) by  $x_{cc}^*$ , then it is possible to note that the opportunity cost of the optimal input for the credit-constrained household ( $x_{cc}^*$ ) is greater than the opportunity cost for the credit-unconstrained household ( $x_{cuc}^*$ ) because it is inflated by  $(\frac{\gamma}{\zeta})p$  amount for credit-constrained households (see equation 3.13). This implies that credit-constrained households will lower the purchase of production inputs and agricultural technology ( $x$ ) to increase the value of the marginal product.

From the above theoretical analysis, it can be noted that total agricultural production and productivity of a credit-constrained household will be lower than that of a non-constrained household because of credit constraints and one objective of this study is to show the effect of this constraint on agricultural productivity under changing climatic conditions. The next section will focus on an econometric strategy to test the above theoretical model empirically.

### **3.2 The Econometric Model**

In relation to credit constraint conditions, farmers are not randomly assigned in different credit constraint categories. The probability of a given farmer falling in a constrained (treatment) or unconstrained (control) category depends, among other things, on the personal characteristics of that individual. In estimating the impact of credit constraints on agricultural productivity, it is crucial to take note of this potential selectivity bias.

Prior studies used different methods to control for such selection bias. Petrick (2004), for instance, used the Heckman estimator to show the effect of credit constraints on agricultural output while, Foltz (2004) used the switching regression technique to estimate the effect of credit constraints on agricultural investment. In another study, Briggeman et al., (2009) used the propensity score matching (PSM) method to control for a potential selection bias in estimating the impact of credit constraints on the value of the production for farm and non-farm sole proprietorships. This method was first suggested by Rosenbaum and Rubin (1983), and it has become a common impact evaluation tool. Using the PSM method can reduce the potential bias by making productivity comparisons between farmers who are credit constrained and those who are unconstrained. The main purpose of using the PSM method is to find a group of non-treated (unconstrained) farmers similar to the treated (constrained) groups in all relevant observable characteristics with the only difference being that one group is constrained and the other unconstrained.

Here, the PSM method is used to control for the possible selectivity bias in estimating the effect of credit constraints on agricultural productivity in rural Ethiopia (For more details, see: Smith and Todd, 2005; Briggeman et al., 2009; and Kassie et al., 2009).

The outcome of interest (which is the real crop revenue per hectare) is identified from the following equation:

$$E[Y_1 - Y_0 | D = 1] = E[Y_1 | D = 1] - E[Y_0 | D = 1] \quad [3.14]$$

where  $Y$  is the real crop revenue (rcr) per hectare and  $D$  indicates to which credit constraint category the household belongs.  $D$  takes the value of 1 for credit constrained farmers (treatment group) and it takes the value of 0 for unconstrained borrowers (control group). Thus, the outcome of interest is the average difference

in  $Y_1$  and  $Y_0$ . However, this matching exercise tries to estimate only  $E[Y_0 | D = 1]$ , which is the counterfactual or the unobservable case, since one farmer falls only in one state (either in the treatment group or in the control group) at a time. It means trying to estimate the impact of being credit constrained on the real crop revenue for those farmers who are actually unconstrained.

Had there been experimental data in which the farmers are randomly assigned to the treatment and control groups, it would have been possible to estimate the average treatment effect as:

$$E[Y_1 | D = 1] - E[Y_0 | D = 0] \quad [3.15]$$

However, the data at hand is only observational and hence, it is a must to follow the Rosenbaum and Rubin (1983) approach to solve the selection bias by estimating the equation below:

$$E[Y_1 - Y_0 | Z, D = 1] = E[Y_1 | Z, D = 1] - E[Y_0 | Z, D = 1] \quad [3.16]$$

where  $Z$  is set of covariates which determine the credit constraint status of farmers. If the probability of being credit constrained is determined by  $Z$ , then it is possible to establish a control group of unconstrained farmers that are similar in  $Z$  relative to the constrained farmers (the treatment group). Thus, from equation (3.16), it is possible to estimate the average treatment effect on the treated (ATT) as:

$$ATT = E[Y_1 - Y_0 | P(Z), D = 1] = E[Y_1 | P(Z), D = 1] - E[Y_0 | P(Z), D = 0] \quad [3.17]$$

where  $P(Z)$  is the probability of selection conditional on  $Z$  or is the propensity score (Pscore) which is:  $P(Z) \equiv \Pr(D = 1 | Z)$ .

The PSM was, therefore, done in two stages. First, the propensity scores (Pscores) were calculated using Stata's "pscore" command, which are the conditional probabilities that a given farmer is credit constrained. Calculating the propensity score is crucial since it is difficult to do the matching on each explanatory variable when there are many covariates. The main purpose of the propensity score estimation is to balance the observed distribution of covariates across the constrained and unconstrained groups. Following Lee (2008), a

matching test was also conducted after matching to check whether or not the differences in covariates in the two groups in the matched sample have been eliminated. In the second stage, the ATT was estimated using Stata's "psmatch2" command and the results are discussed below.

In addition to the PSM, the difference-in-differences (diff-in-diff) method was also used as a robustness test and the result is provided in Table 2A in the appendix.

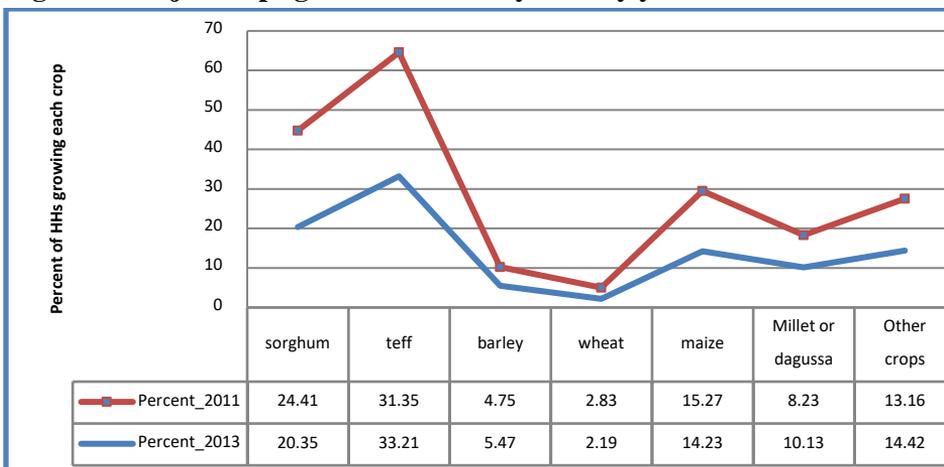
## **4. Results and Discussion**

### **4.1 Descriptive Evidence**

Agricultural production in the study area is dominated by 6 major cereals that account for about 86 percent of the total crop production (Figure 2). Among the cereals, teff, sorghum, and maize are the three major crops grown in the study area and they account for 31, 24, and 15 percent respectively in 2011. The last column in Figure 2 shows that the production of other crops such as oil seeds, pulses, perennials, and fruits and vegetables accounts for less than 15 percent over the years.

Agricultural productivity also remained very low over the years. Although there was a slight increase in productivity in north Shewa and north Wollo zones, the overall real value of output per hectare has been below ETB 1,500 during the study period (Figure 3). As in the case in Ethiopia in general climatic shocks, deforestation and land degradation, as well as lack of access to credit have been among the major causes for the lower agricultural productivity in the study sites.

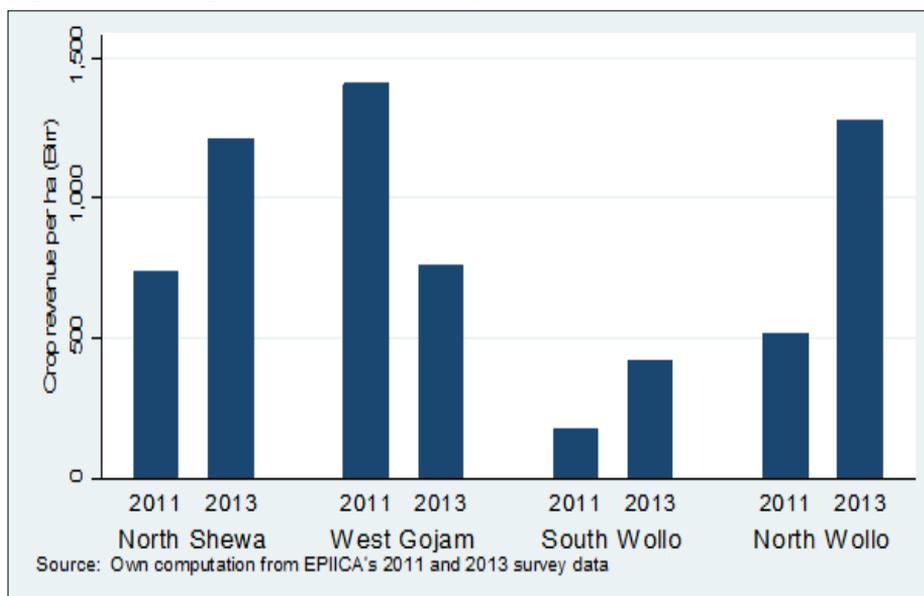
**Figure 2: Major crops grown in the study area by year**



Land expansion to increase agricultural production is no more a feasible option because of the high population pressure and scarcity of suitable farm land. Improving agricultural productivity must be the way out and this requires more investment in sustainable adaptation strategies, improved farming systems and adoption of agricultural technologies such as high-yielding, drought resistant varieties, chemical fertilizers, and soil conservation measures (Kassie *et al.*, 2011). Nevertheless, adaptation efforts have been very weak and technology adoption has remained very low in the Amhara region. There are a number of reasons including a lack of information and know-how about different agricultural technologies, and weak integration of research with agricultural extension to learn from day-to-day problems of farmers and incorporate these in designing better agricultural technology policies as well as minimal access to innovative and reliable credit facilities to purchase recommended agricultural technologies that could improve productivity (BoFED, 2013: p. 35).

Future climate Predictions using General Circulation Models (GCM) also show that the mean maximum temperature will increase by 2.3 °c in north Shewa, south Wollo and north Wollo zones in the 2080s while it will rise by 1.8 °c in west Gojjam zone. In addition, rainfall is expected to decrease by 27.2 percent in the first three zones while reducing by 12.2 percent in west Gojjam zone (Ayalew *et al.*, 2012). This implies that climate change will continue to be a major threat for the study area leading to increased exposure to rainfall variability, recurrent droughts and shortage of water. In the future, this can be expected to further reduce agricultural productivity of the study sites.

**Figure 3: Average real crop revenue per hectare (Productivity)**



## 4.2 Econometric evidence

### 4.2.1 Impact of being an unconstrained borrower on agricultural productivity under changing climatic conditions

The determinants of being an unconstrained borrower is estimated in the first stage of the propensity score matching method (Table 1), checked whether the balancing property is satisfied, and then the impact estimated on the average crop revenue per hectare in the second stage. Climatic factors, membership of social networks and associations such as rotating saving and credit associations (ROSCA), the socio-economic condition of the household, and location are found to be correlated with the probability of being an unconstrained borrower. The result shows that experiencing drought shock reduces the probability of being an unconstrained borrower by about 17 percent. This might be because of the dependence of agricultural production in the study area on rainfall, and lenders do not want to take uninsured risk of loan default in the case of crop failure caused by various climatic shocks including drought.

The probability of being an unconstrained borrower is found to be higher for female-headed households, and married farmers in the study area. The possible reason for this may be because married heads are more likely to be stable, trustworthy and abide by rules and regulations compared to the unmarried or

separated heads; financial institutions view them as more reliable and may allow better access to credit (Mpuga, 2008).

In terms of location, farmers living in west Gojjam zone are less constrained while those in south Wollo are more constrained compared to households residing in north Shewa zone. This implies that the credit constraint conditions of farmers vary across the study sites.

From the second stage regression, it was found that being an unconstrained borrower significantly increases the average crop productivity or crop revenue per hectare. Controlling for the effects of several covariates and the selection bias, having full access to credit is associated with significant crop revenue improvement. Unconstrained borrowers tend to enjoy Ethiopian birr 169 higher crop revenue per hectare compared to constrained borrowers (Table 2). This is the average treatment effect on the treated (ATT) and it is statistically significant.

#### **4.2.2 Impact of being a discouraged borrower on agricultural productivity under changing climatic conditions**

Adopting various agricultural technologies is a common strategy used by farm households to insure themselves against uncontrollable climatic factors. It also ensures their food security, and helps them to adapt to different agro-ecological production conditions, and to meet market demands (Winters *et al.*, 2006). However, credit constraints have significantly negative effects on technological adoption, since such investment requires substantial cash outlay.

In this paper, before estimating the impact of being a discouraged borrower on real crop revenue per hectare, key factors influencing the probability of being discouraged were identified. Climatic factors such as drought and rainfall variability, and year dummies were found to have a significantly positive effect on the probability of being discouraged (Table 3).

Table 2 shows the average effect of being discouraged over agricultural productivity in the study area. The estimated average treatment effect on the treated (ATT) shows that discouraging credit market conditions significantly reduce real crop revenue per hectare by about ETB 443, which is much lower than the productivity of unconstrained borrowers. This indicates the serious adverse effect of credit constraints on agricultural productivity in the study area.

#### **4.2.3 Impact of being quantity constrained borrowers on agricultural productivity under changing climatic conditions**

The result in Table 4 shows that climatic factors, membership in social networks and associations, socio-economic condition of the household, the year dummy, and location of residence are correlated with the probability of being quantity constrained borrowers, though some variables are insignificant. Table 2 shows the average effect of quantity constrained borrowers on agricultural productivity in the study area. Quantity constrained borrowers would have earned crop revenue in real terms of about ETB 275 higher had they not been constrained in the credit market. In other words, the estimated average treatment effect (ATT) shows that quantity constraint has a negative and statistically significant effect on crop revenue per hectare for constrained farmers.

#### **4.2.4 Impact of being risk rationed borrower on agricultural productivity under changing climatic conditions**

Experiencing drought shock and rainfall variability found to significantly increase the probability of being risk-rationed borrower (Table 5). This might be because such farmers do not want to borrow from the formal credit market not to take the risk of loan default in the case of crop failure. After controlling for the potential selectivity bias, it was found that being risk-rationed borrower has a negative but insignificant effect on agricultural productivity in the study area.

### **5. Conclusion and Implications**

The main objective of this paper was to investigate the effect of different credit constraint conditions on agricultural productivity among smallholder farmers in selected zones of the Amhara Regional State in the northern highlands of Ethiopia. Household level survey data were used to estimate these effects. To mitigate biases stemming from heterogeneity, the propensity score matching (PSM) method was applied to measure the effect of the treatment (being credit constrained) on the treated farmers.

The results provide strong evidence for the adverse effects of being credit constrained (falling within discouraged or quantity constrained borrower groups) in improving agricultural productivity in the study area. Farmers want to invest in fertilizers, improved seeds, and drought-resistant crops which can increase productivity in the face of changing climatic conditions. However, adoption of

such technologies is hampered by credit constraints and, as we have seen, this has a direct and negative effect on agricultural productivity in the study area.

The result from the impact estimates using the propensity score matching method indicated that relaxing credit constraints has a significant positive impact on agricultural productivity, while higher transaction costs and discouraging credit market policies were found to reduce productivity significantly. At the household level, the average treatment effect (ATT), which is the actual effect that constrained households experience, are ETB 443 and ETB 275 lower real crop revenue (productivity) for discouraged and quantity constrained borrowers, respectively.

The results also suggest the importance of climatic variables in explaining the probability of farm households falling into different credit constraint categories. Discouraged and risk averse farmers are not willing to participate in the credit market to avoid losing assets in the case of crop failure. A feasible strategy to encourage these farmers to participate and benefit from agricultural loans is linking credit with crop insurance to manage the uncertainty in agricultural production. Designing "productivity-based credit" (PBC) products might also help both lenders and borrowers in two ways. First, it could motivate farmers to work hard, easing the moral hazard problem; and secondly, it could also reduce the probability of adverse selection, allowing lenders to target the right borrowers who really need the loan to invest in productivity-enhancing agricultural technologies.

The solution to the low productivity and credit constraint problems of farm households is not a mere injection of loanable funds into the rural credit market. Instead, government interventions should focus on improving the institutional setup of lending institutions, investing in human capital formation, and building the capacity to innovate new loan products and efficient ways of serving genuine borrowers. This involves designing creative and climate-smart credit policies and procedures which can tackle the information asymmetry problem entailed in rural lending without reducing the welfare of borrowers. To help farmers better adapt to changing climatic conditions, it is, for example, crucial to think of a flexible climate adaptation loan product. Among the study sites, south Wollo and north Wollo zones are more vulnerable to drought and climate variability, and this calls for designing climate-smart loan (CSL) products so that farmers in these zones have better access to the rural credit market and can build their adaptive capacity. Relaxing collateral requirements for small loans and

increasing the loan repayment period to more than a year may also encourage farmers to participate in the rural credit market.

Generally, the results suggest that credit constraints are significant determinants of participation in adaptation strategies and agricultural productivity. This highlights the need to recognize the complex relationships between financial provision and climate change policies, and the implications for situation-specific policy design regarding rural credit and adaptation to climate change in the study area.

## Appendix 1

**Table 1: Determinants of the propensity to be unconstrained borrowers**

Variables used for the PSM regression	Pscore(PSM Stage 1)	
	coefficient	std.err.
<i>Dependent variable: Probability of being unconstrained borrowers</i>		
Rainfall variability (CV)	0.078	(0.123)
HH experienced drought shock	-0.170**	(0.081)
Market-related shocks	0.123	(0.118)
Idiosyncratic shocks	0.096	(0.144)
Participation in Productive Safety net prg (PSNP)	0.30**	(0.132)
Head is member in a ROSCA (Ekub)	1.220***	(0.074)
Age of head	-0.008***	(0.003)
dummy for female head of the household	0.478**	(0.208)
Dummy for a married head	0.448**	(0.199)
Household size	0.001	(0.020)
Head has no education	0.087	(0.090)
Head attended some formal education	0.033	(0.106)
Dummy for west Gojjam	0.365***	(0.097)
Dummy for south Wollo	-0.603***	(0.151)
Dummy for north Wollo	-0.072	(0.155)
Constant	-1.457***	(0.282)
<i>Diagnostic tests</i>		
Number of observations		2,146
Log likelihood		-816.64
LR chi2(15)		502.75
Prob > chi2		0.00
Standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1		

Source: Author's computation from EPIICA's 2011 and 2013 survey data

**Table 2: Effect of different credit constraints on agricultural productivity (Real Crop revenue per Hectare): Propensity Score Matching**

Credit constraint categories	Sample	Treated	Controls	Difference (ETB) <sup>‡</sup>	std.err.	T-stat
Unconstrained borrowers	Unmatched ATT	1275.55 1310.42	903.29 1141.89	372.26 168.53*	62.85 94.42	5.92 1.78
Discouraged borrowers	Unmatched ATT	814.16 809.03	1025.18 1252.08	-211.02 -443.05***	127.23 187.85	-1.66 -2.36
Quantity Constrained borr.	Unmatched ATT	848.94 848.87	1158.35 1124.02	-309.40 -275.15***	92.22 120.20	-3.36 -2.29
Risk-rationed borrowers	Unmatched ATT	1027.80 1028.00	1025.18 1040.91	2.62 -12.91	78.18 104.79	0.03 -0.12

<sup>‡</sup>ETB = Ethiopian Birr, 1 USD = 18.5 ETB as of March 2013, \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

Source: Author's computation from EPIICA's 2011 and 2013 survey data

**Table 3: Determinants of the propensity to be discouraged borrower**

Variables used for the PSM regression	Pscore (PSM Stage 1)	
	coefficient	std. err.
<i>Dependent variable: Probability of being discouraged borrower</i>		
Rainfall variability (CV)	1.976***	(0.182)
HH experienced drought shock	1.289***	(0.186)
Crop damage due to wild animals	-0.138	(0.292)
Market-related shocks	-0.209	(0.220)
Idiosyncratic shocks	-0.336	(0.288)
Participation in Productive Safety net prg (PSNP)	-0.225	(0.194)
Trust farmers' cooperative	-0.088	(0.141)
Year effect	0.487***	(0.133)
Head is member in a ROSCA (Ekub)	-0.158	(0.158)
Age of head	-0.008*	(0.004)
dummy for female head of the household	-0.077	(0.292)
Dummy for a married head	-0.201	(0.261)
Household size	-0.015	(0.033)
Head has no education	-0.167	(0.147)
Head attended some formal education	-0.064	(0.173)
Dummy for west Gojjam	0.037	(0.223)
Dummy for south Wollo	0.776***	(0.206)
Dummy for north Shewa	-0.791***	(0.214)
Constant	-1.418***	(0.436)
<i>Diagnostic tests</i>		
Number of observations		1,412
Log likelihood		-281.51
LR chi2(19)		233.05
Prob > chi2		0
Standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1		

Source: Author's computation from EPIICA's 2011 and 2013 survey data

**Table 4: Determinants of the propensity to be Quantity constrained borrower**

Variables used for the PSM regression	Pscore (PSM Stage 1)	
	coefficient	std.err.
<i>Dependent variable: Probability of being Quantity constrained borrower</i>		
Rainfall variability (CV)	0.086	(0.125)
HH experienced drought shock	0.205**	(0.089)
Market-related shocks	-0.054	(0.129)
Idiosyncratic shocks	-0.186	(0.156)
Participation in Productive Safety net prg (PSNP)	0.341***	(0.112)
Trust farmers' cooperative	-0.022	(0.087)
Year effect	0.394***	(0.081)
Age of head	0.001	(0.003)
dummy for female head of the household	0.136	(0.188)
Dummy for a married head	0.008	(0.172)
Household size	0.006	(0.021)
Head has no education	-0.204	(0.160)
Head attended some formal education	-0.050	(0.206)
Dummy for west Gojjam	-0.136	(0.163)
Dummy for south Wollo	0.359***	(0.121)
Dummy for north Shewa	-0.491***	(0.142)
Head has no education time avg.	-0.197	(0.190)
Head attended some formal education time avg.	-0.028	(0.238)
Head is member of farmers' coop time avg.	-0.003	(0.158)
Land holding time avg.	-0.118	(0.075)
Constant	-0.589*	(0.309)
<i>Diagnostic tests</i>		
Number of observations		1,723
Log likelihood		-866.64
LR chi2(20)		136.38
Prob > chi2		0
Standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1		

Source: Author's computation from EPIICA's 2011 and 2013 survey data

**Table 5: Determinants of the propensity to be Risk Rationed Borrowers**

Variables used for the PSM regression	Pscore (PSM Stage 1)	
	coefficient	std.err.
<i>Dependent variable: Probability of being Risk Rationed Borrowers</i>		
Rainfall variability (CV)	0.791***	(0.148)
HH experienced drought shock	0.247***	(0.096)
Market-related shocks	0.018	(0.133)
Idiosyncratic shocks	-0.350*	(0.187)
Participation in Productive Safety net prg (PSNP)	0.240	(0.158)
Trust farmers' cooperative	-0.132	(0.096)
Year effect	0.181**	(0.090)
Age of head	0.000	(0.003)
dummy for female head of the household	-0.022	(0.216)
Dummy for a married head	-0.004	(0.196)
Household size	-0.003	(0.022)
Head has no education	-0.085	(0.097)
Head attended some formal education	-0.090	(0.120)
Dummy for west Gojjam	0.026	(0.197)
Dummy for south Wollo	-0.196	(0.183)
Dummy for north Shewa	0.052	(0.181)
Constant	-1.496***	(0.338)
<i>Diagnostic tests</i>		
Number of observations		1,600
Log likelihood		-677.66
LR chi2(16)		122.38
Prob > chi2		0
Standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1		

Source: Author's computation from EPIICA's 2011 and 2013 survey data

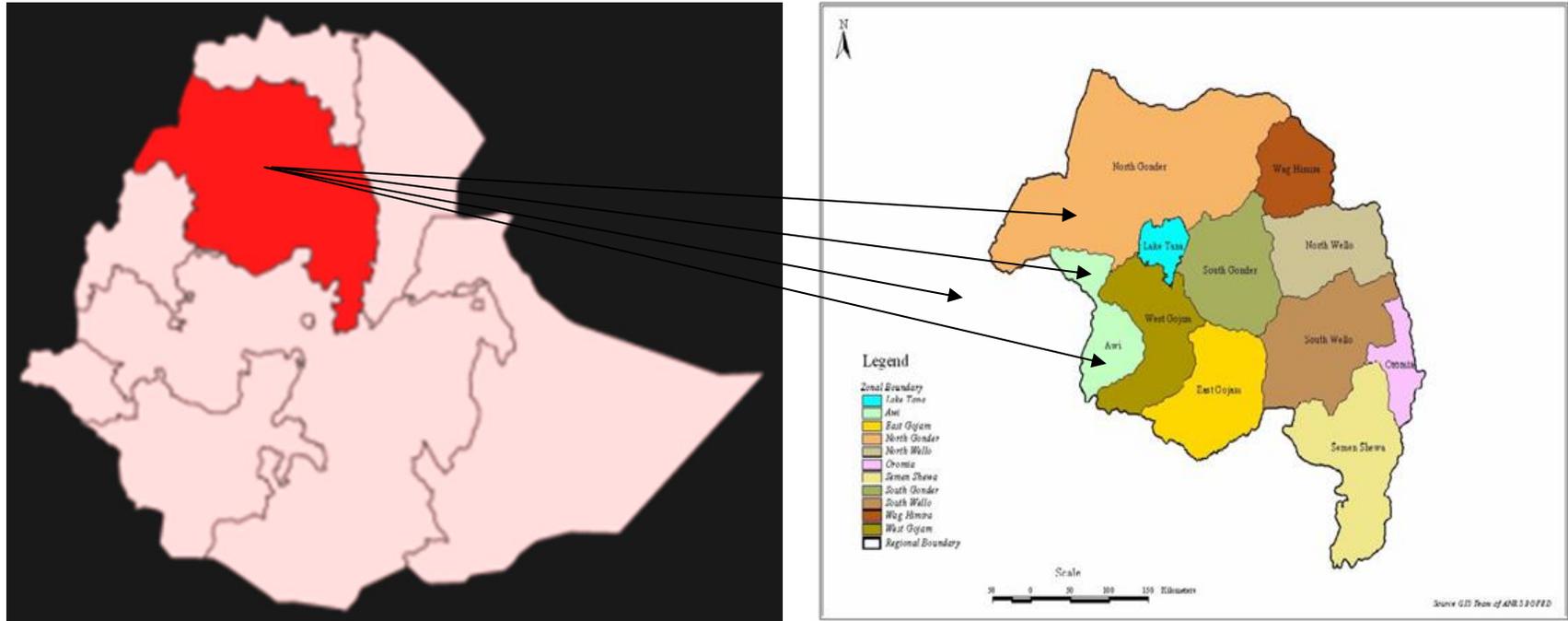
**Table 2A: Effect of Credit Constraint on Agricultural Productivity (using diff-in-diff as a robustness test)**

Credit Constraint cat.	Outcome	Control BL	Treated BL	Difference BL	Control FU	Treated FU	Diff. FU	DID
Unconstrained Borrower	Rcr	1047.95	1131.31	83.36	1064.75	1397.76	333.01	249.64
	Std. Error	59.45	59.45	84.08	72.40	53.18	89.83	123.04
	T	17.63	19.03	0.99	14.71	26.29	3.71	2.03
	P> t	0.00	0.00	0.32	0.00	0.00	0.00	0.04
Quantity Const. Borr.	Rcr	1121.27	972.93	-148.34	1052.42	746.81	-305.61	-157.27
	Std. Error	60.35	60.35	85.34	73.99	77.70	107.29	137.10
	T	18.58	16.12	-1.74	14.22	9.61	-2.85	-1.15
	P> t	0.00	0.00	0.08	0.00	0.00	0.00	0.25
Risk rationed borr.	Rcr	1121.64	1146.75	25.11	922.67	711.43	-211.24	-236.35
	Std. Error	63.99	63.99	90.50	79.64	57.86	98.44	133.72
	T	17.53	17.92	0.28	11.59	12.30	-2.15	-1.77
	P> t	0.00	0.00	0.78	0.00	0.00	0.03	0.08
Discouraged Borr.	Rcr	1097.25	1225.03	127.78	895.40	723.48	-171.92	-299.71
	Std. Error	51.99	51.99	73.52	59.03	54.75	80.51	109.03
	T	21.11	23.56	1.74	15.17	13.21	-2.14	-2.75
	P> t	0.00	0.00	0.08	0.00	0.00	0.03	0.01

<sup>‡</sup>ETB = Ethiopian Birr, 1 USD = 18.5 ETB as of March 2013, \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

**Appendix:**

**Location map of the study area, Ethiopia; Amhara Regional State**



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# **Vulnerability to Drought from Spatial and Temporal Perspectives Using Rainfall and NDVI data: A Case Study from Selected agricultural and pastoral rangelands of Ethiopia**

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## *Abstract*

*This paper tries to assess the degree of vulnerability of households to the vagaries of drought in a spatially explicit manner using the Normalized Difference Vegetation Index (NDVI), Precipitation, and Land use/Land cover. The analysis is done using data from four regions in Ethiopia: the Amhara and Oromiya regions representing crop producing areas, and the Afar and Beni-shangul Gumuz regions representing the pastoral and agro-pastoral areas. The GIS and remote sensing techniques were applied to do a spatial analysis of the degree of vulnerability to climate change.*

*The results indicate that the NDVI of the cropping seasons (or the long and short rainy seasons), the Coefficient of Variation (CoV) of the NDVI and the low frequency NDVI values, all show significant variations both spatially and temporally. Precipitation is positively correlated with vegetation patterns as measured by the NDVI. This implies that increased precipitation is a key driver of NDVI, consistent with the rain-fed patterns of the Ethiopian agriculture. Equally, consistent with Ethiopia's diverse ecology, the results show significant differences in NDVI across different geographical locations.*

**Keywords:** Drought, Vulnerability, Rainfall, spatial analysis, NDVI

**JEL Classification:** Q1, C51

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## **1. Introduction**

Drought is one of the most recurring natural disasters in many parts of Ethiopia. Rainfall variability and the associated drought have been major causes of food shortage and famine in the country. During the last forty years, Ethiopia has experienced many severe droughts leading to production that fell short of basic subsistence levels for many farm households (Relief Society of Tigray, REST and NORAGRIC, 1995, p. 137). Harvest failure due to extreme weather events is the most important cause of risk related hardship for Ethiopian rural households, with adverse effects on farm household consumption and welfare (Dercon, 2002). Future prospects of climate change can also be expected to exacerbate these issues (World Bank, 2008). Hence, assessing the pattern of vulnerability to drought, particularly in relation to climate patterns, will aid in understanding the relationship between parameters in the design of policy response to drought.

Traditionally, assessment of drought conditions has been based mainly on meteorological station observations, which lack the spatial coverage that is needed to characterize and monitor drought conditions. Due to the advent of land observation satellites, it became possible to monitor a variety of dynamic land surface processes covering a wide geographic area (Anderson et al., 1976; Reed et al., 1994; Yang et al., 1998; Peters et al., 2002). These remote sensing technologies provide important data for the spatial and temporal measures of drought impacts. Several studies have attempted to characterize vulnerability to drought in Ethiopia. However, most of these studies have focused on analyzing the drought situation in specific woredas or from the remote sensing perspective alone. In countries like Ethiopia, the number of weather stations remains very limited and it is difficult to gather reliable and adequate data throughout the country. Hence, characterizing and describing how the sensitivity to drought evolves spatially and temporally requires the use of satellite remote sensing data. Thus, the current study attempts to fill this gap in analyzing drought in agricultural and pastoral rangelands of Ethiopia using data acquired from satellite remote sensing.

The overall objective of this paper is investigating drought vulnerability in a spatially explicit manner and in doing so, we set out to assess the vulnerability to drought using the long run rainfall and normalized difference vegetation index (NDVI) datasets; to analyze the spatial and temporal response of the NDVI to

precipitation in the study area; to develop a region-based climatic factor time-series trend (for the period from 2000 to 2018) of MODIS-derived NDVI; and to assess the spatial variation and temporal trends of agricultural and pastoral rangeland vegetation conditions using NDVI.

In this study, vulnerability to drought was assessed using the satellite remote sensing vegetation index (agro-meteorological index) based on the long run NDVI at village level of the study area with three selected parameters<sup>6</sup>. These are: Cropping seasons' NDVI (or the long and short rain seasons); the Coefficient of Variation (CoV) of the NDVI and the Low frequency NDVI values observed from spatial and temporal perspectives.

For cropping season NDVI values, the analysis considered classifying the NDVI values from high, moderate and low values in observed areas from spatial and temporal perspectives. Accordingly, geo-referenced villages were analyzed and classified on the basis of the NDVI values. For the CoV of NDVI, the areas were analyzed from low and high CoV values. Since the NDVI CoV is a good indicator for stability of crop growth, an area showing high CoV for NDVI is an indicator of more vulnerability to a variation of climatic drivers, resulting in significant reduction to biomass and crop yield. On the other hand, a low NDVI CoV is an indicator for stable vegetation growth condition, leading to better accumulated biomass of crops/grass/vegetation in the respective villages. In addition, the low frequency NDVI values classified the villages from the observed NDVI time series data for the periods under the study into high frequency, moderate frequency and low frequency areas. The classification considers how many times the low NDVI were observed in a specific village over the study periods. The frequency range was set ahead of the analysis and the links between rainfall and NDVI-focused vulnerability was analyzed for different states of the geo-referenced villages from spatial and temporal perspectives.

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<sup>6</sup> The normalized difference vegetation index (NDVI), which is the difference between the near infrared (NIR) and visible red normalized reflectance bands is used widely in monitoring of ecosystems (Rouse et al., 1974; Tucker, 1979). The NDVI is used for measuring the changes in chlorophyll content (which is expressed by absorption of visible red radiation) and in spongy mesophyll (identified as reflected NIR radiation) within the vegetation canopy. Accordingly, higher NDVI values are usually associated with greater vigour and photosynthetic capacity of the vegetation or greenness (Tucker, 1979; Chen and Brutsaert, 1998). It is with this purpose that this study uses the NDVI values as an instrument in investigating vulnerability to drought conditions of agricultural and pastoral rangelands of Ethiopia.

## **2. Review of the Literature**

Drought is an interval of time in which the moisture supply for a specific area consistently shows deficit from the expected climate supply and is a natural disaster that is difficult to predict and very complex to study (Mishra and Desai, 2005; Palmar, 1965). The complexity and difficulty are due to slow development and the imprecise nature of the onset and end of the event. Hence, definitions are non-structural and concentrate on coverage of the impact it brings (Wilhite, 1993). In developing nations, drought poses significant stress on existing water and food security issues, and as it progresses, the situation may result in economic risks and financial challenges (Wilhite, 2005; Godfray et al., 2010).

Droughts are generally divided into four categories: meteorological (precipitation deficit), agricultural (soil moisture deficit), hydrological (deficit in runoff, groundwater, or total water storage), and socioeconomic (related to supply and demand of water, and social response) (Wilhite, 2005). All these types of droughts can be linked to a sustained precipitation deficit. However, the elements that identify the hydrological cycle of the different types show different responses to drought.

Historically, droughts have been monitored using ground-based observations or using interpolation techniques (Hayes et al., 1999; Shen and Tabios, 1996; Santos et al., 2010; Aghakouchak et al., 2014; Sheffield et al., 2012). The ground truth observations have been studied mainly from meteorological (Palmer, 1965) and agricultural perspectives (Gallagher et al., 1976). However, many areas used for agricultural production are not well covered by meteorological stations to support ground-based observations of various climatic factors for collecting consistent data covering a long period of time. The recent advent of satellite remote sensing technologies has opened a new path in efforts of drought monitoring unlike the ground-based drought monitoring by providing near real time observations, consistent data records and improved spatial and temporal coverage (Heumann, 2011; Barrett et al., 1990; Barrett and Herschy, 1989; Morgan, 1989).

In satellite remote sensing observations, drought related variables have been captured from two aspects: climatological and ecosystem perspectives. In the climatological aspect, satellite multispectral, thermal infrared, or microwave data are used to acquire climatic factors such as precipitation (Sorooshian et al., 2011),

soil moisture (Entekhabi et al., 2004; Cashion et al., 2005), or evapo-transpiration (Running et al., 1989; Allen et al., 2007; Anderson et al., 2011b; Price, 1982).

Each hydrologic variable is then computed to derive the anomaly or departure of the specific variable from long term average values. The computed hydrologic value is then compared with the envisaged drought indicator for categorization of the drought situation. In ecosystem perspectives of drought monitoring, satellite observations have a key role, assessing the vegetation health and growth by considering the photosynthetic capacity of plants (Tucker and Choudhury, 1987; Asner and Alencar, 2010). In this analysis, precipitation deficit is the center of assessment. Deficit in precipitation can reduce the vegetation photosynthetic capacity and then change the absorption of solar radiation in photosynthetically active wavelengths by vegetation (Asrar et al., 1984). Thus, combinations of satellite visible (VIS) and infrared (IR) bands have been mainly used to assess vegetation changes and water stress (Asrar et al., 1989; Hatfield et al., 1984; Tucker and Choudhury, 1987; Wardlow et al., 2013). In this regard, vegetation indices including Normalized Difference Vegetation Indices (NDVI), Land Surface Temperature (LST), Soil Adjusted Vegetation Index (SAVI), Albedo, Temperature Condition Index (TCI), and Vegetation Condition Index (VCI) are the most widely used indices obtained from Satellite data.

To understand the nature of drought and to design a response plan, it is critical to characterize the event of drought. For this purpose, uses of drought indices that are quantitative data have a real application for interventions such as drought monitoring, mitigation planning and drought assessment (Wilhite, 2004). From the already listed drought types, this study focuses on an agro-meteorological drought (vegetation index) analysis. It is described by precipitation deficit when there is insufficient moisture through rainfall or soil moisture for crops to make optimum growth (Ayoade, 2004) and the NDVI is used for this analysis.

Because of changes in climate drivers and climate variability, drought has become a recurrent and increasing phenomenon in sub-Saharan Africa in general and in Ethiopia particular; it has become one of the most significant of natural disasters causing serious economic, social, and environmental crises (Tadesse et al. 2008). The impact is experienced by making agriculture uncertain, causing the loss of millions of people's lives and livestock over several decades (UNEP, 2006). The situation in Ethiopia today is exacerbated by recurring drought, every two years, and a much wider geographic coverage of affected areas

including those that had previously not been affected (UNEP, 2006; NMSA, 1996).

### **3. Data Type and Source**

For the drought assessment, the Normalized Difference Vegetation Index (NDVI), and Precipitation data are used.

#### **3.1 Vegetation Index**

The data for the drought assessment was sourced from MODIS NDVI<sup>7</sup> (MOD13Q1) consisting of a 12-month time series of 16-day composite data at 250m resolution covering the crop growing seasons, February through August, of the respective periods under study. It was acquired from Land Processes Distributed Active Archive Center (LP DAAC) of the United States Geological Survey website (USGS) (<https://lpdaac.usgs.gov/>).

With the image based on medium resolution, each pixel represents 250m by 250m on the ground. It can show the ground truth, but it is not a high-resolution image and the vegetation greenness of an area less than 250m x 250m can't be caught by the satellite<sup>8</sup>.

The main difference between the Ethiopian Vegetation map and the NDVI is that the latter is associated with data points of households, even if represented at a sub-village level, and shows the vegetation condition (forest cover, agricultural land, and grass lands) of the respective sub-villages. This is because the resolution of the image or each pixels is 250m by 250m and any vegetation in this area in the geo-referenced sub-village is caught by the satellite image and considered as the vegetation condition of that specific sub-village. From the Ethiopian Vegetation map, however, it is not possible to distinguish the three land cover categories, forest, agricultural or grass lands, at a sub-village level.

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<sup>7</sup> In addition to the MODIS, Normalized Difference Water Index (NDWI) is used.

<sup>8</sup> N.B. Most high-resolution images are not available for free; the products are supplied by commercial vendors and are very expensive.

### **3.2 Precipitation**

In addition to the NDVI data, this study included other data sources such as gridded historical climate data from NASA, Tropical Rainfall Measurement Mission (TRMM, <https://pmm.nasa.gov/data-access/downloads/trmm>) and the 0.25o resolution monthly data for the 18 years (2000-2018) gridded climate data focused on precipitation data.

### **3.3 Shape Files for Ethiopian Administrative and Country Boundary**

The country administrative boundary and regional boundaries were used as shape files and the shape files were obtained from the Central Statistics Authority (CSA).

## **4. Method of Data Analysis**

The data were analyzed using ArcGIS Version 10.4.1; Python Programming 3 and Microsoft Excel.

### **4.1 Processing and Analysis of MODIS NDVI Data**

The acquired MODIS NDVI data was extracted by tile and mosaicked using the ArcGIS Mosaic tool. After doing the mosaic, the coordinate system of the images were defined into GCS\_WGS\_1984 and projected into UTM\_37N, using the define projection tool of the ArcGIS, which is an appropriate coordinate system for Ethiopia (ESRI, 2012). The MODIS products are provided in Hierarchical Data Format (HDF), which needed to be converted into a more usable format such as Geo TIFF, using the ArcGIS re-sampling tools. Then the converted images were extracted to the extent of the study regions using the ArcGIS Extract mask tool.

All the NDVI sets of data were stacked sequentially based on the year for the total years of the study (2000-2018). To fill gaps in the time series data of the NDVI, a smoothing was done using a Savitzky–Golay filter (Chen et al., 2004) and TIMESAT software was used for this task. Finally, the NDVI time series data was extracted for the geographic extent of the study area.

## 4.2 Analysis of the Historical Precipitation Data

Historic precipitation data was downloaded from the TRMM for the period 2000-2018. These high-resolution grid data appeared as Hierarchical Data Format (HDF) files which were converted into a raster format using the ArcGIS model builder. The paper has tried to consider the long rainy seasons as they provide a more comprehensive picture of the availability of moisture throughout the year.

### 4.2.1 Vulnerability to drought assessment from agro-meteorological (vegetation index) perspectives

Agricultural drought vulnerability assessment at village level for the study area was based on parameters that derived from the long run NDVI values computed for the periods under study. As noted above, the parameters selected for the analysis were: Cropping seasons (the long and short rainy seasons) NDVI; the Coefficient of Variation (CoV) of the NDVI; and the Low frequency NDVI values observed from spatial and temporal perspectives.

For cropping season (long rainy seasons, February through August) NDVI values, the analysis considered classifying the NDVI values from high, moderate and low NDVI values and from spatial and temporal perspectives. Accordingly, geo-referenced villages were analyzed and classified based on the NDVI values. The CoV of NDVI was analyzed from low and high CoV areas. Lastly, the low frequency NDVI value classified the villages from the observed NDVI time series for the periods under study into high frequency, moderate frequency and low frequency areas. The classification considered how many times low NDVI were observed in a specific village in the study periods. The range for the number of frequency was already set ahead of the analysis.

The values of NDVI and CoV are calculated using equations 1 and 2 below:

$$NDVI = \frac{b_{857} - b_{645}}{b_{857} + b_{645}} \quad (1)$$

$$CoV = \frac{\sigma}{\mu} \quad (2)$$

Where,  $b_{645}$  and  $b_{857}$  are the reflectance at 645 nm and 857 nm respectively. CoV is the coefficient of variation;  $\sigma$  is the long run mean of the NDVI value for the periods under the study;  $\mu$  is the standard deviation for the long run NDVI.

The standard anomaly, which is an important indicator for exposure to risk, was also computed for NDVI, temperature and precipitation data as follows:

$$As = \frac{(x-m)}{std} \quad (3)$$

where  $As$  is the standardized anomaly;  $x$  is the precipitation, temperature and NDVI values for the periods under study;  $m$  for long term mean of the respective climatic factor or indices value;  $s$  is the standard deviation to the long term mean of the respective variable value.

The standardized anomaly maps and profiles help the analysis in identifying areas with strong negative anomalies in rangeland grass and bush (vegetation) development. Based on temporal analysis of the vegetation indices, the protracted anomalies serve as a clear warning of high drought risk in the study area even at village level. For VI data, a negative anomaly is an implication of a below average vegetation performance of the area which in turn can be observed by the satellite. Therefore, for effective crop land and rangelands vegetation assessment analysis, for each identified anomaly, it is critical to identify when and where the vegetation stress event affecting range vegetation occurred, for how long it persisted, its intensity, expressed by the amplitude of the anomaly, and the extent from spatial perspectives.

## **5. Results and Discussion**

This section presents the results of the spatial analysis made to check the hypothesized patterns of NDVI, and precipitation. For better visualization of the data, the graduated symbol and graduated colors are used and the NDVI and precipitation data are displayed using a graduated symbol map.

Figure 1 depicts the pattern of NDVI by village. The black dot depicts location of the village where NDVI data is depicted. As shown on the map, very low NDVI is dominant in the eastern part of the country while very high NDVI is favored in the west. The south-west region is where the majority of high NDVI is concentrated. While the distribution of higher NDVI is generally more dominant in the mid-range (yellow greenish color), it is much more evenly

distributed across the central and western parts of the country. There also appears high NDVI indices in the south-eastern part of the country as opposed to the north-east. Similarly, the south-western part of the country is dominated by high NDVI compared to the north-west.

Figure 2 shows the patterns of rainfall anomalies (in the upper panel) and NDVI (in the lower panel) for the years 2000-2018(2000, 2007, 2014 and 2018). Computation of the anomalies of annual mean rainfall over the long-run mean rainfall was made in two steps: first the mean annual rainfall for each of the years 2000-2018 was computed. These figures were used to compute the long-term mean rainfall which is the mean of the annual rainfall for the whole of 2000-2018. In the second step, the long-run mean rainfall (which is common for all years) was subtracted from the mean rainfall for each of the years to obtain the deviation of mean annual rainfall from the long-term mean and then divided by the standard deviation.

As shown in Figure 2, for the first half of the years 2000, 2014 and 2018, the deviation was always negative while in the second half of these years, except 2018, the deviation was positive. Further, the pattern of the NDVI anomaly showed no distinct upward or downward pattern although it remained positive. The exception was 2004 where there was a spike. This indicates that the NDVI has remained constant. Generally, it cannot be said that the change has an accelerating pattern, at least not over the last 20 years or so.

As can be seen in Figure 3, the months in the year 2000 exhibited the lowest NDVI, while the year 2007 had the highest. The year 2007 also had the greatest pattern of patchiness/ variability in NDVI, in correspondence with the pattern depicted.

## **6. Conclusion and Implications**

In response to the drought situation, Ethiopia has been implementing drought assessment and monitoring missions in various regions of the country. Most of these efforts have been based on conventional methods, heavily relying on the available meteorological data. However, the process of collecting data from meteorological stations is tedious and time-consuming besides covering very limited geographic areas. In addition, information dissemination related to meteorological data and weather information has also been a challenge. It is, therefore, time for decision-makers to take action. Showing the value of using

remote sensing data to identify vulnerable areas to drought was the main objective of this study, and to our understanding, this paper has a good contribution to the spatial analysis of the patterns of drought using gridded historical precipitation data in Ethiopia. The study makes an important contribution on two fronts. First, it adds to the limited empirical literature on Africa that assesses patterns of drought in a spatially explicit manner, as done in this paper. Secondly, from policy perspective, it serves as a source of information for policy makers to design early warning and relief systems.

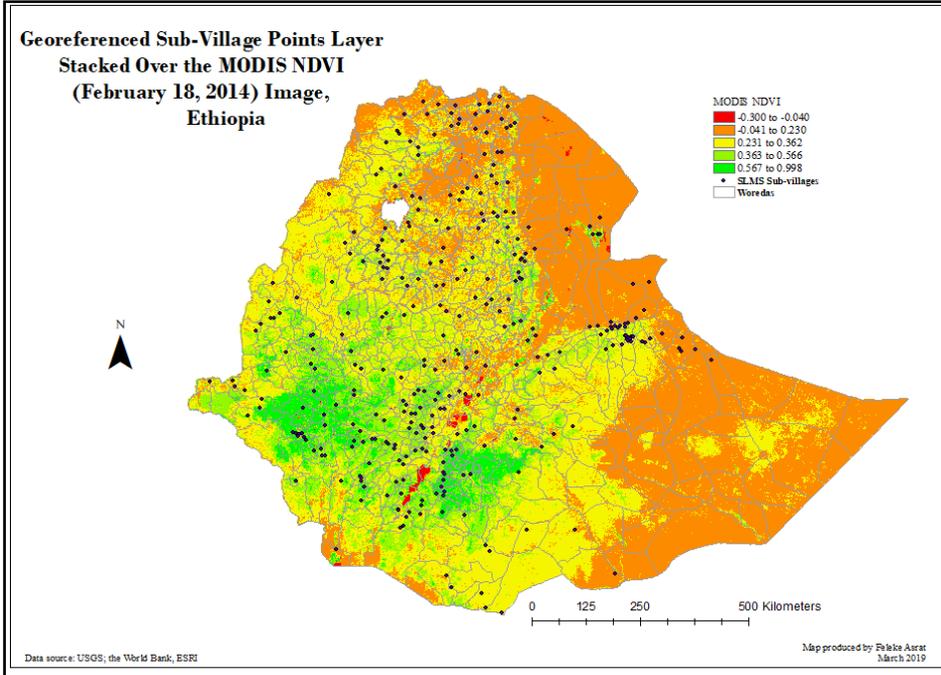
The empirical analysis shows that precipitation is positively correlated with vegetation patterns as measured by the NDVI. This indicates that increased precipitation is a key driver of NDVI, consistent with the rain-fed patterns of Ethiopian agriculture. Equally, consistent with Ethiopia's diverse ecology, the results show significant differences in NDVI across different geographical locations.

The main take-home message of this paper is that there is variability in NDVI across the country even when the analysis is done at a fine level as in the current analysis. NDVI, a measure of greenness, is a necessary condition for vulnerability but not necessarily a sufficient condition. That is to say, areas that are greener are likely to have more vegetation (crop and non-crop), and thus more production, *ceteris paribus*, and vice versa. Equally, socioeconomic conditions are also critical determinants of vulnerability. While this paper does not really cover additional socioeconomic factors, we would note they are also an important contribution for mapping out variations in vulnerability in terms of greenness.

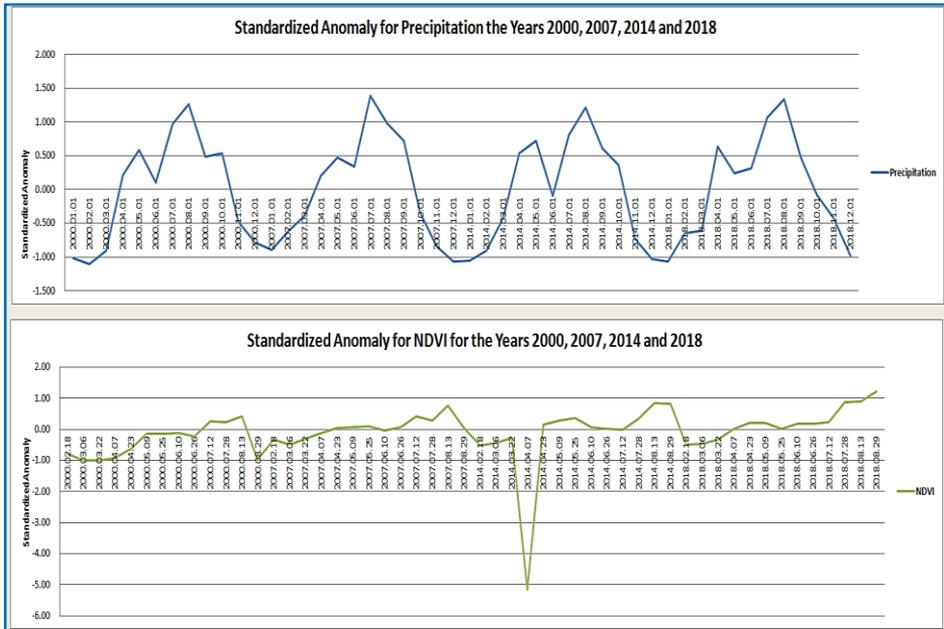
We have not combined spatial data with household survey data to make socioeconomic characterizations at a village level. This limits flexibility with respect to drawing broader conclusions. We expect future studies, combining the findings from this study with survey data, to better illuminate understanding of drought patterns with respect to socioeconomic drivers.

An additional issue worth investigating would be the issue of location differentiated response to climatic and non-climatic shocks. Resilience to such shocks is likely to be different across highlands and lowlands, and analyzing such differences in periods of drought would, therefore, be an interesting and useful addition to the literature.

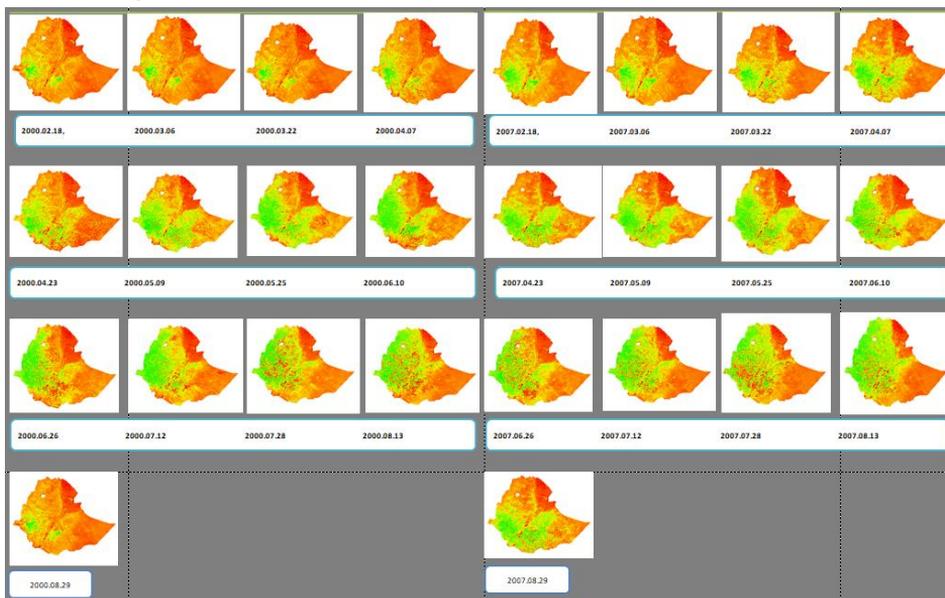
**Figure 1: Geo-referenced sub-village map of Ethiopia**



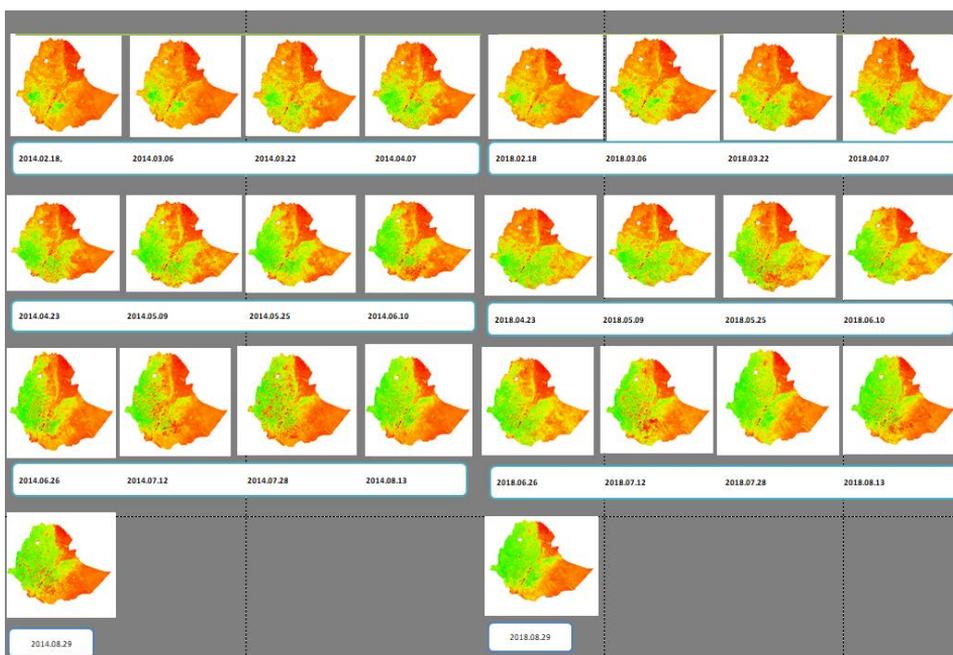
**Figure 2: Standardized anomaly for precipitation and NDVI over the years**

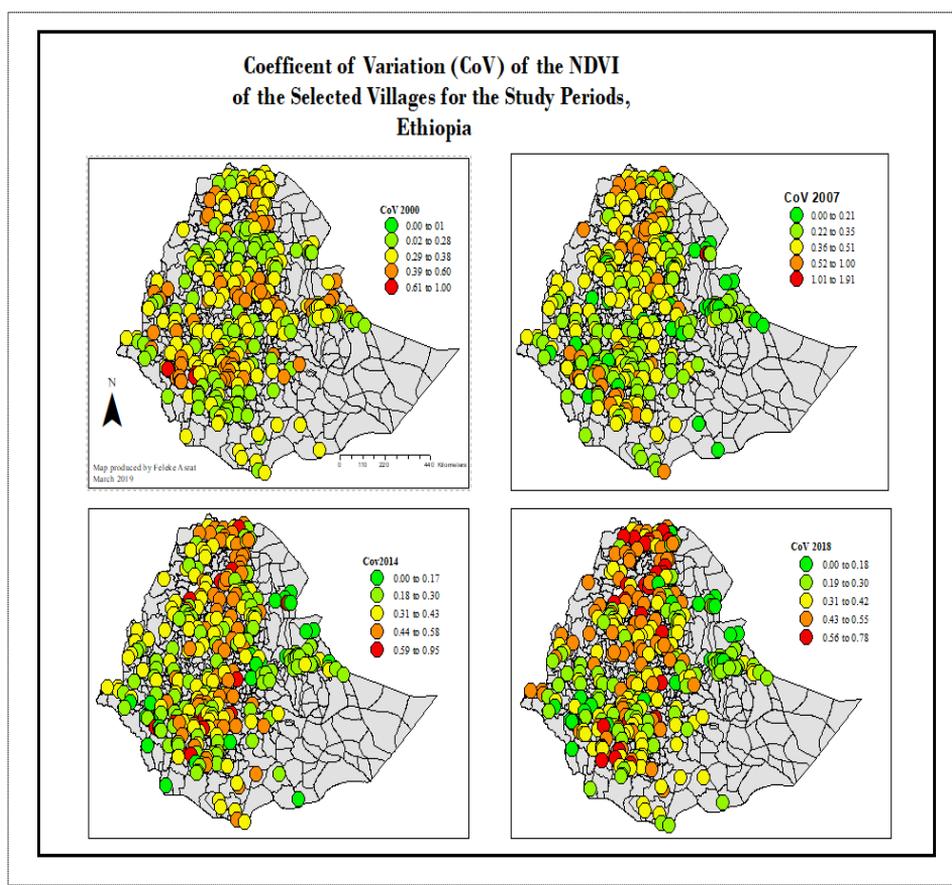


**Figure 3: Spatial and temporal patterns of NDVI in Ethiopia for the study years**



**Figure 4: COV and NDI for selected villages for the study period**





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# **School Readiness: Differences between Children with Kindergarten and O-Class Background in Selected Pre-primary Schools in Addis Ababa**

**Fitsum Zewdu Mulugeta<sup>1</sup> and Fitsum Dagmawi<sup>2</sup>**

## *Abstract*

*Children acquire a positive attitude towards learning as well as adaptive behavior for schooling from pre-primary education. The skills they develop during pre-primary education, such as pre-literacy, pre-numeracy, executive functioning and prosocial behavior, will help them when they enter formal primary education. In Ethiopia, most pre-primary access used to be provided through three-year Kindergartens (KGs) which are more accessible to children from urban and better-off families. A one-year pre-primary education program named O-Class was introduced recently to ensure access to children in rural areas and from low socio-economic status. The main purpose of this study is to compare the school readiness of children entering Grade one after completing either KG or O-Class. The Child Direct Assessment tool of the Measuring Early Learning and Quality Outcomes (MELQO) was used to measure the school readiness of children. This tool assesses children's school readiness through four different domains, language and literacy, math and numeracy, executive functions and socio-emotional skills. Parent/Caregiver Reports of MELQO was also used to gather some background data on the household and family status of the child. Data was collected from children who started Grade one in the 2018/19 academic year after completing either KG or O-Class in the same school at which they are attending Grade one. These are public schools in Addis Ababa. Children with a KG background were found to have better school readiness scores, higher by 0.46 standard deviations from that of O-Class with a medium effect size of .45 Cohen's *d*. Children with KG background also did better for each of the domains except for socio-emotional where no significant difference was detected. Multivariate analysis also confirmed significant difference in the scores of children with KG and O-Class backgrounds even after accounting for other background characteristics. The study concludes that there is a significant difference in school readiness between children with KG and O-Class background, in favor of those*

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*with KG background. This indicates there is the risk of introducing systematic inequality for rural children and children from low socioeconomic status who seem to benefit the most from expanded access to pre-primary education through O-Classes. The study concludes by recommending gradual upgrading of O-Classes into Kindergartens as a long-term strategy for pre-primary education.*

**Key words:** Pre-primary Education, Early Childhood Education, O-Class, Kindergarten, Ethiopia

## **1. Introduction**

Pre-primary education has benefits that range from success in school such as enrollment and progression in primary school, better learning outcomes, and lower-class repetition rates, to long term effects of a reduced chance of involvement in criminal activity during adolescence and adulthood (Barnett, 2008; Goodman & Sianesi, 2005). There are also findings that extend the benefits of preschool education to include better employment and higher income (Heckman & Masterov, 2007) as well as improved socio-emotional development and better health outcomes (Yoshikawa, et al., 2013).

Kindergarten (KG) education in Ethiopia has a history that goes back to the late 19<sup>th</sup> century. It was first started in 1898 with KGs for foreigners living in Ethiopia. KGs for the general public was started in 1963 though providing access to only a few. KGs got their first curriculum and teachers' guide in 1981, followed by development of standards for supervision in 1982 (Zewdie & Tefera, 2017). Up until recently, formal pre-primary education in Ethiopia was provided through KGs and mainly by private, non-government, religious or missionary providers, mostly found in urban areas (Rossiter, 2016; Woldehanna, 2011; Woldehanna & Gebremedhin, 2012). The role of the government was limited to curriculum design and regulation (MoE, 2005). All this biased access to pre-primary education towards children from urban and relatively well-off families, putting children from rural and poor families at disadvantage.

Recently attention to pre-primary education has increased following the ratification of the Early Childhood Care and Education (ECCE) policy framework in 2010 and this has been shown by recent statistics. According to the Education Statistics Annual Abstract for the academic year 2006/07, the national gross enrollment ratio (GER) of KGs was only 3.1 percent (MoE, 2008). By the

academic year 2016/17 GER had reached 45.9 percent , growing by almost 15-fold in ten years. Under its ECCE program, the Ministry of Education increased its participation beyond curriculum development, training and supervisory support into service provision as well as the diversification of the pre-primary education modalities beyond KGs (MoE, 2018).

New pre-primary modalities have been introduced since 2010 in addition to more structured KGs. These include O-Class, Child-to-Child (CtC) and Accelerated School Readiness (ASR) programs. O-Class is a one-year school readiness program for 6-year-old children housed in a primary school. CtC is another program being implemented where children from higher grades of primary school will facilitate the learning of pre-school children through guided play (MoE, 2015). The ASR program provides children with about two months of preparation either during the summer or during the first two months of the academic year before starting their formal primary study. O-Class is being widely implemented by the government while CtC and ASR are implemented in specific areas either by Non-Government Organizations (NGOs) and Regional Education Bureaus (REBs).

O-Classes has contributed significantly to boosting access to pre-primary education particularly for previously unserved children from rural areas. The fact that O-Class could easily be started by adding a class or two in an existing primary school makes it a preferred option as this means a low initial fixed cost. But compared to KGs, children in O-Class are expected to spend only one year of pre-primary education<sup>3</sup> while those going to KG spend 3 years. Understanding the learning differences (differences in school readiness) between children completing these two different programs will help to evaluate the benefit of cost saved by O-Class against the cost of learning lost by non-participation in KGs. This understanding will provide advice for future policy directions on whether or not to gradually upgrade O-Classes to KG levels. The purpose of this study is, therefore, to compare the learning differences between these two programs at the start of Grade one.

The main research question this study aims to answer, in fact, is whether or not there is a significant difference in levels of school readiness between children going through the two different modalities of pre-primary and the implications for educational equity among these children. Put differently, the

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<sup>3</sup> In practice, there are cases where underage children (four and five-year-olds) are enrolled in O-Classes and spend more than one year attending O-Class.

research question is to test if the different modalities of pre-primary education, KG and O-Class, promote equity or not in terms of school readiness and future impact. A lot of investment is being made in O-Classes in terms of developing, piloting, revising and adopting curriculum materials into mother tongue languages as well as training teachers. However, in the absence of any study that shows where the program stands compared to others with rival objectives, it is difficult to make strategic decision regarding the future of the program. The significance of this study is its contribution to the policy discussions over whether the O-Class approach should continue as a sufficient pre-primary program or whether it should be transformed into a multiple year, KG like, program in the future.

## **2. Review of Related Literatures**

### **2.1 Theoretical Framework**

Children need to develop some basic skills by the time they start their formal primary education to enable them to socialize and learn (Duncan, et al., 2008). School readiness (readiness to learn skills) refers to the developmental level of the child making him/her likely to successfully adapt to the challenges of formal education by the time of entry (Ladd, 2009; Kagan & Rigby, 2003). Language and literacy development, cognitive and general knowledge (including maths), approaches to learning (attitude towards learning), physical well-being, motor development, and socio-emotional development are normally defined as the essential domains of readiness (Rimm-Kaufman & Sandilos, 2017; Ladd, 2009; Kagan & Rigby, 2003). Executive functioning, including inhibitions short-term memory and mental flexibility, is also an important marker of school readiness. (Shaul & Schwartz, 2013; Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008).

School readiness foretells success in later years which is why policymakers, researchers and practitioners are concerned about it (UNICEF, 2006; Alexander, Entwisle, Blyth, & McAdoo, 1988). Emergent literacy predicts later reading and comprehension skills useful for understanding and learning additional linguistic and other skills. Future academic and social success in primary education, secondary education and beyond also depend on the adaptive behavior demanded by school environments. This includes inhibition (following rules, sitting still and learning), emotional regulation, and social competency (empathy,

altruism, and understanding feelings). Readiness at the beginning of formal primary education is key as studies suggest that achievement remains stable after the first year of school. (Rimm-Kaufman & Sandilos, 2017; Duncan, et al., 2008; Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Shaul & Schwartz, 2013). In addition to benefits for the child, school readiness offers benefits to the education system through increasing enrolment, retention, achievement, and completion of primary school (Das et al., 2008).

The theoretical background for designing Early Childhood Education (ECE)<sup>4</sup> as well as its objectives have been changing over time, since its beginning in the early 1800s (Meisels & Shonkoff, 2000). Present day pre-primary policy takes the best of different theories depending on the various aspects of application. In a given KG one might observe positive reinforcement from behaviorist theory, affective social development from Freudian, and symbolic play from Piagetian principles being applied in different or combined activities. Despite biases towards one or another theoretical schools of thought, pre-primary pedagogies do not normally strictly follow any specific one (National Research Council, 2001).

This study uses the lens of Lev Vygotsky's theory to look at school readiness in the setting of pre-primary education. Transition of children from home or daycare to pre-primary<sup>5</sup> marks a notable change both for the child and caregivers. The home or daycare environment that the child stays at prior to joining pre-primary mostly will not have explicit learning goals. The objective will be protecting children and nurturing them. When they transition to pre-primary, there will be explicit goals in terms of literacy, numeracy and socialization skills. The network of the children also changes from a more child-adult intensive interaction of home/daycare, where there are more adults per child, to an increased child to child interaction in pre-primary. Additionally, children enjoy more independence and responsibility in pre-primary (Rimm-Kaufman & Pianta, 2000; Tefera & H. Yesus, 2015). To meet these explicit

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<sup>4</sup> The term preschool, particularly in literatures from the United States (US), is used to refer to the part of pre-primary education that is a one to two-year program children attend before joining KG (such as the head start and pre-K). To avoid confusion, the term pre-primary or Early Childhood Education (ECE) is used in the present study to refer to any education that takes place before the child enters primary education.

<sup>5</sup> In most of the international literature KG is used instead of pre-primary but in order to incorporate new modalities of pre-primary which are not necessarily KG (e.g. O-Class) this study used the term pre-primary.

objectives, pre-primaries are organized in such a way that a skilled adult and experienced peer engages the child in activities that will help develop the child's competencies. Vygotsky referred to this as the Zone of Proximal Development – ZPD (Miller, 2002).

ZPD implies that an adult or capable peer encourages and mentors a child to achieve a developmental level which the child could not reach by herself. With its explicitly set literacy, numeracy and socialization learning competencies, pre-primary education aims to help children advance to their levels of potential. Trained teachers interact using prompts, clues, modeling, explanations, leading questions, discussions, joint activities (with teacher and peers), encouragement, control of children's attention and other tools to push them to their ZPD (Miller, 2002; Rimm-Kaufman & Pianta, 2000; Armstrong, Ogg, & Walsh, 2014).

## **2.2 Brain Development**

Advancement in development of brain imaging has enabled us to have a better understanding of the development of the brain and its implication for behavioral development (Brown & Jernigan, 2012). Children are born with much of their nervous system developed but postnatal development is critical to complete its basic formation (National Research Council, 2001). The growth is characterized by its sequential nature, from simple to complex (Wisconsin Council on Children and Families, 2007; National Research Council, 2001; Brown & Jernigan, 2012; Engle, et al., 2007; National Research Council and Institute of Medicine, 2000) and very quick, with eighty-five percent of its core structure being completed by age 3 (Wisconsin Council on Children and Families, 2007). As a result of the change in the structure of the brain as well as increased exposure to new experiences from the environment, preschool age children show huge intellectual leaps (Gerdes, Duren, & Poppe, 2013). The preschool years are therefore a period of change for the developmental agenda (Rimm-Kaufman & Pianta, 2000).

Every child is born with a genetic background inherited from their ancestors, but how their genes are expressed is determined by the environment to which the child is exposed to (National Research Council, 2001). Experience, in effect, acts like a dimmer light; as the dimmer light controls how bright or dim the light will be, experience determines how intensely or weakly a trait encoded within a gene develops.. Environmental stimuli, such as the social interactions

emphasized by Vygotsky, influence cognitive and socio-emotional development. Cognitive and socio-emotional development in turn affects academic and economic (employment) success (Engle et al., 2007; Wisconsin Council on Children and Families, 2007).

When learning new skills there is a danger children might be overwhelmed. Brain imaging show this through the greater number of brain regions active when the child completes a task that is new. Support from adults, scaffolding, enables the child to achieve a task and return to a calm state (Brown & Jernigan, 2012; National Research Council, 2001). For instance, when a child tries to read a new word, it takes a lot of brain activity (attention) and might need the support of an adult, but once the the word becomes familiar, it can be read on its own and with ease. This is what Vygotsky expressed in his concept of ZPD: initially the child cannot do the task alone but with scaffolding this is possible and this will advance the ZPD futher and further.

### **2.3 Pre-primary Education**

According to the summaries of Yoshikawa et al., (2013) gains as a result of preschool<sup>6</sup> education ranges from a third to a full year's worth of learning in terms of language, reading and maths' skills. Better socio-emotional and health benefits were also reported for children who have gone through preschool. The studies on cost-benefit analysis of preschool reviewed by Yoshikawa, et al. (2013) concluded that preschool was a wise investment. Two particular studies in the US revealed a saving in the range of 3 to 7 dollars for each dollar invested in preschool.

Important aspects of preschool education lie in stimulation, a supportive environment, and content-rich well-structured curricula to achieve effective gains in language, math and socio-emotional skills. Yoshikawa, et al. (2013) further noted that preschool education brought more benefit to children from low income families and those from the middle class than those from high income families. Higher gains were observed to children from lower socio-economic background since children from families that were doing well would end up getting quality

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<sup>6</sup> In most literature 'preschool' has been used to refer to the one or two years before KG (pre-K, head-start, etc.) types of program and are not necessarily a synonym for pre-primary. At times nursery is used with the same meaning.

preschool programs regardless of existence of publicly funded programs (National Research Council and Institute of Medicine, 2000).

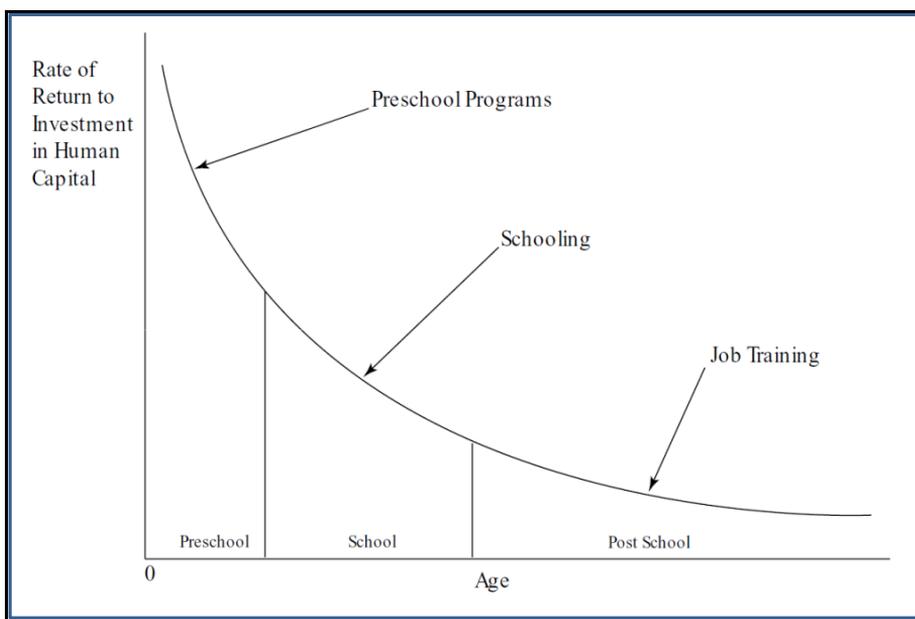
Pianta et al., (2009) conducted reviews and meta-analysis of preschool education and also found that it had a substantial effect on cognitive development. Initial effects of preschool education were found to provide 7 points in IQ tests. This is similar to the findings from the reviews of Barnett (2008), who explained the 7 or 8 points gain in IQ was equivalent of a move from the 30<sup>th</sup> to 50<sup>th</sup> percentile in the achievement test scores. Despite a decline in differences in test scores between children with and without preschool education as the children grow into adolescence and adulthood, there were also longer-term outcomes including a decline in grade repetition and placement in special education, improved social behavior and higher rates of high school graduation (Pianta, et al. 2009). This finding is in line with the findings of Yoshikawa, et al. (2013).

The Economics Nobel Laureate James Heckman along with his colleagues wrote several papers analyzing the importance for later productivity of investing early in the skills of children. They included an extensive review of literature on the issue, and the results show that skills developed early will facilitate skills learned later. In other words, early skills breed later skills. Investments in young children offer a higher economic return compared to remedial investments made for youth<sup>7</sup> to compensate for educational deprivations during early years. The returns are also much higher for children from disadvantaged families as they have limited options to invest in their own children in the absence of government investment. Put differently, it costs less to provide job training for a person with a strong childhood background compared to a person with weaker childhood background. The latter may need a longer, more intensive, and so more expensive training to catch up (Heckman & Masterov, 2007). Heckman along with Cunha and Schennach summarized what they learned from their research and the studies they reviewed in the model depicted in Figure 1.

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<sup>7</sup> The results do not imply that investments in youth should be ignored but imply that later investments would be much efficient if they were backed by good investments in early childhood development.

**Figure 1: Rates of return on human capital investment in disadvantaged children**



Source: Heckman and Masterov (2007, p. 476)

In Ethiopia, access to pre-primary education has expanded from about 5 percent in 2010 to 46 percent in 2016, out of which O-Class has contributed 33 percent (MoE, 2011; MoE, 2018). However, expanded access to pre-primaries in rural areas, when they exist, are of poor quality compared to those in urban (Zewdie & Tefera, 2017). Most teachers have had no or irrelevant training for pre-primary and the teacher-child ratio remains very poor (Mulugeta, 2015).

Woldehanna (2011) and Woldehanna & Gebremedhin (2012), using the longitudinal Young Lives survey data assessed cognitive development (literacy and numeracy) with PPVT and CDA-Q tools, found pre-primary to make a significant contribution to cognitive development. They also considered other factors that could affect cognition scores including nutrition (using stunting – height for age), age, sex, wealth, household size, caregiver education, breastfeeding experience, and birth weight. In contrast to Yoshikawa, et al. (2013), Woldehanna & Gebremedhin (2012) found that the difference in cognition as expressed using PPVT and CDA-Q scores was higher for older children (age 8) as compared to younger (age 5), concluding the pre-primary contribution to difference in cognition widens as children grow.

Woodhead (2009) using survey data underlined the seriousness of the rural-urban disparity with 58 percent urban children surveyed having access to pre-primary while only 4 percent in rural areas. Additionally, rural children enrolled into pre-primary at a later age than urban (55 months for rural children as opposed to 48 for urban). Woodhead (2009) stressed the need to make targeted investments in quality pre-primary education for children from disadvantaged groups in order to deliver the promises of pre-primary education. In addition to the geographical disparity that Woodhead (2009) demonstrated, pre-primary education is also skewed by socioeconomic status (Murray, 2012). Using the rich Young Lives data, Murray (2012) showed that 70 percent of children from the highest (richest) wealth quintile attended pre-primary while only 20 percent did from the lowest (poorest) quintile.

It is clear the foundational capabilities of children rapidly develop between the ages 0-5 (National Research Council and Institute of Medicine, 2000) and inequalities in education set in early with the tendency to affect future outcome (Murray, 2012; Woldehanna & Gebremedhin, 2012; Woldehanna, 2011). Despite a recent trend of improvement in access to pre-primary, it still seems to be biased against children from disadvantaged families (the poor and rurally located) - (Mulugeta, 2015; Zewdie & Tefera, 2017; Woodhead, 2009; Rossiter, 2016). As National Research Council and Institute of Medicine, (2000) warns, a program that does not provide quality pre-primary education for children from disadvantaged families may end up contributing to inequality rather than reducing it. Woodhead (2009) also indicated that the situation in Ethiopia risked re-enforcing inequality instead of delivering on pre-primary's potential to break intergenerational poverty.

Even if Woodhead (2009) is considered to be 'outdated', given the recent dynamics of the pre-primary landscape in Ethiopia, his concerns are valid in the present context. The period since 2010 has seen a near tenfold expansion in pre-primary, but there is no doubt that poor quality program expansion may lead to increased inequality (Rossiter, 2016). In the present study, we have assessed the current trend of expanding O-Classes for underserved children to see if this poses the risk of systematically re-enforcing inequality. Previously conducted studies in Ethiopia have demonstrated that children with pre-primary education tend to do better cognitively (Woldehanna, 2011; Woldehanna & Gebremedhin, 2012).

## **2.4 Measurement of School Readiness**

The five domains of development, cognitive, language, motor, socio-emotional and executive function, are deemed important for school readiness as they predict the future well-being of the child (Early Learning Partnership, 2016; Fernald et al., 2008). These domains are broad and measurement of school readiness is done through the measuring of specific traits within these domains, by measuring constructs. The constructs are measured using specific survey items such as asking a child to count or remember for number knowledge and working memory constructs respectively (Early Learning Partnership, 2016). The language domain includes recognition of letters and sounds as well as comprehension of both oral and print forms. Cognitive domain encompasses analytical skills, mental problem solving, memory and early math. Executive function is at times considered as a sub-category of cognitive domain despite involving both cognitive (memory) and emotional (inhibition) processes. The executive function domain encompasses impulse control, the ability to initiate action and the ability to sustain attention and persistence. The physical domain is made up of gross (large) and fine (small) motor skills, the construct of managing movement and manipulating small objects. The socio-emotional domain, usually measured on the basis of the social competency of the child rather than the common practice of measuring through adult reported behavioral problems (Fernald, Kariger, Engle, & Raikes, 2009).

The Measuring Early Learning and Quality Outcomes (MELQO) tool used in this study was developed to meet the demand for data on early childhood development. The two drivers of this demand were the need for data on the quality of early childhood education in order to improve the quality of the outcome of school readiness programs; and the necessity to intervene in the inequities in development which have lasting implication for learning and well-being (Raikes, Anderson, & Sayre). Child direct assessment (DA) was the main tool of measuring children's school readiness in the present study<sup>8</sup>. The main purpose of the DA is to aid measurement of socio-emotional skills and pre-academic skills (language, literacy, pre-numeracy and executive function) of children aged 3 to 7 (Early Learning Partnership, 2016).

In addition to its international application, the findings from application of MELQO in Ethiopia offered high reliability to support its usability to assess

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<sup>8</sup> See Section 3.4 below for further details of the measurement instrument.

school readiness in Ethiopia. Elements within MELQO were also aligned with the learning competencies of the O-Class syllabi through an adaptation workshop involving the National Education Assessment and Examination Agency (NAEA), Ministry of Education (MoE) and regional education bureaus – REBs (Rossiter, Hagos, Rose, Teferra, & Woldehanna, 2018).

### **3. Methodology**

A cross-sectional survey design was used as the basis for a descriptive and inferential data analysis. The study used multivariate analysis to control for factors that would influence children's school readiness in addition to the type of pre-primary program they have attended. These explanatory variables included household socioeconomic status (SES), parental education, parent-reported behavior of the child and other home environment related variables. Regression analysis was considered appropriate to tease out the contribution of some observable background variables on school readiness and show the association between pre-primary programs and school readiness gap.

#### **3.1 Study setting**

The study was conducted in Addis Ababa, a city with the unique features of having both KG and O-Class programs in public schools that are under the city administration's education bureau. Since both programs are under similar regulatory and budget schemes, comparing their output in terms of school readiness seemed logical. Addis Ababa, being the capital city of the country, is likely to set trends for the rest of the country on which direction to expand pre-primary education in the long run either gradually transforming O-Classes into KG or continuing to focus on retention and expansion of the O-Class model.

The study was school based with school readiness assessments conducted in schools. The home environment, parental background, socioeconomic status and related home characteristics are important determinants of school readiness (Woldehanna & Gebremedhin, 2012; Woldehanna, 2011). In order to account for these variables, data was collected on the home characteristics of the child. This information was gathered from adult caregivers either during school drop-off/pick-ups or during visits to houses of children selected for child assessment.

### 3.2 Population, Sample and Sampling Technique

The study population was composed of children who had just completed either O-Class or KG in public schools of Addis Ababa and who joined Grade one in the academic year 2018/19. According to the 2009 EC (2017/18) Education Management Information System (EMIS) data of the Ministry of Education, there were 10,822 level 3 (final year) KG (KG-3 henceforth) and 2,799 O-Class students in that academic year. Out of the ten sub-cities in Addis Ababa, four, ranking 1 to 4 based on the number of O-Class students in the academic year, were selected for this study. The four sub-cities selected were Gullele, Nefas Silk-Lafto, Yeka and Bole sub-cities. The total number of O-Class children in these four sub-cities was 1,890 with another 5,558 in KG-3, resulting in a total population size of 7,448.

**Table 3.1: Number of O-Class and KG-3 students in academic year 2017/18 by sub-city**

Sub-city	Male	Female	O-Class	Male	Female	KG-3	Total
Gullele	254	271	525	703	699	1,402	1,927
Nefas Silk-Lafto	181	282	463	542	625	1,167	1,630
Yeka	182	273	455	976	957	1,933	2,388
Bole	228	219	447	519	537	1,056	1,503
Kolfe-Keranio	218	206	424	633	503	1,136	1,560
Akaki-Kaliti	78	134	212	447	496	943	1,155
Addis Ketema	85	53	138	605	508	1,113	1,251
Kirkos	25	36	61	380	412	792	853
Lideta	23	29	52	326	259	585	637
Arada	4	18	22	375	320	695	717
<b>Total</b>	<b>1,278</b>	<b>1,521</b>	<b>2,799</b>	<b>5,506</b>	<b>5,316</b>	<b>10,822</b>	<b>13,621</b>
<b>Four sub-cities total</b>	<b>845</b>	<b>1,045</b>	<b>1,890</b>	<b>2,740</b>	<b>2,818</b>	<b>5,558</b>	<b>7,448</b>

Source: Author’s calculation based on 2017/18 EMIS data

Sample size determination followed Krejcie & Morgan (1970) as cited by Chuan (2006). The commonly employed method of Krejcie & Morgan (1970) suggests the formula below (Chuan, 2006):

$$s = \frac{\chi^2 NP(1 - P)}{d^2(N - 1) + \chi^2 P(1 - P)}$$

Where:

*s* = the required sample size

*N* = the population size (7,448)

*d* = the degree of accuracy expressed as a proportion (.05)

$\chi^2$  = chi – square at one degree of freedom and *d* confidence level ( $\chi^2_{1,0.05} = 3.84$ )

*p* = population proportion (assumed to be 0.50 which would provide the maximum *s*)

Plugging the numbers, the sample size estimated for this study was 365. Data collection for the study aimed to collect child assessment data and carry out parent/caregiver interviews for 365 parent-child dyads. Data collected and cleaned resulted in 350 child assessments and 306 parent/caregiver survey. The responses obtained for the child assessment was more than 95 percent of the sample size set. The collected and cleaned data fell short by 15 observations as the data collection period coincided with the examination period of some schools. For the children who were assessed the data collection team managed to trace and interview 87 percent of the parents/caregivers.

The sampling strategy used was first to select sub-cities that had the highest number of O-Class students in the academic year 2017/18 as noted above. This decision to opt for more assessments within a few sub-cities rather than cover all sub-cities was partly dictated by limitation of financial resources. Schools in these sub-cities were selected by prioritizing schools that had larger numbers of students (at least 50) that attended O-Class or KG-3 in 2017/18. This was done to ensure that there will be enough children to be assessed in each school. It was initially planned to assess 45 children from 8 schools distributed in the four sub-cities (one O-Class and one KG from each of the sub-cities). Due to examinations, closure of schools for examinations and fewer numbers of children in the selected schools, the survey team opted to replace or add additional schools.

**Table 3.2: Distribution of sample by school and sex**

O-Class				KG			
School	Female	Male	Total	School	Female	Male	Total
Bole Gerji	20	25	45	Bole Community	23	22	45
Entoto Mariam	2	4	6	Dill Betigil	26	19	45
Quskuam Tayitu Bitul	4		4	Abiyot Fana	17	28	45
Hiber	1	1	2	Yeka Primary	18	20	38
Meri Hedase	11	13	24	Yeka Terara	7	11	18
Addis Amba	22	23	45	<b>Total</b>	<b>91</b>	<b>100</b>	<b>191</b>
Addis Tesfa	16	17	33				
<b>Total</b>	<b>76</b>	<b>83</b>	<b>159</b>				

The final level of sample selection was of children to be assessed. The eligibility conditions for assessment were that the child must be 7 years old or younger and should have completed O-Class or KG-3 in the same school where they were currently attending Grade one. Where there were more than 45 children in a school who satisfied the selection criteria, systematic random sampling techniques was used to select a specific child to be assessed. In schools where the number of those who satisfied the selection criteria was lower than 45, all who met the criteria and were willing were assessed. Table 3.2 summarizes the distribution of children assessed by school.

**Table 3.3: Distribution of children sampled by sub-city, form or pre-primary and sex**

Sub-city	O-Class			KG			Total
	Female	Male	O-Class Total	Female	Male	KG Total	
Bole	20	25	45	23	22	45	90
Yeka	11	13	24	25	31	56	80
Gullele	22	21	43	26	19	45	88
Nefas Silk-Lafto	23	24	47	17	28	45	92
<b>Total</b>	<b>76</b>	<b>83</b>	<b>159</b>	<b>91</b>	<b>100</b>	<b>191</b>	<b>350</b>

### **3.3 Measures**

The study employed the Measuring Early Learning and Quality Outcomes (MELQO) tool which had been developed by a joint initiative led by World Bank, UNICEF, UNESCO, and the Center for Universal Education at the Brookings (Early Learning Partnership, 2016). The child assessment part of MELQO is the Measure of Development of Early Learning (MODEL), composed of child assessment and parent/caregiver interview. This was used to collect data for the present study. The reliability and validity of the MODEL was established through a review of literature and expert input for construct validity, and checked against scores obtained when administered by different assessors. Modifications were made on the basis of Cronbach's alpha calculations (UNESCO, UNICEF, Institution, & Bank, 2017).

MELQO was adapted into six local languages and piloted in Ethiopia in February 2018. Amharic, the language used for data collection for this study, was among the languages adopted and piloted (Rossiter, Hagos, Rose, Teferra, & Woldehanna, 2018). The piloting was supported by the Early Learning Partnership (ELP) of the World Bank and implemented by the National Education Assessment and Examination Agency (NEAEA), the Ethiopian Development Research Institute (EDRI), Research for Equitable Access and Learning (REAL) and the Institute for Education, Health and Development (InEHD). According to their Cronbach's alpha coefficients, the piloting found strong reliability and validity, classifying reliability as high or very high, except for the forward digit span,. Construct validity was also ensured through the tool adoption process by aligning the items with the learning competencies of O-Class stated in the O-Class syllabus. The factor analysis conducted also returned four factors of literacy, numeracy, executive functioning and fine motor (Rossiter, Hagos, Rose, Teferra, & Woldehanna, 2018).

### **3.4 Child Assessment Tool**

The MODEL tool of MELQO has three measures. These are the Child Direct Assessment (DA), Parent/Caregiver Report (PCR) and Teacher Child Report (TCR). The present study used the DA and PCR. School readiness measures were computed on the basis of the scores obtained by administering the DA tool. The DA is composed of 22 items that can be grouped into the domains

of literacy – motivation, alphabet knowledge, expressive language, receptive language; of math – numbers and operations, measurement, spatial relations; socio-emotional – self-regulation, pro-social behavior, social competence, emotional well-being; and executive function – working memory, inhibition, fine motor. These domains measured by the DA tool are those that school readiness literatures underline as important and predictive of academic and social success of children at a later age (Rimm-Kaufman & Sandilos, 2017; Ladd, 2009; Kagan & Rigby, 2003; Shaul & Schwartz, 2013; Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008). Additional information regarding the DA can be found in Annex I.

### **3.5 Parent/Caregiver Report**

The second tool used for collecting data for this study was the PCR. The PCR is a structured questionnaire used to gather additional information about the child and the home environment. The items in the PCR can be grouped into background information on the household members and on caregivers; contextual information in terms of the availability of children's books at home, reading books to the child, lack of attendance on the child, and views of the pre-primary education given to the child; the child's socio-emotional development including concentration, planning of activities, staying on task, exploring, sharing, and aggression; the child's cognitive development – the ability to count, identify letters and numbers, and do simple addition and subtraction; and the characteristics that indicate the socioeconomic status (SES) of the household in which the child is living.

The information in the PCR was gathered by a trained data collector through an interview with an adult of the family that took the child to or from school. When children were not accompanied by adults on their way to school/home, an adult was contacted through home visits. The information collected was used in the regression analysis to account for factors not directly part of the type of pre-primary education program but which could affect the child's school readiness status.

Data collection was conducted using two groups of data collectors, child assessors to administer the DA while data collectors conducted interviews with parents or caregivers. The child assessors were carefully selected so that the assessment could be reliably administered. The selection criteria for child

assessors included previous experience of conducting similar assessments, such as the National Learning Assessment (NLA) and/or the Early Grade Reading Assessment (EGRA). This strategy allowed a reduction in the number of days required to train data collectors. Since all involved had experience of conducting child assessments, all the present study needed to do was train them on the specific requirements of administering the DA. A full day's training for the DA and a half day for the PCR was provided to child assessors and data collectors respectively. Each team was composed of one data collector and two child assessors.

### **3.6 Ethical Considerations**

The following basic ethical principles were followed to ensure that none of the participants of this study ran into any problems.

**The purpose of study explained:** the purpose of the study, the type of data collected, and the process of data collection were carefully explained to school principals, teachers and caregivers in order to clarify any expectations and remove misconceptions.

**Informed consent:** all children and caregivers who were involved during the collection and administration of information were given detailed explanations of the purposes. They were told that they can take part if they choose to and that they were could refuse to take part, stop or take a break at any time, and they did not have to answer any question they did not like. Only after this explanation and their acceptance was activity continued. Since the child assessments were conducted in schools, adult consent for the children assessed was obtained from the school principal and the homeroom teacher.

**Confidentiality:** any information collected has been kept confidential. Any report(s) generated from the data are written in such a way to ensure subjects of the study would not be identified. Raw data was encrypted as soon as completed on the data collection tablets as well as during transfer to server and storage. The data has also been de-identified before being shared with any third party. No part of the child assessment data for an individual child was or will be shared with the school, teacher, or parent.

**No deception:** the study did not involve any form of deception.

## 4. Results and Discussion

### 4.1 Results

#### 4.1.1 Background of study participants

Fifty-two percent of the 350 children assessed were boys; 48 percent were girls. The boys to girls' ratio was similar whether they attended O-Class or KG. On average, the children were 6.8 years old, close to the official age of starting Grade one, age 7.

**Table 4.1: Background characteristics of children assessed**

	Male	Female	Total
Participants	183	167	350
(%)	(52.3)	(47.7)	(100)
<i>Pre-primary education</i>			
O-Class	83	76	159
(%)	(52.2)	(47.8)	(100)
KG	100	91	191
(%)	(52.4)	(47.6)	(100)
Average age	6.81	6.83	6.82
(sd)	(0.4342)	(0.4249)	(0.4292)

Out of the three-hundred fifty children only 306 were matched with interviews of their caregivers. Most of the caregivers who responded to the Parent/Caregiver Report (PCR) were parents of the child. Sixty-six percent were mothers and 17 percent were fathers, accounting for 80 percent. Other respondents included relatives (8.2 percent) and sisters (4.3 percent). The remaining respondents were grandparents, aunts, brothers and maids. Seventy-six percent of the respondents identified themselves as primary caregivers of the child of interest followed by the response 'the mother' (24 percent).

**Table 4.2: Relationship of PCR respondents to the child of interest**

Respondent's relation to the child	Number	Percent
Mother	203	66.3
Father	53	17.3
Grandparent	5	1.6
Sister	13	4.3
Other relatives	32	10.5

Level of education of the mother was reported in 284 cases and for 228 of the fathers. About 18 percent of the mothers and 9 percent of the fathers were illiterate. The number of illiterate mothers and fathers was higher for children who went to O-Classes than in KGs. Illiterate mothers accounted for 19 percent and 17 percent of O-Class and KG mothers respectively; and at 11 and 8 percent for fathers. Mothers' levels of education were lower than those of fathers as reflected in the table below.

**Table 4.3: Levels of education of mothers and fathers of children assessed**

	<b>Mother</b>	<b>%</b>	<b>Cum. %</b>	<b>Father</b>	<b>%</b>	<b>Cum. %</b>
No education/illiterate	50	17.61	17.61	20	8.77	8.77
Literate (informal education)	11	3.87	21.48	15	6.58	15.35
Primary (1-4)	46	16.20	37.68	10	4.39	19.74
Primary (5-8)	98	34.51	72.19	80	35.09	54.83
Secondary	58	20.42	92.61	71	31.14	85.97
Grade 10 + Certificate/Diploma	16	5.63	98.24	20	8.77	94.74
Higher Education	5	1.76	100	12	5.26	100
<b>Total</b>	<b>284</b>	<b>100</b>		<b>228</b>	<b>100</b>	

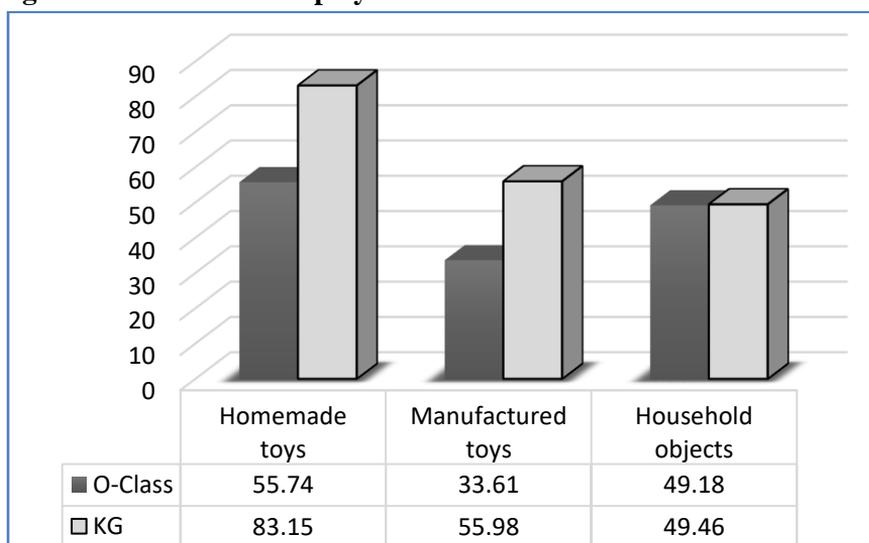
Most of the households had high educational aspirations for the child of interest with 97 percent expecting the child to complete higher education, 2 percent for the child to join higher education and one percent completion of at least Grade 10. Some of the children assessed (around 21 percent) were the only under-18 child in the household while the number of other children in a household was 6 at most. On average, there were 1.3 other children living with the children of interest. The number of other children did not vary significantly between children who attended O-Class and those in KGs.

**Table 4.4: Educational ambition for the child and the number of other children in the family**

Grade 10	1	0.54
Higher Education Student	3	1.63
Complete Higher Education	180	97.83
Total	184	100
<b>Number of Children under-18 in the household</b>	<b>Number</b>	<b>Percent</b>
0	63	20.59
1 or more	243	79.41
Total	306	100
	<b>Mean</b>	<b>Sd.</b>
Average number of other under-18 children in the household	1.33	0.984

Caregivers were asked if the child played at home using homemade toys, manufactured toys and using household objects. The proportion who answered yes was higher for children who went to KG than O-Class in the first two cases, but similar in use of household items. Playing with homemade and purchased toys was higher for children with a KG background than for O-Class ( $\chi^2(1, N = 306) = 27.48, p < .001$  and  $\chi^2(1, N = 306) = 14.7374, p < .001$  respectively). The difference was not statistically significant in the case of playing with household objects.

**Figure 2: Items the child play with at home**



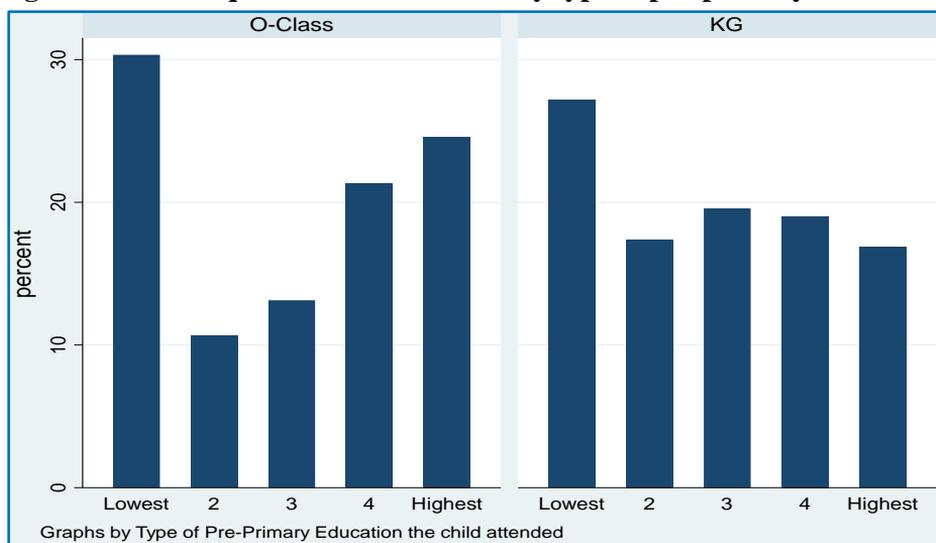
About forty-seven percent of the households did not have children’s books (50 and 45 percent for O-Class and KG respectively). The average number of children’s books that these households had was 4.8 with a range of 1 to 20. This average was 5.0 and 4.7 for the households of children who attended O-Class and KG respectively, not statistically different. 68 percent of those who had children’s books at home had not read to the child in the seven days preceding the survey. For the remaining households, the average number of days of reading a book to the child was 3.1 with a range of 1 to 5. The number of books was not statistically different for children who went to O-Class or KG and the same was true for average number of days children’s books were read among those household that read for the child at least one in the seven days preceding the survey.

**Table 4.5: Children’s books and reading for the child**

<b>Having Children's books at home</b>	<b>Number</b>	<b>Percent</b>
<b>No</b>	<b>143</b>	<b>46.7</b>
O-Class	61	50.0
KG	82	44.6
<b>Yes</b>	<b>163</b>	<b>53.3</b>
O-Class	61	50.0
KG	102	55.4
<b>Average number of children’s books in the household for those having at least one</b>	<b>Mean</b>	<b>Sd.</b>
	<b>4.78</b>	<b>3.8714</b>
O-Class	4.97	4.5496
KG	4.67	3.4219
<b>Average number of days children’s books were read to child</b>	<b>3.13</b>	<b>1.1552</b>
O-Class	2.67	1.0465
KG	3.32	1.1560

Households were also grouped into five wealth groups from poorest to richest as an indicator of relative Socio-Economic Status (SES). The wealth groups were created using an asset index for radio, television, landline phone, mobile phone, refrigerator, running water, gas stove, watch or bicycle. The trend of these wealth categories, as shown in the figure below, was heaviest at the lowest end for both O-Class and KG attendees. The household proportion remained flat for the remaining wealth quintiles of KG but showed an increasing trend for O-Class between quintiles 2 and 5. There was no statistically significant relationship between wealth groups and the type of pre-primary attended.

**Figure 3: Wealth quintiles of households by type of pre-primary attended**



To complement the asset index-based wealth quintiles, food security concerns and food insecurity episodes were also solicited from parents/caregivers. Respondents were asked how often they were worried that they would run out of food before having the means to buy additional supplies as well as if they had actually run out of food during the 12 months prior to the survey. Close to 18 percent worried about food often and about 15 percent often ran out of food before having the means to purchase more. The proportions were similar for households whose children went either to O-Class or KG.

**Table 4.6: Incidence of food security concerns and food shortage**

How often	Worried about food (%)	Run out of food (%)
Never	93 (30.49)	138 (45.25)
Sometimes	158 (51.8)	120 (39.34)
Often/Always	54 (17.7)	47 (15.41)
<b>Total</b>	<b>305</b>	<b>305</b>

Caregivers were also asked to rate the frequency of some behavior patterns displayed, never, sometimes or often/always. The behavioral items caregivers responded to focused on competencies relevant to success in school such as focusing on a task, planning tasks, pro-social behaviors including getting

along with others, sharing toys, and being considerate to others as well as adjusting for changes. The average score was calculated after reversing the scores of some of the items presented negatively (item 5 - rudely intruding others, 7 - having difficulty in doing some things, 18 - kicking other children, 19 - being upset when left by parents and 20 - being sad often). The items had acceptable reliability (Cronbach’s alpha of 0.7082) and averaged at 30.7 in a scale with the maximum possible value of 42. Even if the average for O-Class was higher only by about a point, this difference was found to be significant statistically (a 5 percent level of significance) according to the t-test result of  $t(301) = 2.22, p = .027$ . The items and some of their statistics are reported in Annex II.

**4.1.2 Results from child direct assessment**

The results presented below are defined both as a total score taking all the items together as well as by disaggregating them into the four domains (language and literacy, math/numeracy, socio-emotional and executive functioning skills) essential for school readiness (Rimm-Kaufman & Sandilos, 2017; Ladd, 2009; Kagan & Rigby, 2003; Shaul & Schwartz, 2013). The overall reliability of the DA was very good with a Cronbach’s alpha of 0.9152. Domain specific values of the Cronbach’s alpha were good for executive function and math (0.9341 and 0.8023 respectively) and close to acceptable for literacy (0.6958) and socio-emotional (0.6923).

**Table 4.7: Summary statistics of total score for the DA**

<b>Total Score</b>	<b>N</b>	<b>Mean</b>	<b>Sd</b>
<b>Scale total</b>	<b>350</b>	<b>105.13</b>	<b>13.4909</b>
<b>Sex</b>			
Female	167	106.81**	9.6215
Male	183	103.59	16.1116
<b>Pre-primary Education</b>			
<b>O-Class</b>	<b>159</b>	<b>101.75***</b>	<b>15.7772</b>
Female	76	104.58**	10.2141
Male	83	99.17	19.2365
<b>KG</b>	<b>191</b>	<b>107.94</b>	<b>10.4814</b>
Female	91	108.68	8.7215
Male	100	107.26	11.8625

\*\*\* significant at  $p < 0.01$  and \*\* significant at  $p < 0.05$

The maximum possible total score, for answering all items correctly, was two-hundred and sixty-nine. The average total score found in this study was 105.13 (just over 39 percent of the total possible score) with a range of 23 to 124. The average for children who attended O-Class was 101.76 and for those attending KGs, 107.94. The total score difference between children was higher for KGs by 6.18 (or 0.46 standard deviation). The difference had a medium effect size of .45 Cohen's *d*. This difference was statistically significant at 1 percent level of significance with  $t(348) = -4.38, p < .001$ . The scores of girls were higher than boys by about 3.22 scores, significant at 5 percent level of significance  $t(348) = 2.25, p = .025$ . The greater difference between boys and girls appears to come from children who attended O-Class rather than KGs, as there was no significant difference between boys and girls at KGs while the difference (about 5.41 higher for girls) for those who attended O-Class, was statistically significant at 5 percent level of significance,  $t(157) = 2.19, p = .030$ .

Average score for literacy and language related items was 52.7. The literacy score of children who attended O-Class was 50.1 while that of KG was higher by about 3.4 points (0.41 standard deviation), which was of medium (.42) effect size. The difference turned out to be statistically significant at 1 percent level of significance with the t-test value being  $t(348) = -3.87, p < .001$ . Girls also scored higher in language and literacy items with an average of 53.8, higher by about 2 points – the difference was significant at 5 percent with  $t(348) = 2.30, p = .022$ . Further dissection of the results by sex and type of pre-primary education attended, showed that the boy-girl difference was only significant for children who had attended O-Class,  $t(157) = 2.03, p = .045$ , but not for that of KG.

Differences in math scores of children who attended O-Class and KG was significant at 1 percent level of significance. The average scores of children from O-Class was 42.1 while that of KGs was 44.4. In other words, children who attended KG had a 0.4 standard deviation higher math scores (medium effect size of .4) with a t-statistic of  $t(348) = -3.75, p < .001$ . There was no significant difference between boys and girls on math and numeracy scores,  $t(348) = 1.77, p = .078$ .

**Table 4.8: Summary statistics for the four domain items**

	N	Language and Literacy	Math and numeracy	Socio-emotional	Executive Function
<b>Scale total</b>	<b>350</b>	<b>52.73</b>	<b>43.3</b>	<b>4.29</b>	<b>34.82</b>
<b>Sex</b>					
Female	167	53.79**	43.90	4.34	35.48
Male	183	51.76	42.83	4.23	34.22
<b>Pre-primary Education</b>					
<b>O-Class</b>	<b>159</b>	<b>50.89***</b>	<b>42.11***</b>	<b>4.23</b>	<b>32.97***</b>
Female	76	52.37**	43.25	4.37	34.59**
Male	83	49.53	41.07	4.10	31.48
<b>KG</b>	<b>191</b>	<b>54.26</b>	<b>44.37</b>	<b>4.34</b>	<b>36.37</b>
Female	91	54.98	44.45	4.32	36.22
Male	100	53.61	44.29	4.35	36.50

\*\*\* significant at  $p < 0.01$  and \*\* significant at  $p < 0.05$

There were only two items with a total of five sub-items in the assessment tool on socio-emotional competencies. Based on these, the average score on perspective taking (empathy) and understanding feeling was 4.3. The assessment failed to detect a significant difference between boys and girls,  $t(348) = 0.89, p = .37$  as well as children who had attended O-Class and KG,  $t(348) = -0.91, p = .365$ . The effect size was also small at around .1 Cohen's d. children

The average executive function score was 34.8 overall. The score for KG origin was higher by around 3.4 points (0.38 standard deviation) from that of O-class. The difference was statistically significant at 1 percent level of significance,  $t(348) = -3.61, p < .001$  and was of medium effect size (.39) Cohen's d. Except for the difference between boys and girls among O-Class children, there was no significant difference in executive function by sex. For O-Class children though, the difference was about 3.1 (0.31 standard deviation) in favor of girls with  $t(157) = 1.98, p = .049$ , which was significant at 5 percent level of significance.

**Table 4.9: Summary statistics for executive function items**

<b>Executive Function</b>	<b>N</b>	<b>Mean</b>	<b>Sd</b>
<b>Sex</b>	<b>350</b>	<b>34.82</b>	<b>8.9306</b>
Female	167	35.48	7.9440
Male	183	34.22	9.7276
<b>Pre-primary Education</b>			
<b>O-Class</b>	<b>159</b>	<b>32.97***</b>	<b>9.9749</b>
Female	76	34.59**	8.8139
Male	83	31.48	10.7696
<b>KG</b>	<b>191</b>	<b>36.37</b>	<b>7.6476</b>
Female	91	36.22	7.1021
Male	100	36.50	8.1458

\*\*\* significant at  $p < 0.01$  and \*\* significant at  $p < 0.05$

#### **4.1.3 Multivariate analysis of school readiness differences**

A liner regression analysis was conducted to test the research hypothesis that there is a significant school readiness difference between children who had attended O-Class or KGs. The dependent variable in this regression model was the total row score obtained from the child direct assessment (DA) tool. Variables that could directly or indirectly contribute to school readiness were included in the regression equation in order to account for their effects. These variables were the type of pre-primary education the child had attended (the main variable of interest for this study), the child's characteristics (age and sex), household characteristics (availability of children's books, toys, household's assets and food security), and parent/caregiver reports on child's behavior.

The age of the child was included in the regression because of the likelihood that a correct response for some of the items increases with age regardless of pre-primary education. The sex of the child was included to account for gender differences. The number of children's books available at home, and a child's use of homemade or manufactured toys or household items for play can certainly contribute to child's school readiness outcomes, and were also included in the regression equation. Household's SES, as captured by wealth quintiles based on an asset index and food security (how often did the household run out of food in the 12 months preceding the survey), was included to account for differences that emanate from differences in SES.

The total number of observations available for the regression analysis was three-hundred and two after merging the DA data with the PCR. Four

observations had to be dropped from the 306 parent/caregiver responses due to missing values for some of the variables. Table 4.10 presents the mean and standard deviations of variables used in the regression analysis for variables as well as by groups of pre-primary education and sex of the child.

**Table 4.10: Summary statistics of variables used in the regression analysis**

<b>Variables</b>	<b>Total Mean (SD)</b>	<b>O-Class Mean (SD)</b>	<b>KG Mean (SD)</b>	<b>Female Mean (SD)</b>	<b>Male Mean (SD)</b>
Scale total (DA)	101.0 (12.56)	97.5 (15.27)	103.3 (9.801)	102.8 (8.219)	99.4 (15.41)
Literacy and Language	53.06 (8.321)	50.87 (9.274)	54.49 (7.317)	54.15 (6.314)	52.04 (9.747)
Math and Numeracy	43.69 (5.222)	42.45 (7.270)	44.49 (3.033)	44.32 (3.049)	43.09 (6.598)
Socio-emotional	4.281 (1.113)	4.176 (1.212)	4.350 (1.042)	4.301 (1.091)	4.263 (1.137)
Executive Function	35.27 (8.870)	33.16 (10.32)	36.64 (7.500)	36.09 (7.681)	34.50 (9.816)
Age of the child	6.831 (0.409)	6.832 (0.438)	6.831 (0.390)	6.836 (0.407)	6.827 (0.412)
Number of children's books	2.546 (3.710)	2.504 (4.092)	2.574 (3.450)	2.760 (3.994)	2.346 (3.424)
Child plays with toys	0.818 (0.387)	0.723 (0.450)	0.880 (0.326)	0.801 (0.400)	0.833 (0.374)
Reported child behavior (scale summary)	30.71 (4.666)	31.43 (5.320)	30.25 (4.135)	30.45 (4.731)	30.96 (4.604)
Asset quintile	2.871 (1.503)	2.975 (1.581)	2.803 (1.450)	2.685 (1.466)	3.045 (1.521)
Food security	0.692 (0.716)	0.630 (0.699)	0.732 (0.726)	0.671 (0.725)	0.712 (0.709)
<b>Number of observations</b>	<b>302</b>	<b>119</b>	<b>183</b>	<b>146</b>	<b>156</b>

After accounting for the above variables and running robustness checks (Breusch-Pagan/Cook-Weisberg test for heteroskedasticity<sup>9</sup> and variance inflation factors – VIF<sup>10</sup> – tests), school readiness difference between children who attended O-Class and KG was found to be significant at 1 percent level of significance. Since homoskedasticity was rejected by Breusch-Pagan/Cook-Weisberg test for heteroskedasticity, the estimated regression results were based on robust standard errors. Unstandardized beta values are reported in the regression table below. Children who had attended KG scored about 5.9 points above those who attended O-Class in their child assessment measure of school readiness. All other things being constant, boys scored 3.1 points lower than the girls, a difference that was significant at 5 percent level of significance; a one-year increase in age was found to increase the school readiness score by about 5.2. The counter intuitive finding was that higher frequency of food insecurity was found to be associated with increased score by about 3 points.

**Table 4.11: Regression results using unstandardized beta**

Variables		Total	Literacy and Language	Math	Socio-emotional	Executive Function
<b>Type of pre-primary education</b>	<b>B</b>	<b>5.867***</b>	<b>3.497***</b>	<b>2.204***</b>	<b>0.166</b>	<b>3.792***</b>
	(se)	(1.590)	(1.002)	(0.727)	(0.145)	(1.089)
Sex of the child	B	-3.051**	-1.817**	-1.233**	-0.00106	-1.849*
	(se)	(1.349)	(0.907)	(0.572)	(0.129)	(1.001)
Age of the child	B	5.184**	2.761**	2.565**	-0.142	1.671
	(se)	(2.254)	(1.295)	(1.052)	(0.162)	(1.473)
Number of children's books	B	0.278	0.166	0.0804	0.0311	0.0227
	(se)	(0.169)	(0.126)	(0.0728)	(0.0241)	(0.167)
Child plays with toys	B	-2.636	-1.538	-0.999	-0.0984	-1.453
	(se)	(1.770)	(1.223)	(0.708)	(0.188)	(1.332)
Reported child behavior (scale summary)	B	0.0251	-0.0851	0.108	0.00174	0.200*
	(se)	(0.171)	(0.114)	(0.0767)	(0.0205)	(0.113)
Asset quintile	B	-1.132*	-0.808**	-0.235	-0.0884*	0.0399
	(se)	(0.577)	(0.367)	(0.262)	(0.0459)	(0.373)
Food security	B	3.011***	1.826***	1.117**	0.0682	2.187***
	(se)	(1.036)	(0.677)	(0.448)	(0.110)	(0.764)
Constant	B	65.48***	37.52***	22.65***	5.306***	15.88
	(se)	(16.39)	(9.360)	(7.791)	(1.203)	(10.51)

<sup>9</sup> The Breusch-Pagan/Cook-Weisberg test result for heteroskedasticity was  $\chi^2(1, N = 302) = 99.76, p < .001$ , which led to the rejection of the constant variance hypothesis.

<sup>10</sup> Test for multicollinearity gave the result Mean VIF=1.22 which was within the acceptable value of 10 or below (or even the more conservative value of 5). Hence, multicollinearity was ruled out.

Robust standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Domain specific school readiness scores were found to be positive and statistically significant at 1 percent level of significance for language/literacy, math/numeracy and executive function. The difference in socio-emotional skills was not found to be significant. Girls scored higher than boys in literacy and math at a 5 percent level of significance but only marginally significant for executive function.

Age was found to be positively and significantly associated with school readiness (at 5 percent) in the domains of language and math but not significant in the remaining two domains. The wealth quintile was found to be negatively and significantly associated with literacy domain school readiness (at 5 percent). Food insecurity was found to be positively and significantly associated with literacy (1 percent), math (5 percent) and executive function (1 percent).

## **4.2 Discussion**

Most of the background variables of children who had attended O-Class and KGs in the selected public schools of Addis Ababa were similar. There were no significant differences in age, sex, the wealth index and food insecurity. With the exception of the level of parent-reported child behavior, mothers' education and active playing at home using toys, the remaining variables provided reassurance that the comparison groups, the children who had attended O-Class and KG, were similar in their observable characteristics despite attending different modalities of pre-primary schooling.

The scores of children who had attended KG, hence school readiness, was significantly higher than those who had attended O-Class. Children with a KG background did better both at their aggregate scores as well as in their domain-specific scores for language and literacy, math and executive functioning. The differences were significant even after accounting for background variables in a regression model. The difference was not only significant statistically, it was also of medium effect size of .45 on the total score. The effect size could be interpreted as an average child who had completed KG performed better than 66 percent of those who had completed O-Class.

Looking at the regression results, *ceteris paribus*, (other things being equal) a child who had completed KG had a 5.9 points higher score than a child with O-Class background. On the other hand, a child who was, say 7 years old,

scored 5.2 points higher than a 6-year-old child on average. It seems that the difference in scores between children who had attended O-Class or KG is more than the difference due to a 1-year age difference. Food insecurity was found to be associated with a better school readiness score. This is counter intuitive with expectation, that children from food insecure households would performing lower than those from food secure households. Future studies should explore why that is the case.

Possible explanations might include food allocation within a household prioritizing children. Even if the household is food insecure, it might feed children first instead of reducing overall consumption. Other possibilities include children from such families benefitting from either school feeding or other welfare programs allowing better feeding for such children than the rest even if the household was food insecure. It is also possible such children might benefit from school feeding programs, getting prioritized for support, and ending up with better access to food than children where the household could barely afford to cover its consumption needs.

Girls scored higher than boys on the child assessment. The difference was also significant for girls who had attended O-Classes but not for those attending KG. The result was similar on literacy and language domain, with girls significantly outperforming boys overall and among those who had attended O-Class. In the remaining domains the difference among boys and girls was insignificant except for those with O-Class background in the case of executive functioning. Looking at the regression results, the story slightly changes with overall, language and literacy as well as math scores being significantly higher in favor of girls and being only marginally significant (at 10 percent level of significance) for the case of executive functioning. No gender difference was detected in the socio-emotional domain. The difference between boys and girls, particularly among those with an O-Class background needs further study why it is so.

School readiness levels at the start of formal education have a long-term impact on the child's adaptation to school and learning, which in-turn affects the child's academic and social success as primary students, adolescents or adults (Pianta et al, 2009; Yoshikawa, et al., 2013; Barnett, 2008). Differences in academic performance are set-in in the early grades of primary education and are likely remain in the years to follow (Murray, 2012; Woldehanna & Gebremedhin, 2012; Woldehanna, 2011). Pre-primary education plays an important role in

preparing children for primary education by scaffolding the development of their cognitive, language, socio-emotional and executive skills at the time when their development is fast and flexible (Wisconsin Council on Children and Families, 2007; National Research Council, 2001; Brown & Jernigan, 2012; Engle, et al., 2007; National Research Council and Institute of Medicine, 2000; Kagan & Rigby, 2003; Duncan, et al., 2008).

Pre-primary education in Ethiopia has been biased towards the better-off and those in urban areas while putting children from rural areas and from low socioeconomic status at a disadvantage (Zewdie & Tefera, 2017; Woodhead, 2009; Murray, 2012; Mulugeta, 2015). However, it benefits children with disadvantaged backgrounds (low income or uneducated families, and those in rural areas), most in terms of school readiness. Returns on public investments in the pre-primary education of disadvantaged children is higher than that of children from well-to-do families as the latter can afford better access from private providers in the absence of government provision (Yoshikawa, et al., 2013; Heckman & Masterov, 2007). O-Class was introduced as a means of providing access to underserved children for access to pre-primary education (Rossiter, 2016). As intended, the O-Class has played a big role in expanding access to pre-primary education, with access growing almost tenfold in less than a decade in which w O-Class contributed to more than 70 percent of additional access (MoE, 2008; MoE, 2018).

O-Classes managed to achieve such impressive result, expanding access to millions of children in just a few years, because they are easy and cheap to establish. This is because O-Class is essentially no more than a downward expansion of existing primary schools by a year. One of the risks of doing so, however, is loss of quality resulting from an over-quick expansion (Rossiter, 2016). Ongoing interventions such as the General Education Quality Improvement Program for Equity (GEQIP-E) can help in mitigating this risk through teacher training and coaching, curriculum enhancement, and oversight improvement of the O-Class input, process and outcome results (school inspection levels).

The second and more serious risk of O-Classes emanates from its design. O-Class is designed to be no more than a one-year program for six-year-olds without any plan for younger preschoolers (4-5 year olds). While children in big towns like Addis Ababa have access to both public and private KGs in addition to O-Class, children in rural areas only have access to O-Classes. This forces

children from rural areas and those from low income families to stay out of school during their early years. Now, our knowledge base shows that starting preschool early has a lot of advantages for school readiness, leading to academic success as well as better lifetime outcome (Engle, et al., 2007; National Research Council and Institute of Medicine, 2000; Murray, 2012; Woldehanna & Gebremedhin, 2012; Woldehanna, 2011).

In addition to not starting early, children who attend O-Class have only one year of pre-primary experience while their peers with KG backgrounds can have 2 or 3 years of pre-primary schooling by the time they enter Grade one. As found in this study, children entering Grade one after attending O-Class performed significantly lower than those with a KG background. According to the regression results, children who had attended O-Class had a lower score than their KG peers greater than what they would have had they been younger by one year.

As stated above, O-Class was launched to serve underserved children with pre-primary education. In other words, it was meant to close the gap in pre-primary education between the rich and the poor as well between urban and rural areas, and to reduce inequality. The results of the present study show that children with O-Class background are falling behind those from KGs in their school readiness. If the pre-primary education provided to disadvantaged children is not of good quality, as Woodhead (2009) puts it, it can contribute to inequality instead of equality.

## **5. Conclusion and Recommendations**

### **5.1 Conclusion**

Children who have entered Grade one after completing the one year pre-primary program of O-Class have a lower school readiness score than those attending Grade one after completing KG. Despite the well-intentioned aim of providing access to children who would otherwise miss the opportunity of pre-primary education, O-Class is introducing systemic inequality between children who go to O-Class (most from rural areas and from low income families) and those attending KGs (from urban areas and well-to-do families). This difference can be seen among children going to schools that share some similarities, being both public and under the Addis Ababa Bureau of Education. The difference could be expected to be even greater had the comparison been made with private

and NGO-run KGs, which are better resourced than public KGs. Among the shortcomings of O-Class is its failure to address the needs of children younger than six, contrary to what the knowledge base affirms – it is better to start early. Additionally, the duration of O-Class, and thus, the amount of pre-primary learning, is shorter than KG.

The gap in school readiness as measured by MELQO DA used for this study was 5.9 after accounting for relevant variables. This is wider than the gap that would have been created if the children were younger by one year, when the gap would be 5.2. The number of points children lose by attending O-Class instead of KG is greater than the number of points they would have lost by being one year younger. The implication is that O-Class is introducing systemic inequality and undermining the promise of pre-primary education as an opportunity to close the school readiness gap between disadvantaged children and those with well-to-do backgrounds.

## **5.2 Recommendation**

Without undermining the contribution of O-Class in granting opportunity of pre-primary education and school readiness for children who would not get this otherwise, the program has the potential to create inequality compared to children who attend KGs. The O-Class is being encouraged as the main means of provision of pre-primary education by the government. Given the present low access rate to pre-primary, this modality is justifiable as an ‘emergency’ type of short-term approach. However, as suggested by the findings of this paper, the long-term direction for pre-primary should be the expansion of the more comprehensive KG approach as it helps children to better prepare for formal primary education. The main recommendation of this study is, therefore, to gradually move away from the O-Class policy and expand KGs’ modality as part of the government’s design for its long-term education roadmap and strategy.

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## **Annexes**

### **Annex I: Additional Information about Direct Assessment (DA)**

DA as administered in this study had twenty-two items with a total of 121 sub-items, with the first set of items related to literacy and language. The number of sub-items under each of the items is summarized in Table A.1 below. There were eight items under literacy and language, covering interest (motivation) in learning, expressive language, expressive vocabulary, letter identification, letter sound identification, letter sound discrimination, listening comprehension and name writing. These aimed to assess the school readiness of the child in terms of pre-literacy language development. Some of the items used supporting materials such as a card of facial expressions (happy, neutral and sad faces), a card of the Amharic alphabet, a story and a blank paper for writing names.

The second set of items asked the children to copy three shapes, a cross (X), a circle and a rectangle, with the intention of measuring their fine motor skills. Fine motor had one item and three sub items corresponding to each of these shapes. Prints of the shapes and space for copying was the support material used for this item. This was then followed by items assessing emerging math/numeracy skills which included receptive spatial vocabulary, oral counting, producing sets, number identification, number comparison, simple arithmetic, and mental transformation. Pictures of a ball and a box with a different spatial location, small uniform items for counting, a card with numbers from 1-20 and cards of images for assessing metal transformation were used with numeracy items.

Four items were used to assess working memory. These were forward and backward number spans, head, shoulders, knees and toes (HSKT) tasks as well as pencil tapping. Children were asked to repeat a set of numbers read to them by the assessor either as they were or backwards, depending on the instruction. They were also asked to respond to HSKT requests based on the instruction - opposite of what was requested - and tap pencils on a hard surface. HSKTs task required the children to stand up and carry out activities, which provided them with some opportunity of movement so that they would not be bored in responding to instructions over an extended period.

Finally, the DA assessed the children on their prosocial behavior. Two items, perspective taking/empathy and understanding feelings were put at the end of the activities. The responses of the children were captured as appropriate, given

the acceptableness of their responses within the cultural context. Supporting material was used in the prosocial behavior assessment.

**Table A.1: List of items in the DA**

<b>Items</b>	<b>Number of sub-items</b>
<b>Language/Literacy</b>	
1a-f – Interest in Literacy	6
2a-e – Expressive Language	5
3a-b – Expressive Vocabulary	2
4a-p – Letter Identification	16
5a-e – Letter Sound Identification	5
6a-c – Letter Sound Discrimination	3
7a-e – Story Listening Comprehension	5
8a – Name Writing	1
<b>Fine Motor</b>	
9a-c – Copying Shapes	3
<b>Math/Numeracy</b>	
10a-d – Receptive Spatial Vocabulary	4
11a – Verbal Counting	1
12a-c – Producing a Set	3
13a-j – Number Identification	10
14a-c – Number Comparison	3
15a-d – Simple Addition and Subtraction	4
16a-d – Mental Transformation	4
<b>Working memory</b>	
17a-e – Forward Digit Span	5
18a-e – Backward Digit Span	5
19a-e, h-q – Head, Shoulders, Knees, Toes Task	15
20a-p – Pencil tap	16
<b>Pro-social behavior</b>	
21a-c – Perspective taking/Empathy	3
22a-b – Understanding feeling	2

## **Annex II: Summary of Caregiver Reported Behavior Items**

**Table A.2: Summary of behavioral items caregivers reported on**

<b>Item</b>	<b>N</b>	<b>Mean</b>	<b>Sd.</b>
1. Does the child stay on task?	306	1.71	0.4843
2. When asked to do several things, how often does the child remember all the instructions?	306	1.69	0.5118
3. How often does the child plan ahead?	277	1.16	0.7871
4. How often does the child stop an activity when told to do so?	305	1.47	0.6881
*5. How often does the child rudely intrude on others?	304	1.67	0.5899
6. How often does the child keep working at something until s/he is finished?	306	1.56	0.5713
*7. How often does the child have difficulties doing things that s/he does not like?	299	0.47	0.6144
8. How often does the child explore the function of new objects?	305	1.67	0.5169
9. How often does the child accept responsibility for his/her actions?	304	1.56	0.6108
10. How often does the child show consideration of other people's feelings?	290	1.59	0.5140
11. Does the child often get along with other children s/he plays with?	305	1.69	0.5058
12. How often does the child offer to help someone who seems to need help?	305	1.56	0.5411
13. Does the child take turns when playing together with others?	301	1.78	0.4280
14. How often does the child share with his/her peers?	302	1.38	0.5862
15. Does the child often adjust easily to transitions? (for example, a new teacher or classroom)	304	1.72	0.4584
16. How often does the child settle down after periods of exciting activity?	306	1.52	0.5907
17. When interacting with others, for example, sharing toys, does the child show self-control?	295	1.41	0.6313
*18. Would you say the child kicks, bites, or hits other children or adults?	305	1.43	0.6409
*19. How often is the child upset when left by parents/guardians?	304	1.28	0.6817
*20. Would you say that the child is often sad or unhappy?	306	1.46	0.6377
21. How often does the child describe his or her feelings? For example, "I'm happy..." or "I'm sad..."	304	1.31	0.6061
<b>Test scale</b>	<b>306</b>	<b>30.70</b>	<b>4.6789</b>
<b>O-Class</b>	<b>122</b>	<b>31.41</b>	<b>5.3270</b>
<b>KG</b>	<b>184</b>	<b>30.23</b>	<b>4.1419</b>

\* Item has been reversed as it was framed negatively.

# **Determinants of Commercialization of Maize: Evidence from Smallholder Farmers in Sidama Zone, Southern Ethiopia**

**Debela Geleta<sup>1</sup>**

## *Abstract*

*When viewed from the point of view of agricultural production, the concept of agricultural commercialization primarily hinges on the process of maximizing the proportion of agricultural production made available for buyers in the output market. The contemporary view of market participation by farmers or commercialization of agriculture as typical features of transforming the agricultural sector is over and above the question of whether or not a cash crop is present in a production system. The commonest types of commercialization occur on the output side of production whereby production, over-and-above consumption, is maximized and contributes to an increased marketed surplus, or on the input side with the increased use of purchased inputs. This study is focused on the output side of marketed maize by smallholder farmers in Southern Ethiopia. It was carried out to identify factors influencing the market participation (commercialization) of maize farmers in the study area by focusing on the marketed surplus of the maize output of farm households using a Probit model and cross-sectional data collected from randomly sampled farmers in Boricha woreda, Sidama Zone, Ethiopia. The result of the Probit model indicated that three variables are significant at various levels of significance: the education level of household heads, the total quantity of crops produced and the price of maize sold. It results show that these factors, if properly addressed, could have important and major implications for Ethiopia's agricultural transformation program.*

**Keywords:** Commercialization, Agriculture, Maize, Probit, Regression, Southern Ethiopia.

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## **1. Introduction**

The commercialization of agricultural output is the process whereby farmers engage in producing primarily, even totally, for sale in local or distant markets without giving prime importance to meet their own specific consumption needs. It entails a process of moving the goal of agriculture to market-oriented production with major consequences in terms of income, consumption and the widening of the choice matrix of the rural household. Equally, farm households at subsistence level may also participate in commercialization by supplying a certain proportion of their output to the market, and this research has focused on the level of commercialization of maize produced by subsistence level rural households. Even when farmers are operating at subsistence level, there still exists some level of commercialization among rural farm households (Gebreslassie et al., 2015; Goletti et al., 2003).

The underlying assumption of the study is that smallholder farmers differ in their level of agricultural output and thus in their decisions on commercialization. The causes of the diversity can be attributable to various demographic, social, economic, or institutional factors. This article aims to uncover the reasons behind any diversity of commercialization among smallholder rural farm households by looking at the determinants of commercialization using a probit model.

## **2. Methodology**

### **2.1 Sampling**

Since the study was carried out at household level, it focused on the total number of households in the *woreda*. According to the 2007 census report there are 47,150 households in total in the rural kebeles of the *woreda*. This provides the total size of the target population of the study.

The sample size was determined by using the formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where  $n$ , is the sample size,  $N$  is the total size of the target population,  $e$  is the level of error and given  $N = 47,150$  and  $e = 0.07$  level sampling error. (Yamane, 1967; Cochran 1963)

$$\text{Then, } n = \frac{47,150}{1+47,150(0.07)^2} = \frac{47,150}{(1+47,150(0.0049))} = 203$$

If we add 10% contingency  $0.1 * 203 = 20$

Hence, the sample size is  $n = 223$

These 223 households are selected using stratified random sampling technique where by agro ecological zone is the basis of the strata

## 2.2 Model Specification

The dependent variable is a dummy variable where the value 1 is given for farmers involved in commercialization of maize output and 0 otherwise; and limited dependent variable models are most suitable for this type of dependent variable. Discrete regression models are models in which the dependent variable assumes discrete values. Econometricians have developed a model that best captures the behavior of a discrete dependent variable. For the simple discrete dependent variable, the three most commonly used approaches to estimate such models in econometric literature are the Linear Probability model, the Logit model and the Probit model. The linear probability model has an obvious limitation in that the estimated probability values can lie outside the normal 0 to 1 range; it also assumes that the marginal or incremental effect of explanatory variables remains constant. More convenient functional forms for models with binary dependent variables are the Logit and Probit models and the choice between the two is one of mathematical convenience. This study has employed the Probit model. (Amemiya, 1981; Gujarati, 2007; Wooldridge, 2009; Gerard et al, 1990).

The Probit model is generated by a simple latent model of the form shown below

$$y_i^* = X' \beta + \epsilon \dots \dots \dots (1)$$

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \dots \dots \dots (2)$$

Where  $y_i^*$  is the latent variable or unobserved variable;  $y_i$  is the  $i^{th}$  farmer and its value is 1 if she/he participates in commercialization of maize output and 0 otherwise;  $X'$  is a vector of explanatory variables;  $\beta$  is a vector of parameters to be estimated and  $\epsilon$  is the error term which is normally distributed with mean 0 and variance  $\delta^2$ .

With the assumption of normal distribution functions, the model to estimate the probability of observing a farmer participating in commercial decision can be stated as:

$$P(y_i = 1|X) = \Phi(X'\beta) = \int_{-\infty}^{x'\beta} \frac{1}{\sqrt{2\pi}} \exp(-z^2/2) dz \dots \dots \dots (3)$$

Where  $p$  is the probability that the  $i^{th}$  farm household who is participating in commercialization and 0 otherwise.

The specific model of commercialization decision and level of commercialization can be given by:

$$Y_i = \beta_0 + \beta_1 AGEHH + \beta_2 SEXHH + \beta_3 EDUHH + \beta_4 FMSZE + \beta_5 HHLBR + \beta_6 QTITY + \beta_7 FRSZE + \beta_8 MASSN + \beta_9 EXTEN + \beta_{10} ACRDT + \beta_{11} MKTDS + \beta_{12} OFINC + \beta_{13} IMPSD + \beta_{14} PRIMZ + \beta_{15} TRPLU + \epsilon_i \dots \dots (4)$$

Where *AGEHH* is the age of the household, *SEXHH* represents sex, *EDUHH* is education of the household, *FMSZE* is family size, *HHLBR* is household labor or family labor, *QTITY* is quantity, *FRSZE* farm size, *MASSN* is association, *EXTEN* represents extension, *ACRDT* is credit, *MKTDS* is market distance, *OFINC* is off farm income, *IMPSD* is improved seed, *PRIMZ* is price and *TRPLU* is tropical livestock unit.

### 3. Hypothesis

The description of these explanatory variables, their measurement and expected relationship with the dependent variable is presented in the table below.

**Table 1: Independent variables and expected sign**

Variable	Type of variable	Description	Measurement	Hypothesis
AGEHH	Continuous	Age of the household head	Number of years	Negative
SEXHH	Dummy	Sex of the household head	1 for male and 0 otherwise	Positive
EDUHH	Continuous	Education level of the household head	Year of schooling	Positive
FMSZE	Continuous	Family size	Number of individuals	Positive
HHLBR	Continuous	Number of adults	Number of individuals above the age of 12	Positive
QTITY	Continuous	Quantity of commodity	Total output of crop produced measured number of quintals	Positive
FRSZE	Continuous	Farm size	Number of hectares	Positive
MASSN	dummy	Membership of associations	1 if he/she is a member and 0 otherwise	Positive
EXTEN	dummy	Access to extension	1 if there is access and 0 otherwise	Positive
ACRDT	Dummy	Access to credit	1 if there is access and 0 otherwise	Positive
MKTDS	Continuous	Distance to the nearby market	Number of hours	Negative
OFINC	Dummy	Off farm income	1 if there is off farm income and 0 otherwise	Negative
IMPSD	Dummy	Improved seed	1 if the household adopts high yielding variety and 0 otherwise	Positive
PRIMZ	Continuous	Price of the product being used	Ethiopian birr	Positive
TLPLU	Continuous	Tropical livestock unit	Scale	Positive

#### 4. Results and Discussion

The variables expected to affect farmers' decision to commercialize their farm produce were selected to fit the Probit model and the results are depicted in Table 2.

**Table 2: Probit Maximum likelihood of estimation of commercialization decision**

<b>Dependent variable: participation in commercialization (SLDMZD)</b>				
<b>Explanatory variables</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>t-statistics</b>	<b>P-value</b>
AGEHH	-0.0231077	.0170039	-1.36	0.174
SEXHH	0.1954044	.561824	0.35	0.728
EDUHH	0.1208529	.06775	1.78	0.074 ***
FMSZE	0.1039887	.1356226	0.77	.0443
HHLBR	-0.1280551	.1337656	-0.96	0.338
QTITY	0.1655023	.0658325	2.51	0.012 **
FRSZE	0.3663482	.4717113	0.78	0.437
MASSN	-0.4780167	.454487	-1.05	0.293
EXTEN	0.0533136	.5176473	0.10	0.918
ACRDT	-0.2758627	.3680102	-0.75	0.453
MKTDS	-0.0447252	.0305281	-1.47	0.143
OFINC	-0.0777361	.3767729	-0.21	0.837
IMPSD	0.0537876	.6128458	0.09	0.930
PRIMZ	0.0062688	.0010692	5.86	0.000 *
TRPLU	-0.0827441	.0714737	-1.16	0.247
Constant	-1.663086	1.491264	-1.12	0.265
Number of observation = 203				
LRchi2 (12) = 128.55				
Prob> chi2 = 0.0000				
Pseudo R2 = 0.5683				

Source: own survey and calculation 2018.

\*, \*\*, \*\*\* significant at 1%, 5% and 10 % respectively

As can be observed from the Probit regression results, the likelihood ratio chi-square of 128.80 with a p-value of 0.0000, tells us that our model as a whole

is more statistically significant than a model with only the constant term. This is further evidenced by the frequencies of actual and predicted outcomes of the decisions on commercialization. The model correctly predicted 92% of the total observations. This justifies the credibility of the model in addition to the theoretical justification identified above from the relevance and authenticity of the model.

The Probit regression on the results of participation in commercialization decisions, in Table 2, show that only three of the fifteen variables used in estimation of the commercialization decision were found to be significant at various levels of significance. In addition, another four were not as expected or hypothesed, irrespective of their significance. Among the variables that were as expected, three were significant at various level of significance - the education level of household head (EDUHH), the total quantity of crops produced (QTITY) and the price of maize sold (PRIMZ.)

Table 2 can only tell us the direction of the relationship between dependent variables and a set of independent variables. We have seen the direction of the relationship pertaining to commercialization decisions and its determinants, but in order to interpret the quantitative implications of the determinants of the commercialization decision, we need to compute the partial effects, using marginal effects for continuous explanatory variables, and average effects for binary explanatory variable. The partial derivatives (marginal effects) of the variables on the probability of farmers' participation decisions to commercialize their farm produce are computed by means of the variables for all observations. (Table 3 below.)

It is a well-known fact that education enables individuals to make more informed and rational decisions, paving the way for access to information on new ideas relating to output, markets, prices, and other areas. It also enhances farmers' ability to consider and process these ideas. The more a household head is educated the more likely he/she is to acquire, analyze and properly evaluate the advantages or disadvantages of commercialization of their farm produce. This intuitive argument is evidenced by the econometric result of Table 3. It shows the coefficient of the partial effect of education (EDUHH) to be positive and significant at ten percent level of significance. Keeping all other factors constant, an increase after a year of schooling increases the probability of commercialization of maize by two percent for an average farm household head. This result is confirmed by other researchers like Kirui and Njiraina (2013) in

their studies on the determinants of agricultural commercialization among the rural poor with special emphasis on the role of ICT and collective action initiatives as well as of gender perspective in Kenya which revealed education and commercialization to be positively and significantly related.

**Table 3: Partial effect for Probit model of commercialization decision**

<b>Dependent variable: participation in commercialization (SLDMZD)</b>				
<b>Explanatory Variables</b>	<b><math>\frac{dy}{dx}</math></b>	<b>Standard Error</b>	<b>Z</b>	<b>P-value</b>
AGEHH	-0.0046768	.00352	-1.33	0.184
SEXHH	0.0435281	.13728	0.32	0.751
EDUHH	0.0244598	.01303	1.88	0.060 ***
FMSZE	0.0210466	.02679	0.79	0.432
HHLBR	-0.0259175	.02633	-0.98	0.325
QTITY	0.0334965	.01154	2.90	0.004 *
FRSZE	0.0741464	.0933	0.79	0.427
MASSN	-0.0869073	.074	-1.17	0.240
EXTEN	0.0109611	.10784	0.10	0.919
ACRDT	-0.0588595	.08186	-0.72	0.472
MKTDS	-0.0090521	.00619	-1.46	0.144
OFINC	-0.0161041	.08002	-0.20	0.841
IMPSD	0.0109792	.12645	0.09	0.931
PRIMZ	0.0012688	.00031	4.13	0.000*
TRPLU	-0.0167468	.01465	-1.14	0.253

Source: own survey and calculation 2018.

\*, \*\*, \*\*\* significant at 1%, 5% and 10 % respectively

The coefficient of the partial effect of total crop produced (QTITY) is shown as positive and significant implying that as the farm household production increases the probability of participation in commercialization increases. Table 3 shows that as a farmer's produce increases by one quintal, the likelihood of adoption decreases by 3.4 %. The total quantity of farm produce has a positive correlation with the amount of crops available for sale. This is in close conformity with classical microeconomic theories of production.

The coefficient of the partial effect of price of maize sold (PRIMZ) is also positive and significant at one percent level of significance implying that when the farm household gets high prices for its produce the probability of selling

farm produce increases. The table above demonstrates that as the price of maize sold increases by 20 Birr per quintal, the probability of commercialization increases by 2.5%. The positive and significant relationship between price and quantity supplied is, of course, inherent in the classical economic theory of supply, which states that as prices increase, the quantity supplied also increases.

## **5. Conclusions**

It is clear that education, training and/or increasing the reasoning and logical capacity of farmers, formally or otherwise, will have a profound effect in galvanizing agricultural commercialization. Agricultural commercialization, of course, refers to the process of increasing the proportion of agricultural production sold by farmers; and the boosting of agricultural output using the different possibilities available will increase both the probability and the level of agricultural commercialization of farm households.

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# Determinants of Under-Five Child Mortality in Benishangul-Gumuz Regional State of Ethiopia

Kidist Demirew Getachew<sup>1</sup>

## *Abstract*

*Under-five Mortality (U5MR) in Benishangul-Gumuz is the highest among Ethiopia's regional states, next to the Afar region. The risk of a child dying before completing five years of age in Benishangul-Gumuz region is 72.8 per 1000 live births. This paper aims to verify the main determinates, socioeconomic, demographic and environment factors, of U5MR in Benishangul-Gumuz Regional State using data from the Ethiopian Demographic and Health Survey (2016). The method of analysis is descriptive and econometric employing Probit model estimation. The result reveals that "Mother's educational level" "Preceding Birth Interval", "Duration of breastfeeding", "Income or wealth of the household" and "Married Marital Status" have a negative and statistically significant relationship on Under-five Mortality. The policy implications of the results of the analysis emphasize that empowering women through education, health and income provide very important instruments to reduce Under-five Mortality in the region.*

## 1. Introduction

Child Mortality is the main indicator of the level of health status and welfare of the population. It reflects a country's level of socio-economic development and quality of life and is used for monitoring and evaluating population and health programs and policies (WHO, 2013). There are a number of different types of child mortality rate indicators, including neonatal and post-neonatal, infant, and under 5 mortality rates. Among these the Under 5 Child Mortality Rate (U5MR) is often identified in many researches and policy statements as the best concept for capturing mortality risks during the susceptible years of childhood. It has now

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been used as one of the indicators of the United Nation 2015 Millennium Development Goals.

Given the importance of child mortality, many studies have been undertaken to define its determinants. Fitsum (2011), Ayichew (2011), and Kumar and File (2010) have looked at the determinants of child mortality in Ethiopia identifying such factors as the importance of health facilities, diseases, urbanization, birth intervals, living standards and mother's education while Iram and Butt's work on Pakistan underlined the importance of household, demographic and environmental factors, including breast feeding as well as prenatal care, income and environmental contamination.

According to UNICEF's 2015 figures, about 5.9 million children worldwide still die every year before their fifth birthday, 16,000 every day. At the prevailing rate of progress, it will take to 2025 to reach the global target (UNICEF, 2015). Ethiopia, for example, has made good progress in reducing child mortality but the problem still remains serious. It is still one of the countries with the highest U5MR in the world. So, identifying and assessing factors affecting child mortality should be the first step in planning the reduction of child mortality and promoting the health of society. Understanding the determinants help policy makers to make more cost-effective interventions and policies for reducing child mortality, and the aim of this study was to investigate the determinants of U5MR using descriptive and comparative analysis and econometrics models in the Benishangul-Gumuz Regional State.

## **2. Empirical Review**

Fitsum (2011). identified preventable and curable diseases as the main causes of death in early childhood and this is why childhood mortality is treated as a development issue rather than a simple health problem. Ethiopia is among the place where the rate of such deaths is high, which is an indicator of poor standards of living. Fitsum used descriptive statistics and Probit model regression analysis to assess the structural relation between childhood mortality and maternal, child specific and household related variables. He chose infant and under-five child mortality as dependent variables with maternal characteristics of total number of child born, maternal educational level, maternal age at first born, child characteristics of gender and twin, and household characteristics of safe water, access to toilet facility, electricity, technology and information, floor

material, fuel and other variables as explanatory variables that might contribute to under-five child mortality. His results indicated that the total number of children born has a negative and significant effect on child's chance of mortality. Furthermore, maternal education, age at first birth, access to toilet, safe water, power and radio lowered the chance of mortality. However, multiple births, boys, children living in houses with dirty floors or using polluting cooking fuels faced a high chance of childhood mortality. Some variables showed a low level significance depending on different approaches of defining childhood mortality. Fitsum recommended interventions designed to reduce child mortality should pay attention to socioeconomic factors while designing and implementing prevention and curative healthcare interventions designed to consider the peculiarities of each society and villages. The source of the data for his study was the Ethiopian Demographic and Health Survey (EDHS, 2011).

Ayichew (2011) emphasized that infant and under-five child mortality was an important indicator of socioeconomic development. His study, analyzing the determinants of interregional variation in infant and child mortality rates, indicated that although Ethiopia had registered improved infant and child health, the gain was not uniformly shared across regions. The study analyzed the determinants of interregional variation in infant and child mortality rate in Ethiopia. The main purpose of the study was thus to fill the gap of information by explaining regional infant and under-five mortality rates using regional level panel data spanning 9 years (1999/2000 to 2007/2008). He employed both random effect and fixed effect models to address the panel nature of data, the most widely used panel data estimation method in applied economic research. The study also used econometric estimates of infant and under-five mortality. However, the Hausman test result indicated that the fixed effect model was more suitable than the random effect model for the panel data analysis. In the study, infant and under-five mortality rates were taken as dependent variables while health infrastructure variables, socioeconomic and demographic variables and regional location or geographic variables were all considered as independent variables. The data was extracted from different sources; health and health related indicators from the publications of the Ministry of Health, educational statistics from the Ministry of Education and regional location from the Ministry of Foreign Affairs website. The estimated results indicated that infant and under-five child health outcomes were strongly sensitive to the availability of skilled health professionals and health facilities; increasing real per capita public health

spending was important to infant and child health outcomes; and the share of population living in urban areas had strong effects on both infant and child mortality rates. These findings suggest that much of the observed regional disparities could be reduced through public policy interventions aimed to increase the supply of health resources while at the same time equalizing their distribution across regions.

Kumar and File (2010) investigated the predictors of child (0-5) mortality in Ethiopia. Their main objective was to identify the factors that reduced child mortality and suggest viable strategies to increase health services and reduce child mortality in Ethiopia. The study used a cross tabulation technique to estimate the predictor of child mortality and showed that birth intervals and the mother's standard of living index were the vital factors associated with child mortality. Although there had been a reduction of in child mortality rates, they found the level of mortality was worsened by poverty and inadequate maternal education. Education could indirectly decrease mortality rate and fertility rates by reducing desired number of children. Kumar and File examined the predictors of child mortality using secondary data from the EDHS (2005) and the interlinkages between child mortality and socioeconomic, bio-demographic and maternal health care variables. The linkages were tested by applying cross tabulation analysis using SPSS. The variables involved were the education of the mother, the standard of living index, place of residence, birth order, sex of child, birth intervals, and mother's age at birth of child. Their findings suggested that the most important socioeconomic predictor of child mortality was a mother's education, with the mortality rates decreasing along with increases in mothers' education levels. Birth intervals also played a significant role in reducing the risk of child mortality. Other characteristics that affected child mortality were the place of residence and mother's age at birth. A mother's standard of living index was found to have a significant effect. So, attention should be given to mothers' education, birth intervals and the standard of living index factors to reduce the risk of child mortality in Ethiopia.

Iram and Butt (2008), undertook a study to identify and quantify the relative importance of various socioeconomic factors and maternal care practices in determining child mortality at different ages in Pakistan. Using a sequential probit model that took into account the cause of death they examined the role of household, demographic and environmental factors as determinants of early child mortality. A number of individual, household and local characteristics related to

the probability of child mortality and they identified mother feeding as a protection from early exposure to disease and ill-health in different ways. The result of the analysis also indicated that the mother's education was strongly related to a reduction of neonatal mortality, infant mortality as well as child mortality, through improved child caring practices and through other proximate determinants such as prenatal care, income and environmental contamination

### **3. Data and Methodology**

Data obtained from complete registration of births and deaths is the best source for direct estimation of child mortality. Unfortunately, this is unavailable in Ethiopia, and estimation of child mortality has to be based on cross-sectional surveys collecting complete birth histories from respondents. This study is based on a database compiled as part of the 2016 Ethiopian Demographic and Health Survey (EDHS). The data set consists of a national representative sample of household level data. The EDHS was conducted by the Central Statistical Agency (CSA) in collaboration with the Ministry of Health. Prior to the 2016 survey, EDHSs were conducted in 2000, 2005 and 2011. Here, we have used intensively the 2016 EDHS. In addition to EDHS data, we have also used World Bank, UNICEF and other reports.

As we are dealing with determinants of U5MR, there are households which lost their child/children and others which did not. The dependent variable under investigation is therefore a dichotomous variable that takes values 0 and 1 only. This thesis employed the Probit model, one of the estimation methods of binary variables. The model takes the form:

$$\Pr(Y = 1 / X) = \Phi (X^T \beta)$$

Where Pr denotes probability and  $\Phi$  is the cumulative distribution function (CDF) of the standard normal distribution. The parameters  $\beta$  are estimated by maximum likelihood.

Structurally, the Probit model can be described as follows. Let the observed outcome (whether the child is alive or not in this case) be  $y_i$ . As referred from Fitsum (2011), there exists an unobserved threshold level that marks a child's survival (or not) to his/her fifth birthday. This underlying latent variable,

say  $Y_i^*$ , is assumed to be a function of several observed personal and socioeconomic factors, say a vector of  $x_i$  and unobserved characteristics, say  $\varepsilon_i$  for individual  $i$ , this can formally be expressed as:

$$Y_i^* = x_i' \beta + \varepsilon_i, \quad \varepsilon_i \sim NID(0, \sigma_\varepsilon^2) \quad i=1, 2, 3, \dots, 13 \quad (1)$$

If this threshold level is set to zero, without loss of generality, then the Probit model can be fully described as;

$$y_i^* = x_i' \beta + \varepsilon_i, \quad \varepsilon_i \sim NID(0, \sigma_\varepsilon^2) \quad i=1, 2, 3, \dots, 13 \quad (2)$$

And

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases} \quad (3)$$

This model assumes that  $E[\varepsilon / x] = 0$ . In other words it means that the independent variables are exogenous.

The variables in this study include the Dependent Variable with the response (outcome) variable in this study Under-five mortality; Independent (predictor) Variables, that might be expected to be associated with under-five mortality rate. These include:

- Mother's Educational Level (with additional categories of No Education, Primary, Secondary and Higher),
- Duration of Breastfeeding,
- Birth Interval,
- Marital Status,
- Income/Wealth of the Household,
- Mother's Age at First Birth,
- Getting medical help for self and distance to health facility,
- Family Size in Number,
- Place of Residence (Urban or Rural),

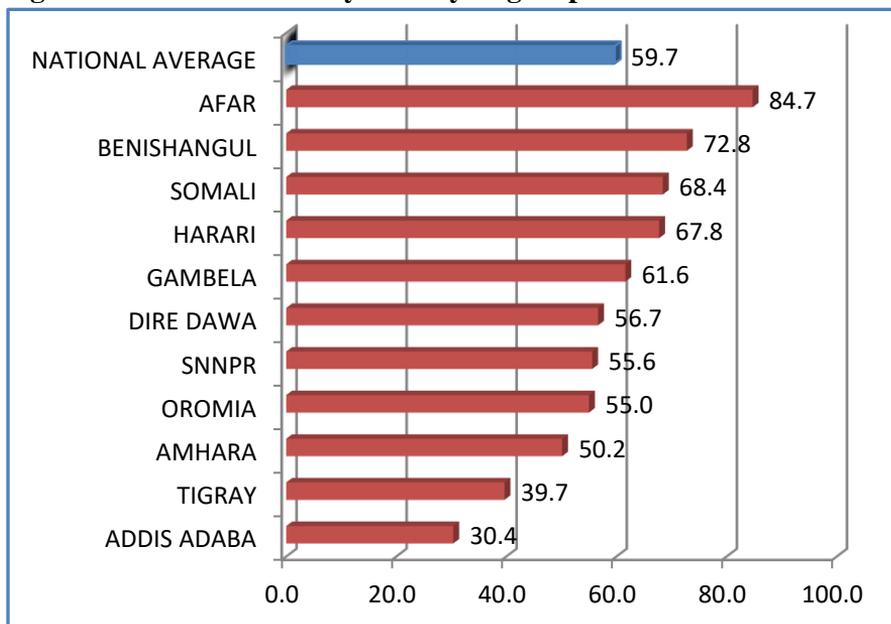
- Sex of Child,
- Source of Drinking Water,
- Sanitation, and
- Type of Birth (Single/Multiple)

#### **4. Data Analysis**

##### **4.1 Descriptive Analysis**

Generally, the risk of a child dying before completing five years of age is still high in less developed countries. WHO Global Health Observatory (GHO) data (2016) indicated that African U5MR was 76.5 per 1000 live births, almost 8 times higher than the European Region (9.6 per 1000 live births). In addition, imbalances in child mortality between high-income and low-income countries remain large. In 2016, U5MR in low-income countries was 73.1 deaths per 1000 live births, almost 14 times the average rate in high-income countries (5.3 deaths per 1000 live births).

**Figure 6: Under 5 Mortality Rate by Region per 1000.**



Source; EDHS (2016)

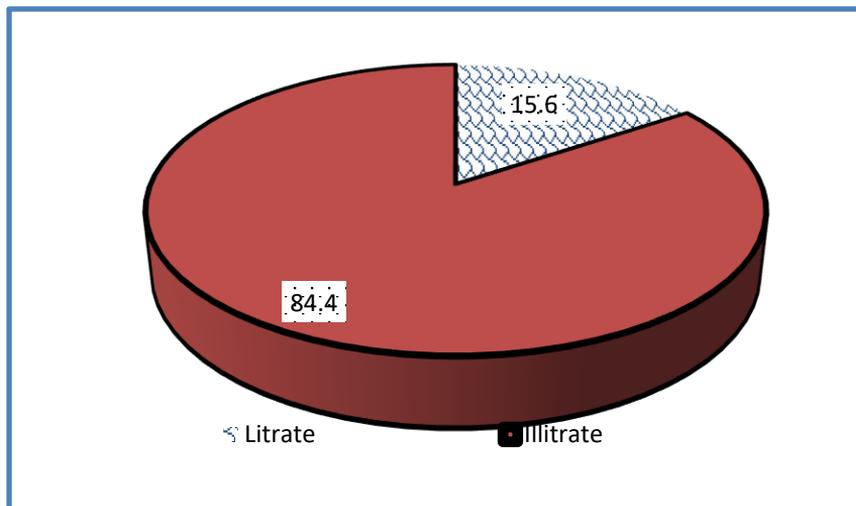
In Ethiopia, although U5MR has reduced over the years, it remains high with significant regional variations. At the national level, U5MR is about 59.7 per 1000 live births (Figure 1). Looking at the regional comparisons, the highest U5MR are found in the most underdeveloped regions, Afar, Benishangul-Gumuz, and Somali. The lowest mortality rate has been observed in Addis Ababa which has better health and socio-economic infrastructure. After Addis Ababa, the more developed regions, Tigray, Amhara, Oromia, SNNP and Dire Dawa, show U5MR below the national average.

U5MR in Benishangul-Gumuz is second next to Afar. The risk of a child dying before completing five years of age in Benishangul-Gumuz is 72.8 per 1000 live births, almost 22 percent higher than the national average. This raises the question of why the U5MR in Benishangul-Gumuz region is so high; and this study assesses a range of possible contributing factors. These include the mother's educational level, birth interval, duration of breastfeeding, income/wealth of household, family size, mother's age at first birth, marital status, types of birth (single/multiple), place of residence, sex of the child, source of drinking water, sanitation, and distance from health facility. Among these, the variables most closely linked with mothers' empowerment for child care are the main focus of this thesis - mother's educational level, birth Interval, duration of breastfeeding, income/wealth of the household, family size, mother's age at first birth, and types of birth (single/multiple). Other variables are included to make the model complete and stable.

#### **4.1.1 Mothers' Education Status**

Mothers' educational status is a very important factor to reduce child mortality rate. Better educated mothers can take care of children more effectively; the risk of a child dying in an educated mother's family is very low. Using the EDHS (2016) data, we can see the negative correlation of mothers' educational status and child deaths in Benishangul-Gumuz region, with a correlation coefficient of -0.11. Figure 2 shows that 84.4 percent the total under-five child deaths, came from families where the mothers were illiterate; only 15.6 percent of deaths were from the families of literate mothers. Literate mothers have better capability to raise their children and provide healthy living compared to illiterate mothers.

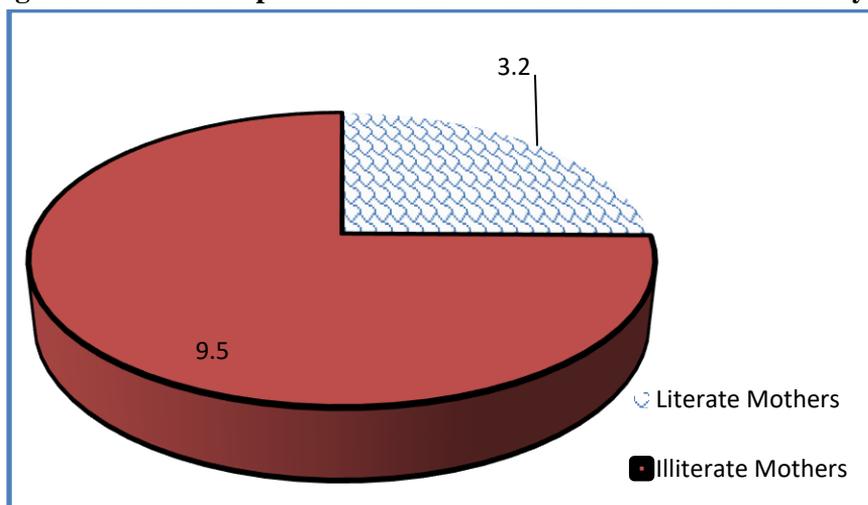
**Figure 7: Mother's literacy by U5M (in %)**



Source; Author's computation based on EDHS (2016)

Figure 3 demonstrates the correlation that exists between mothers' education and Under-Five Mortality in relation to total births. Out of 100 births in educated mothers' family, 3.2 percent of the children died before their fifth birthday; the figure for families of illiterate mothers was nearly 10 percent. It is clear that as mothers become educated, Under-five Mortality tends to decline.

**Figure 8: Relationship between Total Birth and Under Five Mortality**

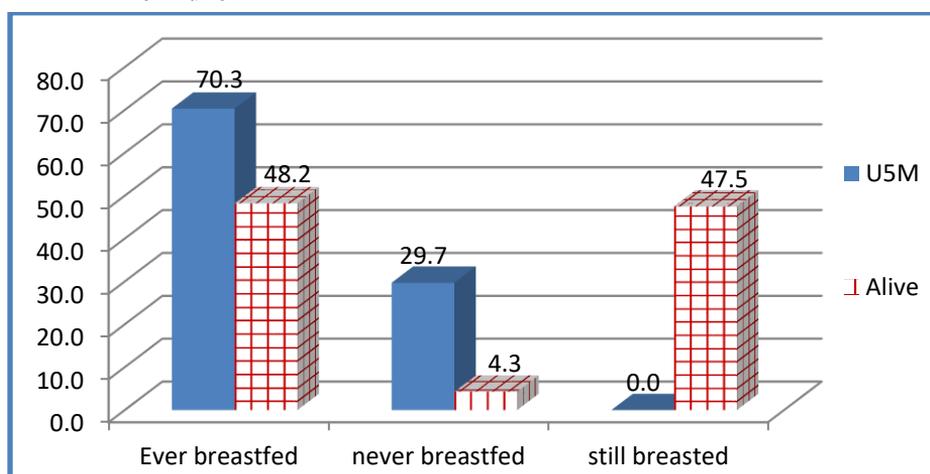


Source; Author's computation based on EDHS (2016)

#### 4.1.2 Duration of Breastfeeding Status

Figure 4 shows the highest mortality rate is found among those who never practiced breastfeeding; about 35 percent of children who were never breast-fed died. Of those breast-fed for the first six months, only 10 percent died, while from the cohort that still breastfed almost none died. Mothers' breast milk contains antibodies to help children fight off viruses and bacteria and, as health workers attest, it also lowers the risk of having asthma or allergies, ear infections, respiratory illness or bouts of diarrhea. Children who never get breast milk do not receive minerals, vitamins, proteins or immunity against many diseases. The correlation of the duration of breast feeding and U5M is negative with a correlation of coefficient of -0.19. This means that as the duration of breastfeeding increases, the Under-five Mortality tends to decrease.

**Figure 9: Duration of breastfeeding with under-five mortality and alive children**

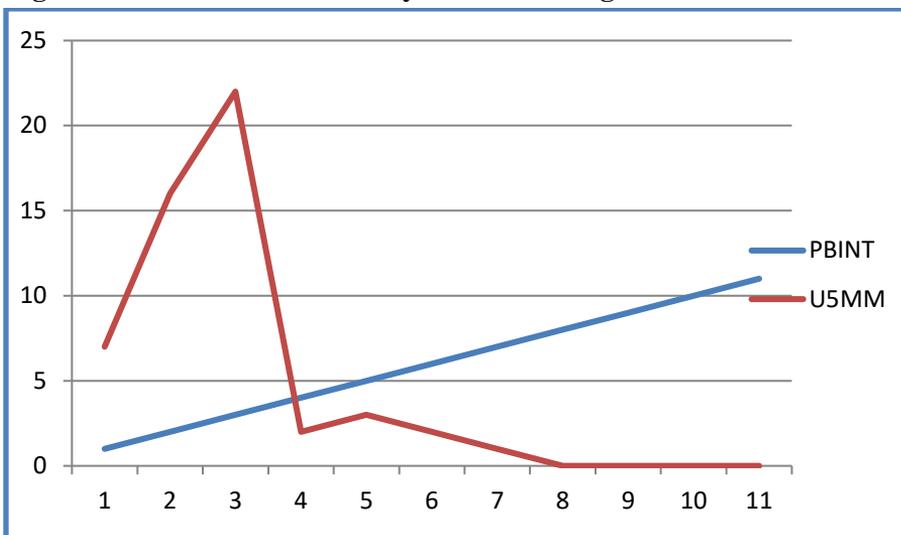


Source: Author's computation based on EDHS (2016)

#### 4.1.3 Preceding Birth Interval

The length of a Preceding Birth Interval is one of the determinants of the Under-five Mortality in Benishangul-Gumuz region. The relationship between the Preceding Birth Interval and Under-five Mortality is negative; the correlation coefficient of the two variables is -0.13. Figure 5 shows that when as the birth interval is low, the Under-five Mortality Rate is relatively high, and as the interval increases, the chance of children below five dying declines. A birth interval of two years appears to be the most dangerous.

**Figure 10: Under-five Mortality with Preceding Birth Interval in Years**



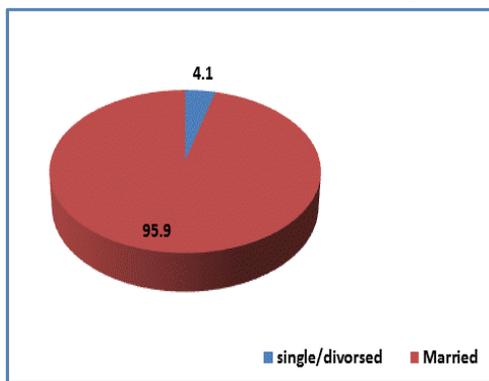
Source; Author’s computation based on EDHS (2016)

**Marital Status**

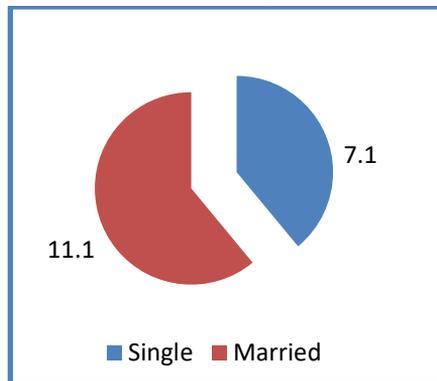
Figures 6 and 7 demonstrate that about 95.9% of the total of 879 observations are married families; 4.1% are of single parent or divorced families. In married families, about 7.1% of children died before their 5th birthday; in single or divorced families about 11.1% died. Respondents make it clear that marriage is highly valued in the Benishangul-Gumuz region and an unmarried woman who has a child is out-caste and a shame to her parents. The percentage of woman’s either never married, or living with parents, widowed or divorced is 4.1%. Interviews underline the culture of Benishangul-Gumuz encourages couples to remain together in marriage and single or divorced families are limited in number. Under-five mortality in married families is relatively low, compared to single or divorced families.

Figure 6 shows the distribution of the population with regard to marital status among married people or single/divorced/widower. Figure 7 shows the percentage of under-five mortality among married mothers (11.1 percent) and single mothers (7 percent.).

**Figure 11: Marital Status**



**Figure 12: Under-five Mortality/Martial Status**

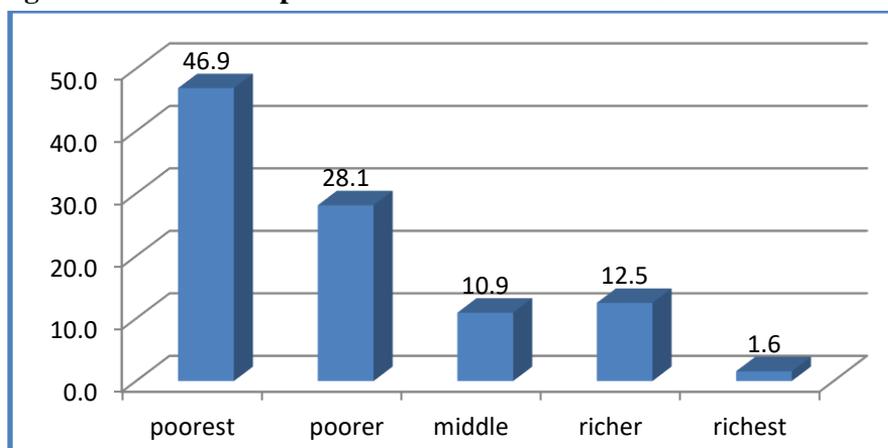


Source; Author’s computation based on EDHS (2016)

**4.1.5 Income/wealth index**

We used the wealth index as a measure of income as one of the key variables that have a positive impact on the welfare of children. The wealth index is calculated from a score given to households on the basis of the number and kind of consumer goods Author’s. Figure 8 shows that as the income of the family increases, the incidence of child death decreases. 46.9% of child death occurred in the poorest families while only 1.6% of deaths occurred in the richest families. The correlation coefficient between the wealth index and Under-five Mortality is negative at -0.08, showing the treatment, value and care given to children rises as income increases.

**Figure 13: Relationship between Wealth Index and U5M**

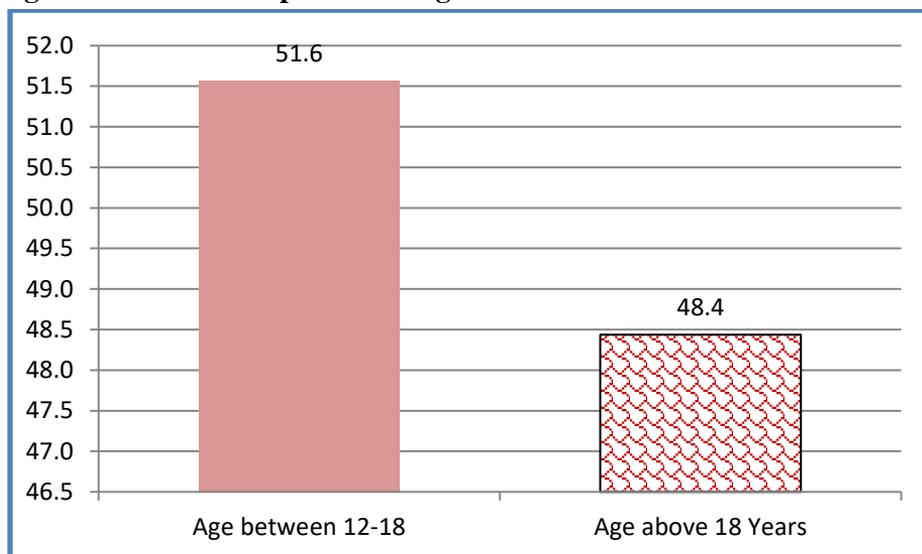


Source; Author’s computation based on EDHS (2016)

#### **4.1.6 Mothers' age at First Birth**

The age of a mother at first birth is an important variable to determine the cause of high mortality because mothers, at a first birth, are often not mature physically or mentally; informants make it clear the survival rate of both mother and child is relatively lower as compared to matured mothers. That is why health workers as well as the government and NGOs which work with children and mothers argue strongly against early marriage. It is also forbidden in the Constitution (Article 34, 1995) with the aim of protecting mothers' and preventing child mortality. Despite this, as Figure 9 shows, out of 879 mothers, 53.3% first gave birth between 12-18 years and nearly 52% of Under-five Mortality is associated with these mothers. For cultural reasons, early marriage in Benishangul-Gumuz is a common practice and it certainly contributes to a higher U5MR in the region.

**Figure 14: Relationship between Age of Mother at First Birth and U5MR**



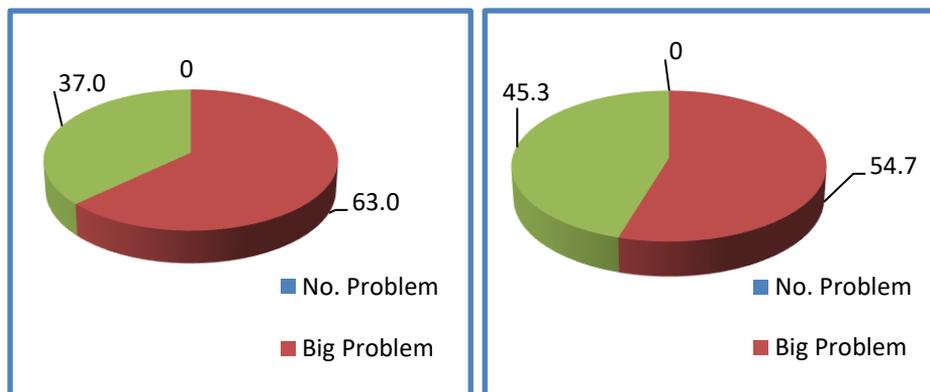
Source; Author's computation based on EDHS (2016)

#### **4.1.7 Access to Health Facilities (HFs)**

Access to Health Facilities is another key variable to address Under-five Mortality and access in the Benishangul-Gumuz region is a crucial problem. As Figure 10 demonstrated, out of a total of 879 respondents, none agreed that they had good access to HFs. 63 percent of respondents said they had severe access problems; and the other 37 percent classified problems in accessing the HFs as

mild. Figure 11 relates Under-five Mortality associated with severe and mild problems to HF's access, underlining that the access to HF's is very poor and Under-five Mortality was directly linked to the problem of access. Benishangul-Gumuz region's access to health facilities is one of the least in the country.

**Figure 15: Response to HF's Access in %    Figure 16: Response to HF's Access against U5M %**

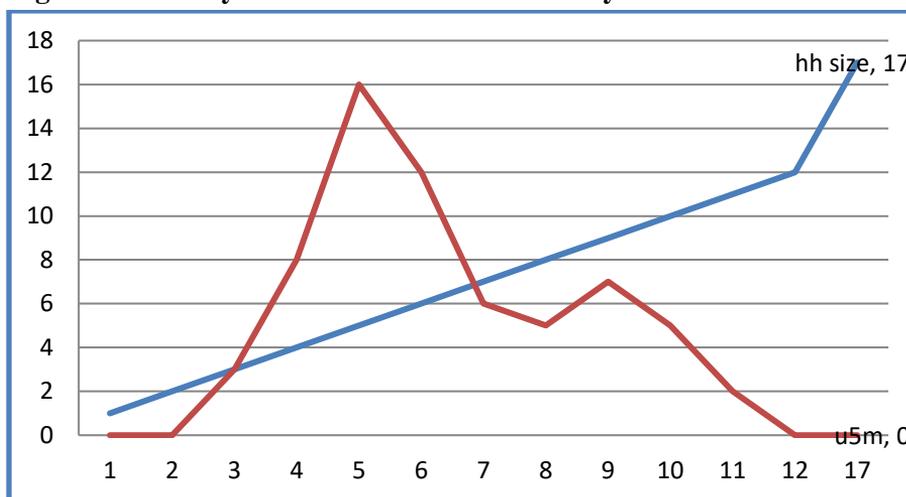


Source: Author's computation based on EDHS (2016)

#### **4.1.8 Family Size**

As the size of a family increases up to 5 (Figure 12), Under-five Mortality also increases. Above five U5M tends to decline. This may be because of the difficulty of managing the family and provide the domestic protection required to raise healthy children. Women have the responsibility to cook, clean and provide for the household, and it is hard to perform all these activities along with raising many children. When the number of household members is greater than five, there are likely to be other grownups to help to siblings or share responsibilities for domestic activities.

**Figure 17: Family size with under-five mortality**



Source: Author’s computation based on EDHS (2016)

**Place of Residence (Urban/Rural)**

Benishangul-Gumuz region is largely rural Health and education facilities and other socio-economic infrastructures are very limited and there is high probability of child illness leading to death. Out of the total sampled children, 5.7 percent lived in urban areas (Table 1), the remainder in rural areas, and most Under-five Mortality occurred in rural areas. In Benishangul-Gumuz region, Under-five Mortality is largely a rural phenomenon.

**Table 14: Children by Residence**

Description	Urban	rural	Total
Under-five Mortality (U5M) (%)	1(1.6%)	63 (98.4%)	64 (100%)
Alive Child	49 (6%)	766 (94%)	815 (100%)
Total	50	829	879
% of	5.7%	94.3%	

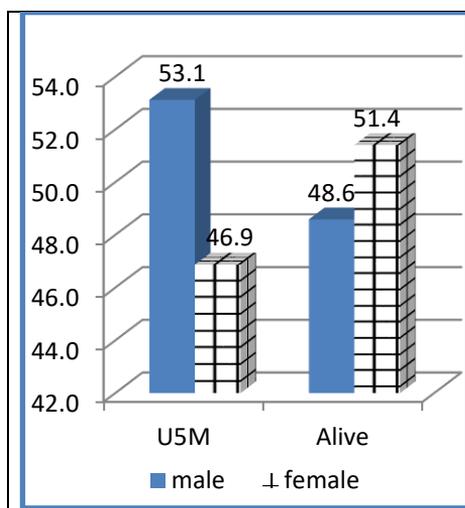
Source: Author’s computation based on EDHS (2016)

**Sex of the Child**

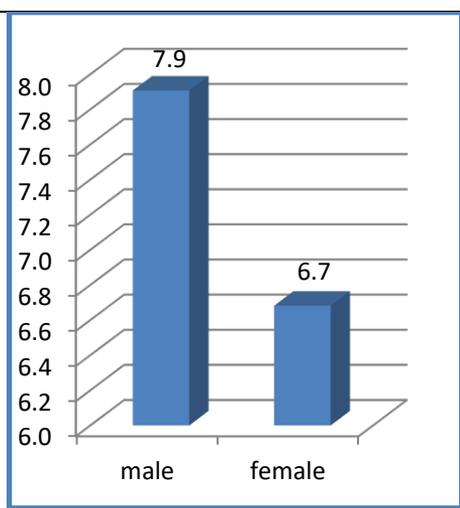
Sex preference may be one of the contributing factors to higher Under-five Mortality in Benishangul-Gumuz region. The analysis of both dead and alive children found 53.1% of deaths were of male children and 46.9% female (Figure

13). In addition, out of the total children who reached their fifth birthday 48.6% were male and 51.4% are female. Of total births, 7.9% of those who died were male, 6.7% female (Figure 14). This raises the suspicion of existence of a cultural preference for female children in Benishangul-Gumuz region. Interviews with native residents note that the family of the groom is obliged to provide cattle to the family of the bride, which means female children are considered as a source of wealth to their family.

**Figure 18: Sex Composition in relation to U5M and living from Total Birth**



**Figure 19: Percentage of death to U5M and living from Total Birth**



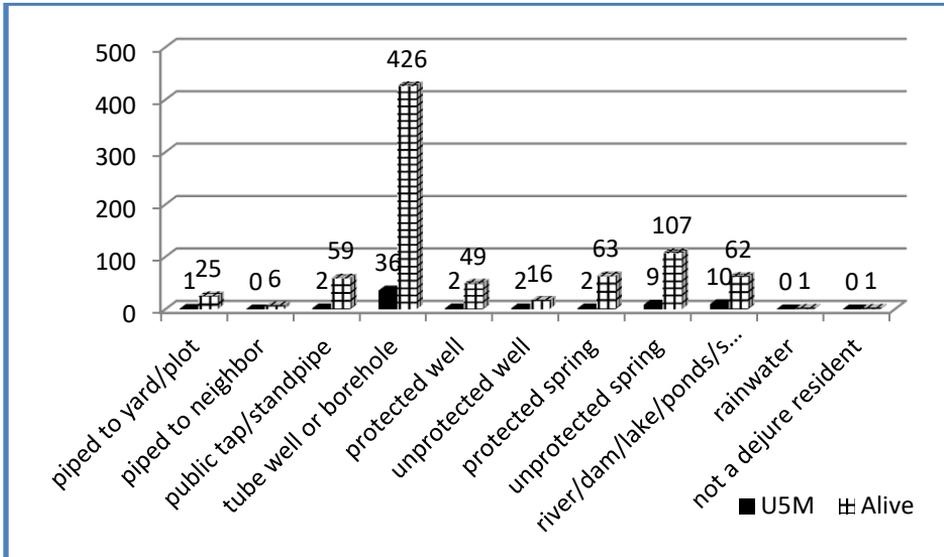
Source: Author's computation based on EDHS (2016)

#### 4.1.11 Source of Drinking Water

Rural areas in Benishangul-Gumuz region have low standard infrastructure with limited clean water access. Figure 15 shows many families use unsafe sources of drinking water. Access to piped water (private or public) is limited while unsafe sources of drinking water, rivers, dams, lakes, ponds, streams, irrigation canals, unprotected springs, tube wells or boreholes are common. It is observed that families of both dead and living children used more unsafe sources of drinking water though there were differences between the two groups. Higher mortality was found where the sources of drinking water were tube wells or boreholes and other unprotected sources which can carry different

kinds of diseases like diarrhea, cholera, guinea worm, typhoid, dysentery and others and under-five children have low fighting capacity .

**Figure 20: Sources of Drinking Water**

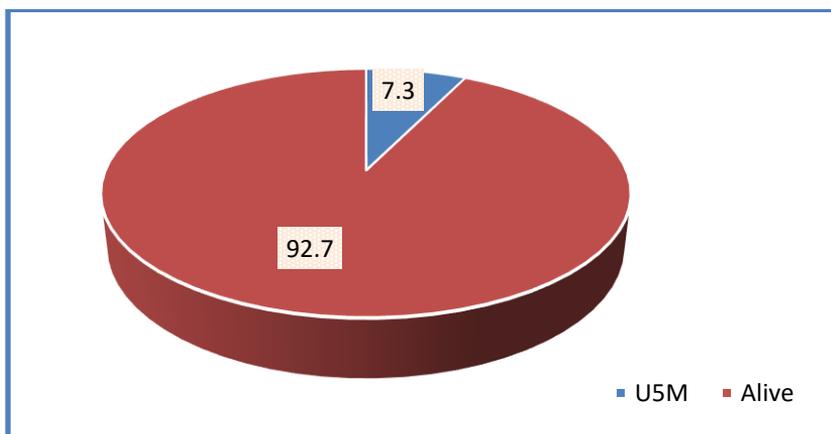


Source: Author’s computation based on EDHS (2016)

#### 4.1.12 Access to Toilet Facilities and Sanitation

Sanitation is another variable that can determine the health status of children and their families. Families follow a unsafe hygiene system. Because of their toilet facilities, they are likely to be exposed to illness or death. The major types of toilet facilities used by U5M families are open pit and open field, classified as traditional, or flush or pit latrines, ventilated and improved pit latrines or pit latrines with slab defined as modern facilities and rarely available. The situation of families with living children is not much different but those families do have relatively better access to safer sanitation. 92.7% of the under-five deaths occurred in families using traditional and unhygienic facilities (Figure 16) which allow for numerous contagious diseases, including cholera, typhoid, infectious hepatitis, polio, cryptosporidiosis, ascariasis, pneumonia, and worm infestations. Children under the age of five are particularly susceptible to such infections.

**Figure 21: Access to traditional Sanitation Facilities by U5M and living children’s Families**



Source: Author’s computation based on EDHS (2016)

#### **4.1.13 Type of Birth**

Under-five Mortality appears higher in multiple rather than single births. Of total multiple births, about 25% of children passed away before they celebrated their fifth birthday while only 7% of single birth children died before their fifth birthday (Table 2). This shows the probability of Under-five Mortality is higher in multiple-birth than in single birth.

**Table 15: Children by Type of Birth**

Type of Birth	Single Birth	Multiple Birth	Total
Alive	797	18	815
U5M	58	6	64
Total	855	24	879
% alive from total	93.21637	75	92.719
% dead from total	6.783626	25	7.281001

Source: Author’s computation based on EDHS (2016)

## **4.2 Econometrics Analysis**

### **4.2.1 Variables Definition and Hypotheses**

The econometric analysis was made using a Probit model where a dichotomous dependent variable takes the values of 0 and 1. “1” stands for the

under-five mortality and “0” stands for alive and breathing under-five children. The Probit model works for a binary dependent variable, assuming that the probability of a positive outcome is determined by the standard normal cumulative distribution function. It can compute robust and cluster-robust standard errors and adjust results for complex survey designs.

In addition, to investigate the partial effect of each explanatory variable on the dependent variable, assuming other things remain the same, we have also estimated the marginal effect of explanatory variables on the dependent variable. (Stata Manual, version 14).

Margins are statistics calculated from predictions of a previously fitted model at fixed values of some covariates and averaging or otherwise integrating the remaining covariates. The estimates margins of responses for specified values and present the results as a table. Capabilities include estimated marginal means, least-squares means, and conditional marginal and partial effects (which may be reported as derivatives or as elasticities), average and conditional adjusted predictions, and predictive margins

The types and definitions of variables and related hypotheses are presented in Table 3.1 below. They show the relationship, positive or negative, that the explanatory variables have with the dependent variable, Under-five Mortality.

**Table 3.1: Variable Code, Type and Definition of Variables, and Hypotheses**

<b>Variable code</b>	<b>Variable Type</b>	<b>Definition of Variables</b>	<b>Hypotheses</b>
EDUM	Discrete	Mother's educational level (Categories: no education, primary, secondary and higher)	Negative
DOB	Continuous	Duration of breastfeeding	No breastfeeding - positive Breastfeeding - negative
PBINT	Continuous	Birth interval	Negative
MSS	Dichotomy	Marital status	Single - Positive Married - Negative
WEALTH	Discrete	Income/wealth of household	Negative
AGEHH	Continuous	Mother's age at first birth	Negative
ACCESS		Getting medical help; distance to health facility	Major problem - positive Minor problem/ no problem - negative
HHSSTOCK	Continuous	Family size by number	Positive
RES	Dichotomy	Place of residence (urban or rural)	Urban - positive Rural - negative
SEX	Dichotomy	Sex of the child	Male - positive and Female - negative
DRINK11	Dichotomy	Source of drinking water	Non-potable water - positive Potable water - negative
TOILET11	Dichotomy	Sanitation	Traditional - positive Modern - negative
CHNO22	Dichotomy	Types of birth (single/multiple)	Multiple - positive Single - negative

Source: Author's computation based on EDHS (2016)

### 4.2.2 Results and Discussion

As mentioned in the descriptive analysis above, the focus econometric analysis is on key variables, either closely linked to mothers' child care characteristics or those which empower women directly or indirectly in child care. With the introduction of key and controlled variables, the model is found to be stable, as a whole. The sensitivity of model stability can be seen as follows:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \dots = \beta_n = 0$$

$$H_0: \beta_1 \neq \beta_2 \neq \beta_3 \neq \dots \neq \beta_n \neq 0$$

The Ch2 test results shown on the Table 3.2 tends to accept the null hypothesis which indicates that at least one variable is statistically different from zero; that is the model is stable, having at least one coefficient different from zero.

**Table 3.1: The Maximum Likelihood Estimates of the Probit Model**

Variables	Coefficient	Std. Err.	Z	P>z	Marginal effect
EDUM	-0.30951	0.1762	-1.76*	0.079	-0.02599
DOB	-0.52566	0.0710	-7.41***	0.000	-0.04414
PBINT	-0.01194	0.0060	-1.98**	0.047	-0.00100
Mss	-0.8146	0.3392	-2.4**	0.016	-0.12799
WEALTH	-0.12714	0.0660	-1.93*	0.054	-0.01068
AGEHH	-0.01571	0.0228	-0.69	0.491	-0.00132
Hhsstock	0.008274	0.0394	0.21	0.834	0.00069
RES	-0.25303	0.5155	-0.49	0.624	-0.02125
SEX	-0.03571	0.1515	-0.24	0.814	-0.00300
drink11	0.339704	0.3579	0.95	0.343	0.02242
toilet11	0.349683	0.4169	0.84	0.402	0.03909
Access	0.112626	0.1559	0.72	0.47	0.00946
chno22	0.459071	0.3404	1.35	0.177	0.05590
_cons	49.55037	7.0389	7.04	0.000	

dy/dx is for discrete change of dummy variable from 0 to 1

<b>Number of obs= 736</b>	<b>Log likelihood= -159.292</b>
<b>Wald Chi2(13) = 70.1</b>	<b>Prob&gt;Ch2=0.0000</b>

\*\*\*, \*\*, & \* indicates the level of significance of variables at 1%, 5% & 10% respectively

Source: Author's computation. Model output based on EDHS (2016) using Stata 14

Using the estimated results of the Probit model and the marginal effect results shown in Table 3.2, discussion and possible explanations for the five significant independent variables follow here:

**Mother's Educational Level:** Mother's educational level is statistically significant at 10 percent in affecting Under-five Mortality negatively, a result in line with our hypothesis. Changing the educational status from no education to some level of education, lowers the probability of under-five mortality. This shows that in educated families, we find less under-five mortality than in uneducated families. Educated mothers are better informed about mother and child health care and also more willing to adopt new technologies, accept advice from extension services, diversify income, become visionary in educating their families, or producing marketable crops. It all contributes positively towards a healthier life for children. This result is in conformity with the findings of other studies (Ramakrishna, G. and Asseffa, D., 2002) and (Haile et al., (2005). Analysis of educational status changes reveals that the probability of Under-five Mortality decreases by approximately 2.6 percent with every additional unit of mothers' educational level. The coefficient and marginal effect of education indicates that empowering women through education is key to addressing the Under-five Mortality in the region. The result suggests the Federal Ethiopian Government in general and the Regional State Government in particular should give due emphasis to expanding female education to reduced child mortality.

**Preceding Birth Interval (month):** A narrow preceding birth interval negatively affects Under-five Mortality in conformity with our expectation and it is found statistically significant at less than 10 percent significance level. The marginal effect of the preceding birth interval reveals that the probability of Under-five Mortality decreases approximately by 0.10 percent as the preceding birth interval increases by one unit (year). This indicates that wider birth interval will lessen the mortality rate in the study area.

**Duration of Breastfeeding (Month):** The Probit output result revealed that the duration of breastfeeding negatively influences the Under-five Mortality in agreement with our hypothesis and is statistically significant at 1 percent level. The marginal effect of duration of breastfeeding indicates that the probability of the Under-five Mortality Rate will decrease by approximately 4.42 percent when breastfeeding increases by 1 unit (month). The coefficient and the marginal effect of breastfeeding indicate that breastfeeding brings about a more substantial reduction in Under-five Mortality than any other intervention. All stakeholders

in the region are therefore advised to encourage mothers to increase breastfeeding to reduce Under-five Mortality.

**Income/Wealth of the Household:** The income or wealth of the household has a negative relationship with Under-five Mortality at 10 percent significance. This again agrees with our hypotheses. The marginal effect of household income reveals that the probability of occurrence of Under-five Mortality decreases by approximately 1.03 percent when the level of household income increases by 1 unit. In addition, the absolute value of the coefficients of income increases as the income category of the society changes from poorest, to poor, middle, richer and richest family groups. Programs targeted to increase the income of households and bridge income disparities will result in reducing Under-five Mortality.

**Marital Status:** Marital Status is the final major determinants of Under-five Mortality. It is statistically significant at less than 5% probability level and has a negative relationship with Under-five Mortality in conformity with our hypothesis. The marginal effect of marital status reveals that the probability of occurrence of Under-five Mortality decreases by approximately 1.3 percent when the marital status changes from single to married. The welfare of children is relatively better in married families than in single or divorced families. The culture of Benishangul-Gumuz is in favor of keeping traditional norms where marriage is respected and the bonds that keep couples together is powerful. A woman who is unmarried and has a child is regarded as shameful by both society and her family. Treatment of the child in such circumstances is likely to be as good as in married families.

All other variables included in the model were statistically insignificant but the signs of the coefficients were in line with our hypotheses as noted in the descriptive analysis.

## **5. Conclusions and Recommendations**

### **5.1 Conclusions**

The Under-five Mortality Rate in Benishangul-Gumuz is relatively the highest among Ethiopia's regional states, next to the Afar region. The risk of a child dying before completing five years of age in Benishangul-Gumuz is 72.8 per 1000 live births, almost 22 percent higher than the national average. Recognizing the problem, this paper has tried to identify the main determinates of Under-five Mortality in Benishangul-Gumuz region using the Ethiopian

Demographic and Health Survey (2016). Using a Probit model estimation, five of 13 explanatory variables were found to have a negative and statistically significant effect on the Under-five Mortality Rate in Benishangul-Gumuz Regional State: a Mother's Educational Level; the length of a Preceding Birth Interval; the Duration of Breastfeeding; the Income or Wealth of a household and the income disparities of the society; and Marital Status.

## **5.2 Recommendations**

These five statistically significant determinants of Under-five Mortality in the Benishangul-Gumuz region are all related, directly or indirectly, to women's empowerment in education, health and income. We would, therefore, suggest a number of recommendations in these areas to tackle the problem of the excessive Under-five Mortality Rate in the region:

Taking into account the impact of mother's education on Under-five Mortality, the region should expand formal as well as informal education especially for females. Females constitute around 50 percent of the population so investing on female education will have a pivotal effect in improving the socio-economic status of half the population as well as reduce Under-five Mortality;

Encourage women to widen birth intervals through the promotion of Family Planning by the Regional Government and NGOs to expand the birth intervals will closely minimize the under-five mortality.

Duration of breastfeeding has a negative impact on under-five mortality. Thus, it is recommended that all concerned bodies, governmental and non-governmental, should encourage breastfeeding through awareness and other training programs for the advancement of child health, and emphasize the importance of extending its duration;

Government and NGOs should target policies, programs and projects to increase the income of households and aim to reduce the income disparities of the society in favor of the poor;

The Government should make efforts to maintain the culture of the region and its emphasis on favoring marriage. This may be due to the culture of the region. Single or divorced family is discouraged in the Benishangul-Gumuz region making children treatment in the single or divorced families less favorable than that of married families. Thus, it is recommended to maintain the good culture of the society as it favors married couples for better nutriment of children.

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