Ethiopian Economics Association (EEA)

PROCEEDINGS OF THE THIRD REGIONAL CONFERENCE OF THE SOUTHERN NATIONS NATIONALITIES AND PEOPLES REGIONAL STATE ECONOMIC DEVELOPMENT

Edited by

Worku Gebeyehu

Demirew Getachew

Published: March 2014

ISBN – 978-99944-54-35-8

FOREWORD

The Ethiopian Economics Association (EEA) and its Hawassa Chapter are happy to issue the proceeding of the Third Annual Conference on the SNNP Regional State Economic Development which was organized on the March 28, 2013 at SNNP Regional State Bureau of Finance and Economic Development Conference Hall. EEA in collaboration with its chapter organized this important regional conference as one of its objectives of broadening its activities and coverage at regional level so as to contribute to the economic advancement of regional state through enhancing economic policy formulation capability; the dissemination of economic research findings; promotion of dialogue on critical socio-economic issues; promotion of education in economics in higher learning institutions; enhancing national, continental and global networks of professionals and institutions; and advancement of the professional interests of its members.

The conference attracted about 170 participants that are drawn from SNNP Regional State Government Offices, Universities, Civil Society Organizations, and EEA members. The participants of the conference expressed their satisfaction on the organization of the conference and the content of the papers presented. They reflected that the papers largely focused on local issue that can contribute to the development of the region. They also recommended that the issues raised in the discussion are critical that need to be taken by policy makers and implementing organs of the regions. In the one day conference nine papers that focused on the regional socio-economic condition presented and discussed.

All papers which were presented at the Third Annual Conference were reviewed by external reviewers and Comments and suggestions including editorial comments were communicated to authors for improvement. Finally, those papers which passed all the review and editorial process published in the

Proceeding of the Third Annual Conference on the SNNP Regional State Economic Development.

I would like to take this opportunity to express my heartfelt gratitude, on my own behalf and on behalf of the Ethiopian Economic Association, to the many people and organizations that made the conference a resounding success. First and foremost, I thank the authors of the papers and the audience whose active participations made the Third Annual Conference meaningful and dynamic. The SNNP Regional State Bureau of Finance and Economic Development deserves huge thanks for granting us free use of its conference hall. The professionals who dedicated their time to the conference and served as chairpersons deserve due thanks for their special contributions.

The staffs of the Economics Department of the Hawassa University, which runs the EEA Hawassa Chapter and EEA Secretariat, deserve a special recognition for their enthusiasm and perseverance in managing the conference from inception to completion. I would like also to thank Hawassa University for the continuous support given to the EEA Hawassa Chapter and the material, technical and finical support given for the successful conclusion of the Third Annual Conference.

Finally, I would like to seize this moment to express our gratitude to our partners who have shared our vision and provided us with generous financial support to materialize the activities of EEA. These include; The Friedrich Ebert Stiftung of Germany, The African Capacity Building Foundation (ACBF), The Think Tank Initiative of International Development Research Centre (IDRC) of Canada; and Civil Society Support Program (CSSP).

Alemayehu Seyoum Taffesse (DPhil)
President of the Ethiopian Economics Association

TABLE OF CONTENTS

HOUSEHOLD DEMAND FOR IMPROVED WATER SUPPLY SERVICE IN ETHIOPIA: The CASE OF SODO TOWN

Belaynesh Tamire[1]

Abstract

Water is crucial for human life and one of the resources for economic development. However, the provision of improved water supply service is inadequate both in urban and rural areas of Ethiopia. Hence, an efficient water supply service is needed to all the households in the country. This particular research study is conducted to gather information on the existing situations and problems related to the water supply services in Sodo town and to suggest some measures for policy improvement. A contingent valuation method was applied by using bidding game elicitation format with a single bound close-ended question followed by open-ended follow up question. Data was collected from 160 household heads by using face-to-face interviews. The collected data was analyzed by using both descriptive and econometric data analysis techniques. Results of descriptive analysis reveal that of the total sample households, 47.5% have private connection. However, only 18.49% households were satisfied with the status quo. About 99.37% sampled households preferred to have the improved services and almost 94% of households expressed their willingness to pay for the proposed scheme of improved service in the town. The empirical result of probit model suggested that whether or not the household is willing to pay for improved water supply service are affected by gender of the household head, house ownership, and years of stay in the area, sources of water, quantity of water used per day, time loss to fetch water and initial bid price. In the Tobit model, gender of the household head, level of education, level of satisfaction and initial bid price are found to determine the amount of money individuals were willingness to pay. The study concluded that demand side information is important to bring efficient water supply service.

Key words: Water, Willingness to pay, Contingent valuation method, Sodo town

[1] Wolaita Sodo University
belytame23@yahoo.com or belsihne2010@gmail.com

1. Introduction

In the year 2000, the United Nations, through the Millennium Development Goal (MDG) for environmental sustainability, set the international target to halve the proportion of people without sustainable access to safe drinking water by the year 2015. Estimates of the annual investment required to finance this target vary enormously, but the majority are almost certainly underestimates since they do not account for maintenance and rehabilitation of existing infrastructure, nor consider the costs of maintaining the institutions and support services required for service sustainability (Harvey, 2007).

In most developing countries provision of water supply service is inadequate both in urban and rural areas. This will make meeting the MDG on environmental sustainability target questionable. According to WHO/UNICEF (2000), 1.1 billion people lack access to improved water supply. Due to population growth and rapid urbanization this number will likely rise rapidly in the coming years unless serious measures are undertaken to stem the tide. Massive investments in supply infrastructure are required as well as reforms in the operation and maintenance of supply systems to increase efficiency (Engel et al, 2005).

The urban water supply situation in many developing countries is getting worse. Many households do not have private connections and have no choice but to purchase water from vendors, collect from public taps or wells. Many households that tap into a piped distribution system may share the resource with neighbors and have water for only a few hours per day (Casey et al, 2006).

In developing countries like Ethiopia where most people have a low standard of living and their capacity to pay for service is low, the supply of safe water is the task of the government and other institutions which do not work for profit maximization but aim to improve people's health and welfare. The provision of

adequate, reliable and clean water service that meet the water user's demand should be implemented so as to achieve its objectives (Alebel, 2002).

The Ethiopian government plan for Accelerated Sustained Development and to End Poverty (PADEP), covering the period 2005-2010, aimed at increasing access to improved water sources to 84% by 2010. This ambitious target goes well beyond that of the MDGs, which aim at halving the share of people without access by 2015. According to one set of government figures, which is used by the Ministry of Finance and Economic Development for planning purposes, access to drinking water reached 68.5% in 2010. According to another set of government figures, based on national survey data and used by the WHO and UNICEF to monitor the MDGs, in 2008 access to an improved water source was only 38%. In 2010 the government presented the equally ambitious Growth and Transformation Plan (GTP) 2010-2015 that aims at increasing drinking water coverage based on government's definition from 68.5% to 98.5% (World Bank, 2011).

Coming to the specific town of Sodo, the situation of water supply service creates a serious problem. Implying that there is an imbalance between demand for and supply of water in the town which leads to search for the possibility of payment by the households in providing improved service. This needs demand side analysis; which is important for the planning process. Therefore, this study is designed to provide demand side information of water supply problem.

Different studies were conducted in line with willingness to pay (WTP) for environmental quality services in general and water supply service in particular. Adenike and Titus (2009) carried out a study that shows households. WTP and income has a positive relationship. As the level of income increases, the proportion of income spent for service improvement becomes higher in Nigeria. Casey et al., (2006) used the Contingent Valuation Method (CVM) to estimate the WTP in Brazil and found that residents are willing to pay more than R$12 (US$6.12) per month.

On the other hand, in Ethiopia, many studies had been undertaken on WTP of water services. The study conducted by Alebel (2002) found out that WTP for improved water service is higher than the existing tariff and the consumer affords to pay if price is equal to the average incremental costs. Besides, Gossaye (2007) employed the CVM to investigate the WTP for improved water supply service in Debre Zeit town. His study showed that all respondents who participated in the survey were for the improvement but the amount of payment varies from one individual to another. In addition, Medhine (2006) bound out income, water related disease, and sanitation facility and other socioeconomic variables are the main determinants of WTP for improved water supply services in Addis Ababa.

So far, to the best of the writer's knowledge, there has been no study undertaken in Sodo town to analyze the factors affecting the WTP for improved water supply. Thus, the objective of this study is to identify the factors that influence WTP for improved water supply service in order to guide policy makers on ways of promoting the service.

This paper is organized into five sections. The first section covers the introduction. The empirical review of literature is presented in section two. The third section consisted of the methods and materials used for the study. The empirical results and discussions are found in the fourth section. Finally, the conclusions and policy implications of the study are deal with in section five.

2. Literature Review

Environmental Valuation

Natural resource economists divide value into two main categories: use value and non-use value. Use value refers to the intended use of the service and good by an individual. The use value also is divided in two, direct use value and indirect use value. Use values such as fishing and hiking are the more direct and quantifiable category of environmental values, but they capture only a portion of the total economic value of an environmental asset. Indirect-use values consist

of indirect benefits arising from ecological systems, biological support, climate regulation, physical protection and global life support (Perman et al, 2003).

The second category, non-use values, which are slightly more complicated, involve a more abstract concept of valuation. There are three kinds of non-use values. Altruism is a non-use value obtained from the welfare of other individuals or groups. In this case, altruism might motivate a passenger to offset emissions because it improves the air quality for others. Bequest value is also one of the non-use values that are related with the welfare of future generations. For example an elderly airline commuter may choose to buy offsets because s/he may want her grandchildren to live in a world with cleaner environment**.** Finally, existence value refers to the non-use value which is derived from merely knowing that some aspect of the environment exists. We might be WTP for clean air, for example, just for the sake of knowing that it is clean. In general total economic value is the summation of use and non-use value (Perman et al, 2003).

Non-Market Valuation

The individual demonstrates preferences which in turn place values on environmental resources. That society values environmental resources is certain; monetizing the value placed on changes in environmental assets such as coastal areas and water quality is more complex. Environmental economists have developed a number of market and non-market-based techniques to value the environment. Environmental valuation techniques are broadly classified into two approaches: revealed preference approaches (RPA) and stated (or expressed) preference approaches (SPA). Revealed preference approaches make use of individuals' behavior in actual or simulated markets to infer the value of an environmental good or service. Stated preference method to elicit environmental value is largely based on the assumption that individuals are WTP for environmental gains while WTA are a compensation for some environmental losses (Perman et al., 2003).

RPA uses the information that is available in the market and is specifically related to the non-marketed value under consideration to infer value estimates. In the SPA people are asked their WTP for hypothetical situations.

Travel Cost Method (TCM)

TCM is one of the categories of revealed preferences that costs incurred by visitors could be used to develop a measure of the recreation value of the sites visited. In general TCM focuses on recreational uses of natural resource. The central idea of TCM is to infer the values placed by visitors on the environmental amenity services from the costs that they incurred in order to experience the services (Perman et al, 2003).

Hedonic Pricing Method (HPM)

The HPM is another technique that determines environmental valuation under the category of revealed preference. The earliest applications HPM were planned to capture the WTP measures related with variations in property values that result from the presence or absence of particular environmental goods or services. This technique was undertaken by comparing the market value of two properties which differ only with respect to a specific environmental attribute. Economists may assess the implicit price of that amenity by observing the behaviour of buyers and sellers. Therefore; the variation on the approach of comparing the effects of an environmental attribute would involve comparing the price of a single piece of resource over successive sales.

Contingent Valuation Method (CVM)

CVM is one of the SPAs which directly ask people in a hypothetical market what they are WTP for environmental goods/services for the benefit they obtain and/or what they are willing to receive by way of compensation to tolerate a cost. In this method people are asked whether they are WTP for preservation of native forests or not. It may also take the form to ask people the WTP for

access to clean water, or what compensation they are WTA if they face a lose to the access to clean water.

The Contingent Valuation Method (CVM) has become a major tool for estimating the value of natural resources like water especially in developing countries (Whittington, 1998 and Merret, 2002). Over the last two decades a flurry of CVM studies have been undertaken to assess the effective demand for water and sanitation services among rural households in developing countries.

Alebel (2002) conducted a study to find out determinants of the WTP of water consumers and to determine whether it is possible to introduce full cost recovery program to provide improved water supply in urban areas of Ethiopia. He used a CVM to examine the determinants of WTP and the value elicitation method used is bidding game. He used Censored Least Absolute Deviation (CLAD) estimation for the empirical analyses. He also used the Probit model to see the effect of the explanatory variables on the choice of households to improved water service. According to his findings, CLAD estimation result showed gender, income, monthly expenditure for water consumption, quality and time taken to fetch water from existing sources significantly affect the respondents' WTP. The Probit estimate result showed that wealth, income, education level, source used by the household, quality and time taken to fetch water from the existing source affect the choice of the respondents to the improved service.

Medhine (2006) undertook a study on the determinants of households' WTP for improved water service by using the CVM. The study used cross sectional data through single bounded elicitation format with an open-ended follow up question using face-to-face interview. Probit and Tobit models were adopted for the empirical analysis of the study. Accordingly, the results of the study revealed that respondents' WTP is affected by a number of explanatory variables including sanitation facility, water related disease and socio-economic variables like income, age, sex, marital status, educational level and family size

of the respondent. The mean WTP for private connection is found to be 20 cents per Baldi (20 liters container) and 15.79 cents per Baldi from close ended and open-ended questions, respectively, which are well above the current subsidized tariff.

In 2007, Gosaye's also undertaken a study on households' WTP for improved water services in Debre Zeit town by employing CVM. The survey result shows that 99.57% of the survey respondents use pipe water. However, only 10.26% of the respondents were satisfied with the status quo level. All the survey respondents expressed their WTP above the existing tariff level, though the amount of money they are WTP varies from individual to individual. The survey result also shows that mean WTP for one bucket or for 20 litres of improved water service is 10.2367 and 12.4786 cents according to the dichotomous choice and open-ended survey responses, respectively. The total WTP for one bucket of improved water services is 262,781.45 cents or Birr 2,627.82 per day or Birr 959,159.30 per year. The results of both Probit and OLS econometric models show that age, household size, reliability dummy and the income variables influence the households' WTP for the improved water services in the Debre Zeit town.

Wendimu and Bekele (2011) analyzed a study on the determinants of households' WTP for quality water supply, using the CVM. The study was conducted with randomly selected households in the factory villages of Wonji Shoa Sugar Estate. The study used a close ended format questionnaire with additional close ended format and open ended follow-up questions to elicit the market value. For empirical analysis, Tobit model is used to determine the household WTP for the quality of water supply. Their findings revealed that the income of the household, educational level of the respondent, reliability on existing water supply, respondent perception about quality of the existing water supply, household family size and age of the respondent are significant variables that explain WTP. The mean WTP for quality water supply is found to be $ 0.025 per 20 litre container which is well above the current tariff rate of $

0.005 per 20 litre container. Their study concluded that there is a need to consider the demand side of the market for water as opposed to the supply side in service providing development programs and the need to consider the effect of awareness, income and education in water development programs and design mechanisms be addressed appropriately.

In 2012, Dessalegn was conducted a study on factors determining residential water demand in north western Ethiopia – Merawi town. Data from 200 households were collected and analyzed by using SPSS. Logistic regression and standard multiple regression analyses were used to determine the factors explaining households water source choice decisions and determinants of residential water demand of the surveyed households. The analysis pointed out that monthly expenditure; housing ownership and educational status of the household head were statistically significant predictors of the households' decision to have private pipe connection.

3. Methodological Framework

3.1. Study Area, Data Sources, Sampling and Design of Survey Questionnaires

Sodo town is situated in Wolaita Zone of the Southern Nation's Nationalities and Peoples Region. Of the 13 weredas, which are found in Wolaita Zone, Sodo town is considered to be one of the most urbanized. In the year 2012, the total population of the town was estimated to be 96,140 and that of total households living in the 23,814.

Ground water is the main source of water in the town. Regarding the tariff system, the municipality use progressive tariff system based on the types of customers (domestic, commercial and institutional) and the volume of water consumed. Presently, the total connection of water are 4254 of which 3727 are for domestic, 365 for commercial and 162 for institutions including public associations and public taps in the town.

In 2012, the actual water supply coverage of the town was only 52%. However, due to high shortage of water coupled with the fast growth of the town and its rising population, the Sodo water supply office has been implementing a project that aims to handle the existing problems and to supply water with full coverage in the coming two years.

Both primary and secondary data sources were used to carry out the study. The source of the primary data was cross-sectional collected from the sample intended to represent the population. The secondary data was obtained from institutions and reference materials.

To determine the sample size, we used Yamane's[2] (1973) sample selection formula. Accordingly, 160 households were selected to represent all those in the town. Sample households were drawn from the three[3] local administrative Kebeles of Sodo town and the survey questionnaires were administered through a simple random sampling based on proportional probability sampling techniques.

A survey questionnaire was designed to determine the households' demand for improved water supply services in Sodo town. Ten enumerators were employed to administer the questionnaire and pre-test the drafted questionnaire to determine the starting price for the bidding game, as well as to enable the enumerators to have practice in administering the CVM survey and to check the wordings and ordering of the questionnaire. During the pretest survey, the WTP questions were open-ended, and the respondents were asked how much they were WTP for a jerrycan (20 liters container) of

[2] According to Yamane, for any sample, given the estimated population proportion of 0.5 and 95% confidence level, the sample size is given by

$$n = \frac{N}{1 + Ne^2}$$

Where N = Total population size
e = Precision level with 95% confidence interval
n = Total sample size

[3] Gido, Kidane Mihret and Fana Kebeles

improved water supply. Accordingly, three prices (10, 15 and 20 cents) were used as starting price for the WTP bidding game.

After a little adjustment of the draft questionnaire and setting of the starting price for the bid game, a final questionnaire was developed for the main survey which consists of four sections. The first section covers household characteristics. The second section covers the current situation of water use and its problem in the town. The third section is related to household perception and attitude of water supply services and section four consisted of the household WTP for improved water services. Accordingly, the data was coded and prepared for the analyses in appropriate ways and finally STATA software version 10 was employed to construct CVM models.

3.2 Methods of Data Analysis

This study employed both descriptive and econometric techniques. The descriptive analysis is performed to explain the socio-economic characteristics of the sample households. The econometric analysis is based on CVM to identify the WTP for improved water supply services in the town.

Econometric Model Specification

In this study, the respondents were asked single bound close ended 'Yes' or 'No' questions followed by open-ended questions to elicit households' WTP for the improved water services. Thus, to analyze survey responses two different econometrics models were specified: one for the single bound and the other for open-ended survey responses. The econometric analysis for a single bound question is Probit model which is used to identify which factors are responsible for being willing or unwilling to pay for the improved services. For the open-ended questions, Tobit model is used to elicit households WTP responses for the improved water supply. Hence, the respondents were asked at first whether he/she is interested in the proposed improvement or not and paying

the initial price. The next question is for the person who is interested in the improvement. This is followed by the question of the maximum amount that they will be WTP which is useful for the Tobit analysis.

The Probit Model

Probit model is used to identify factors that influence a household's WTP decision.

The probit model can be defined as

$$Y_j^* = \beta' X_j + \varepsilon_j \cdot \quad \textbf{(1)}$$

Where; β' is vector of parameters of the model, X_j is vector of explanatory variables and ε_j (the error term) and is assumed to have random normal distribution with mean zero and common variance δ^2 (Greene, 1993). Y_j= unobservable households' actual WTP for the improved water supply service, which is also named to be a latent variable What we observe is a dummy variable WTP_j, which is defined as:

$$WTP_j = 1 \text{ if } Y^*_j \succ 0 \quad \textbf{(2)}$$

$$WTP_j = 0, otherwise \quad \textbf{(3)}$$

In this case, the respondents were asked whether accepting the starting point price and WTP to get the improved service or not. The probability of 'Yes' response or 'No' response can be cast in terms of random utility maximization chosen by the respondent. It is clear from the random utility framework the point of view of the researcher.

$$pro(WTP_j = 1) = \Phi(\beta' X_j) \quad \textbf{(4)}$$

$$pro(WTP_j = 0) = 1 - \Phi(\beta' X_j). \quad \textbf{(5)}$$

Thus, the expanded form of the probit model is:

$$Pro(WTP_j = 1) = \beta_0 + \beta_1 SEX + \beta_2 AGE + \beta_3 EDUC + \beta_4 HHSIZE + \beta 5INCOME + \beta 6HOUSE + \beta 7YEAR + \beta 8SOURCE + \beta 9QUANTITY + \beta 10SATISF + \beta_{11} TIME + \beta_{12} DISEASE + \beta_{13} BID + \varepsilon_j \quad \textbf{(6)}$$

The Tobit Model

For the open-ended responses, the Tobit model is appropriate to estimate the amount of money a household spends on water supply service in relation to socio-economic variables.

Since the data for water supply expenditure is available only for those households who are WTP, those value of $WTP \leq 0$ will be censored.

Let *MWTP* be a latent variable which is not observed when it is less than or equal to zero but is observed if it is greater than zero. Following Maddala (1983), the Tobit model for observed *MWTP* is given by

$$MWTP_j = \alpha + \beta' X_j + \varepsilon_j \text{ if } WTP \succ 0, \quad \textbf{(7)}$$

$$= 0, otherwise \quad \textbf{(8)}$$

Where *MWTP* is the unobserved maximum willingness to pay for individual *j* is censored, α is the intercept term, β vector of coefficients, X_j vector of independent variables and ε_j is the disturbance term which is independently and normally distributed with mean zero and common variance δ^2 with $\varepsilon_j \sim N(0, \delta^2)$.

Therefore, for the Tobit model the expanded form is represented as

$$MWTP_j = \beta_0 + \beta_1 SEX + \beta_2 AGE + \beta_3 EDUC + \beta_4 HHSIZE + \beta_5 INCOME + \beta_6 HOUSE + \beta_7 YEAR + \beta_8 SOURCE + \beta_9 QUANTITY + \beta_{10} SATISF + \beta_{11} TIME + \beta_{12} DISEASE + \beta_{13} BID + \varepsilon_j \quad \textbf{(9)}$$

Table 1: Definition of variables used in the analysis

Variable Definition	Description
Willingness to Pay (WTP) (dep. var. in Probit Analysis)	1 if WTP>0 and 0 otherwise (i.e. 1 for a yes answer to the offered starting bid and 0 otherwise)
Maximum WTP (MWTP) (dep. var. in Tobit Analysis)	Maximum WTP of the respondent in cents per jerrycan (20 liters container)
Starting bid (BID)	The initial bids offered to the respondents DC question in cents per jerrycan 10, 15, and 20 cents
Gender (SEX)	Gender of respondent coded as 1 if respondent is male and 0 otherwise
Age (AGE)	Age of respondent in year
Educational level (EDUC)	Educational level of respondents represented as 0 for illiterate and 1 for literate (including read and write)
Family size (HHSIZE)	Number of members of the household
Income of the household (INCOME)	Monthly income of the head of the household in Birr
House ownership (HOUSE)	House ownership of the respondent, 1 if owns the house and 0 otherwise
Years of stay in the area (YEAR)	Number of years the household stay in a particular area =1 if respondent stays more in a particular area and 0 otherwise
Source of water (SOURCE)	Household source of water 1 if the household use piped water and 0 otherwise
Volume of water (QUANTITY)	The quantity of water used per day
Level of satisfaction (SATISF)	Perception of the household about the service 1 if the household satisfied by the existing situation and 0 otherwise
Time spent to fetch water (TIME)	Household time spent for fetching water 1 if the household spent more time to fetch water and 0 otherwise
Water born disease (DISEASE)	Members of the household suffered from water related disease 1 if the household suffered by different disease and 0 otherwise

4. Results and Discussions

4.1 Descriptive Analysis

Of the total sample households, 69.4% were male and the remaining 30.6% were female. The average age of the sampled household is 41.36 years. The mean of the household size is 5.15 with minimum 1 and maximum 12 household members. Regarding the educational level of the household head, 10.62% of sample households were illiterate and the rest were literate (including at least those who read and write).

Concerning the occupation of the respondents, 57.6% of them run their own private businesses and 41.6% were involved in governmental and non-governmental organizations while the remaining 22% were not working. The survey result showed that the average number of years a household lived in the area was 11.93 years. 66.88% households lived in their own houses while the remaining 33.13% lived in houses rented from Kebeles and individuals.

The mean monthly income of the respondent was 2700.83 Birr. To cross check the income figure the respondents were also asked to state their monthly expenditures. The survey result showed that the average monthly expenditure was 2333.88 Birr which was spent for both food and non-food items. Thus, it is found that respondents were fair in estimating their income.

The study urged the respondents to tell for what purpose the water is used. Almost all the respondents used water for drinking, cooking and sanitation purposes while 9.23% households said they also used it for livestock consumption. Most of the sampled households, about 91.25 % used pipe water.. Of the total respondents, 47.5% have private connection, 30.62% and 13.13% use piped water from vendors and public taps, respectively. Only 8.75% households use other sources of water like wells, springs, and rivers. Asked why they do not have private connection, 42.86% of the respondents said the main reason was due to high connection cost. About 25.71% reported that they do

not have their own house. Others, 24.29%, said that there are no water lines around the area. The rest, 7.14%, said they do not need to have private connection.

Asked whether they have ever applied to the town's water supply office to have access to the existing water line, 38.89% said they applied and 61.11% did not. Those who did not apply gave different reasons. Among them 3.84% said the water supply office did not accept their application, 54.55% said connection costs were high, 34.55% said they did not have their own house and only 1.82% said they do not need to have pipe connection. The remaining, 5.45% said that it was due to the fact that the area was newly established.

Responses on the amount of water consumption per day show that sampled households, on average, consume 3.120312 jerrycan or 62.40624 litres of water per day. When we see the average monthly expenditure of water, the household spends 52.11616 Birr per month which ranges between 0 to 300 Birr. When we consider the average monthly income of the household (2700.83 Birr), on average a household spends only 1.97% of its monthly income on water.

The average time loss to fetch water from the existing sources is about 42.23 minutes at a time. In relation to the responsibility of water fetching, 52.73% respondents said that it was the responsibility of female members of the family while only 1.82% said male members were counterparts. The rest 45.45% of the respondents said that it was the duty of both male and female to fetch water. With regard to service delivery, the data shows that only 18.49% respondents were satisfied with the existing situation of water services.

The result also showed that 61.25% of the total sampled households use purification method to keep the quality of water while the remaining did not use any purification method. Asked whether they were affected by water borne diseases due to the poor quality of drinking water, 80.63% said 'No' and 19.38% 'Yes'. The most common water borne diseases were diarrhea, typhoid, and cholera.

Respondents were also asked whether or not they need an improvement for water supply service. The result showed almost 99.37% sampled household preferred to get improved service. In terms of responsibility of water provision, 66.88% of the households said the government is the only responsible body and 2.5% said the society should take the responsibility for the improvement. Others, 28.75%, said both the government and the society should be responsible for the improvement and 1.88% said they did not know the responsible body for water services.

Responses on the household WTP for the improved system revealed that 93.75% respondents answered positively. The survey result also suggested that households are, on average, willing to pay 33 cents per jerrycan which is well above the current tariff rate (8 cents per jerrycan) charged by the water supply office of the town.

For the valuation question three starting values were chosen based on the modes of their occurrence during the pretest survey. These prices are 20, 15 and 10 cents per jerrycan, and 53, 52 and 55 respondents were randomly selected and given the respective starting price for the biding game. From the survey, out of 53 respondents who were given 20 as a starting price, 88.68% responded 'Yes' and 11.32% 'No' for the first bid. Out of 52 respondents, 90.39% gave a 'Yes' and 9.61% a 'No' response for the first price of 15 cents per jerrycan, whereas out of 55 respondents, 94.37% gave a 'Yes' and 3.63% a 'No' answer for the third bid (10 cents).

Table 2: WTP response against starting bids per jerrycan

Response to initial Bids	**Initial Bids (in cents)**		
	10	15	20
Yes	53	47	47
No	2	5	6

Source: Survey Result (2012)

When we see the frequency distribution of household WTP, about 50% of households were WTP less than and equal to 25 cents per jerrycan. Around 41.87% of respondents expressed their WTP between 25 and 50 cents per jerrycan. Only 8.13% of respondents were WTP more than 50 cents per jerrycan.

Table 3: Households MWTP responses per jerrycan

MWTP (in cents)	Freq.	Percent	Cum.
0 – 25	80	50	50
26 – 50	67	41.87	91.87
51 – 75	4	2.5	94.37
76 – 100	8	5	99.37
100 – 125	0	0	99.37
126 – 150	0	0	99.37
151 – 175	0	0	99.37
176 – 200	1	0.63	100.00
Total	160	100.00	

Source: Survey Result (2012)

In this study, of the total sampled households only 6.25% were not willing to have private connection for the new system of improved water services. From those households almost half of them (50%) said it is because they do not have enough money to pay for the improved services. About 10% of the households said they are satisfied with the existing services. The remaining 40% of the households responded that they have no their own house. From those households that are not WTP, 60% are WTP for the provision of public tab instead of private connection. Besides, around 4 households have zero WTP for the improvement, and then a follow up question was raised to the respondents. Responses for zero WTP of the new provision, about 75% said the government should supply freely and 25% of them said they are satisfied with the existing water supply services provided by the town. The following table describes variables used in the analysis including means and standard deviation.

Table 4: Summary of description of variables used in the analysis

Variables	Mean	Std. Dev	Min.	Max.
WTP	.9375	.2428215	0	1
MWTP (in cents)	.3303125	.2593592	0	200
SEX	.69375	.4623821	0	1
AGE	41.36875	11.79736	20	82
EDUC	.89375	.3091249	0	1
HHSIZE	5.15625	1.85495	1	12
HOUSE	.66875	.4721405	0	1
YEAR	11.93062	12.71682	0.083	58
INCOME	2700.838	2136.366	100	11300
SOURCE	.475	.5009425	0	1
QUANTITY	3.120312	1.481004	0.25	7
SATISF	.18125	.3864347	0	1
TIME	25.99375	25.49349	5	120
DISEASE	.19375	.3964762	0	1
BID	0.145	0.0469845	10	20

Source: Survey Result (2012)

4.2 Empirical Analysis

The WTP question for private connection is presented for all respondents (for both who have private access to the existing pipe system and those who have not). The general approach of this technique is to estimate a valuation function that relates the hypothesized determinants with the WTP responses. The variables to be included in the models were mainly based on the degree of theoretical importance, and their significant impact on WTP.

Before running the econometric models, it is important to check whether there is multicollinearity which leads to estimation problems of the models and results in to large variances of the coefficient of the independent variables. According to Gujarati (2000), if the correlation matrix is less than 0.8, multicollinearity is not a serious problem. Thus, the results of correlation between explanatory variables revealed that the correlation matrix is less than

0.8 and hence there is no problem of multicollinearity. In the same manner, in cross sectional data, problem of heteroskedacity is expected which leads to wrong estimation of standard errors and test statistics. To correct this problem we estimated the model by using the robust standard errors and test statistics.

Results of Probit Estimation

The overall significance of the model showed that the Wald Chi Square is 35.03% which is significant at 1% level of significance with p-value 0.000. On the other hand, the pseudo R^2 of the data is 48.06% which measures the goodness of fit of the model. The model result along with respective significance values and its marginal effects are presented in the table below.

Table 5: Results of Probit model for WTP of improved services

Explanatory Variables	Coef.	Robust Std Dev.	Z	P>|z|	Marginal effects (dF/dx)
SEX	-1.483102	.53962	-2.75***	0.006	-.0023006
AGE	-.0275617	.0219482	-1.26	0.209	-.0000496
EDUC	1.765532	1.153069	1.53	0.126	.0434821
HHSIZE	-.0809761	.1310037	-0.62	0.536	-.0001457
INCOME	.0000347	.0000973	0.04	0.972	6.24e-09
HOUSE	1.036672	.4106732	2.52**	0.012	.0046082
YEAR	.0492236	.0274952	1.79*	0.073	.0000886
SOURCE	1.356902	.4854395	2.80***	0.005	.0040857
QUANTITY	-.2291774	.1293498	-1.77*	0.076	-.0004123
SATISF	-.540948	.4807391	-1.13	0.260	-.0018721
TIME	.0241644	.0115143	2.10**	0.036	.0000435
DISEASE	-.092774	.6775599	-0.14	0.891	-.0001838
BID	31.68053	7.542264	4.20 ***	0.000	.0569953
_cons	-2.029602	1.844186	-1.10	0.271	
Pseudo R2	0.4806				
Wald chi2	35.03				0.000

*** Significant at 1%, ** Significant at 5%, * Significant at 10%

Gender of the household head significantly affected WTP at 1% level of significance with a negative sign. As expected this negative sign implied that when the household is headed by male it is less likely to pay for the improvement of water supply services. Thus, the probability of household head change from being female to male would reduce the probability of household WTP by 0.23% keeping all other things constant.

The variable housing arrangement was found to be significant at 5% level of significance and has positive sign. This finding confirms the expectation that house ownership has a positive effect to WTP implying that the household who owns a house is more willing to accept the improvement. Thus, the probability of a household having privately owned house would increase the probability of household WTP by 0.46% while other things held constant. A similar study in Nazareth town by Alebel (2002) suggested that house ownership has a significant effect on household WTP for improved water supply services.

Household years of stay in the area was another factor which significantly affects WTP of water supply services. As expected this variable was significant at 10% level and had a positive sign. Thus, a one year increase in the area makes an increase in the probability of WTP by $8.86*10^{-06}$ holding all other variables constant. The result is consistent with a previous study made by Medhine (2006) in Addis Ababa city.

The variable source of water significantly affects the WTP for water supply services. It has a positive sign and highly significant at 1% level of significance, because those households who already had private connection know the uses of having piped water for improved water supply services than those they did not. Thus, the probability of a household using private pipe would increase the probability of household WTP by 0.4% while all other factors are held constant. Our result is similar to another empirical study obtained in a similar area done by Alebel (2002) in Nazareth town.

The volume of water used per day was found to be significant at 10% and it is negative in sign which shows the households who use more water were not WTP for the proposed scheme. The marginal effect shows that, holding other things constant, a one unit change in the quantity of water per day would decrease the probability of household WTP by 0.041%. The sign of this variable is in line with similar findings of Gosaye (2007) in Debre Zeit town.

Likewise, time loss to fetch water is another variable which was found significant at 5% and had a positive sign. This result is in line with the argument that households who spent more time to get water are more WTP for the new scheme. The marginal effect reveals that, other things being held constant, one additional minute increase in water fetching would increase the probability of household WTP by $4.35*10^{-06}$. This result supports the empirical finding of a similar study made by Alebel (2002).

The initial bid, which is used to test for the existence of starting point bias, showed that it is highly significant at 1% and positive. The positive sign implies that respondents' willingness to pay the amount which is upwardly biased in this study. If the initial bid increased by 1 cent, the probability of household WTP for improved water supply services increased by 5.7%, keeping other things held constant. This finding fits with the empirical results of similar studies done in Debre Zeit town by Gosaye (2007). He found that the initial bid positively predicts the WTP for improvement. Medhine (2006) also found the initial bid negatively correlated with the WTP for the system.

Results of Tobit Estimation

The likelihood ratio for the estimation model of chi2 (13) is equal to 30.74 which shows the overall significance of the model. The pseudo R^2 is 52.55% which indicates the regression result explains 52.55% of the total variation implying that there are other explanatory variables which have an effect on the household WTP amount. Accordingly, the regression result reveals that four variables were significantly influenced the MWTP of the household.

Table 6: Results of Tobit model for MWTP of improved services

Explanatory Variables	Coef.	Robust Std Dev.	Z	P>|z|	Marginal effects (dF/dx)
SEX	-.1043947	.0476132	-2.19**	0.030	-.0657819
AGE	-.0004204	.0025693	-0.16	0.870	-.0002933
EDUC	.1669861	.0774427	2.16**	0.033	.1583669
HHSIZE	-.0053272	.0119396	-0.45	0.656	-.0037168
INCOME	-9.43e-07	.0000106	-0.09	0.929	-6.58e-07
HOUSE	.0196587	.0450297	0.44	0.663	.0139552
YEAR	.0003532	.0023373	0.15	0.880	.0002465
SOURCE	-.0300902	.0440486	-0.68	0.496	-.0210845
QUANTITY	.0135045	.0146092	0.92	0.357	.0094222
SATISF	-.1064025	.054406	-1.96*	0.052	-.0879191
TIME	.0002637	.0008736	0.30	0.763	.000184
DISEASE	.0152635	.0549985	0.28	0.782	.0103936
BID	1.696544	.4468686	3.80***	0.000	1.183689
_cons	.0097688	.1437947	0.07	0.946	
Pseudo R2	0.5255				
LR chi2	30.74			0.003	

*** Significant at 1%, ** Significant at 5%, * Significant at 10%

Gender of the household head was found to be significant at 5% level of significance and had negative sign indicating that if the household was headed by male its WTP would be reduced. The marginal effect indicated that, keeping other things constant, the probability of household head change from being female to male would reduce the probability of household MWTP amount by 6.57%.

The variable level of satisfaction was significant at 10% level of significance with a negative sign. If the household is satisfied with the existing system it is not willing to pay for the new scheme and the amount the household being WTP is in line with the expected sign. Thus, the probability of household being satisfied

on the existing system of services would reduce the probability of the household WTP amount by 8.79% while other factors held constant.

As the result suggested, level of education was another important variable which influence the amount of the household WTP for improved water supply services. As expected it was found to be significant at 5% level of significance with positive sign. This showed that as people attain more education they had more awareness and knowledge about environmental services. The regression result indicated that the probability of the household head change from being illiterate to literate would increase the probability of MWTP by 15.83%, holding all other factors constant.

The coefficient estimate of initial bid price was also highly significant at 1% level and it had positive sign. As the initial bid increase the WTP amount for improved water supply services also increase. Thus, if the initial bid increase by 1 cent the probability of the household WTP amount increased by 118% keeping all other variables constant.

4.3 Estimating Total WTP and Total Revenue

In this section, total WTP and the total revenue at various prices that household's would be WTP is calculated. In the year 2012, the total population of the town was estimated to be 96,140 and their total household estimated to be 23,814. In order to get the aggregate WTP of the total households, first the estimated number of households in each WTP class interval would be obtained by multiplying the percent of the households in each interval by the total number of the households in the town. Then multiply the total number of the households in the town by the mean WTP to estimate total WTP (TWTP) by assuming the midpoint of each WTP interval as the mean WTP (Perman et al, 2003).

Thus, the aggregate revenue that can be expected from the provision of improved services as shown in Table 7 is calculated by multiplying the mid points

of the WTP interval (column c) by total number of households' WTP for the improved services at least the minimum amount (column f). The aggregate revenue expected from the provision of the improved water services if each household consumes only one jerrycan or 20 litres of water from the improved source is shown in the Table (column f).

Table 7: Estimated Total WTP and Total Revenue from the proposed water supply services (cents per jerrycan)

WTP interval (a)	Freq. distribution (b)		Mid–point (c)	Total households (d)	Total WTP (e)	Minimum amount of household WTP (f)	Total revenue (g)
	No.	(%)					
0 – 10	23	14.47	5	3445.88	17,229.4	23,814.0	119,070
15 – 25	60	37.74	20	8987.4	179,748.0	20,368.12	407,362.4
30 – 40	30	18.86	35	4491.33	157,196.55	11,380.72	398,325.2
45 – 55	34	21.38	50	5091.44	254,572.0	6889.39	344,469.5
60 – 70	3	1.88	65	447.7	29,100.5	1797.95	116,866.75
75 – 85	1	0.63	80	150.03	12,002.4	1350.25	108,020.0
90 – 100	8	5.04	95	1200.22	114,020.9	1200.22	114,020.9
Total	159	100		23,814.0	763,869.75		1,608,134.8

Source: Survey Result (2012)

As can be seen in the above Table, by summing up the total WTP amount of each class interval, the total WTP (aggregate benefit) for proposed improved water supply service is found to be 763,869.75 cents per jerrycan for improved water services. The total revenue is also estimated to be 1,608,134.8 cents or 16,081.348 Birr per month or 5,869,692 Birr per year if the improvement were implemented.

5. Conclusions and Policy Implications

5.1 Conclusion

In this study both primary and secondary data were used. For the primary data CVM was employed on 160 randomly selected households. The questionnaire was structured for face-to-face personal interview using bidding game format to elicit households' willingness to pay with an open ended follow-up question to determine the MWTP. For data analysis the study used both descriptive and econometric techniques. Probit model was used to determine the probability of household WTP for improved water supply services and Tobit model to identify factors that affect the amount of money an individual spends on water supply services per jerrycan.

The results of descriptive analysis indicated that about 91.25% households use pipe water. Of the total surveyed households 47.5% have private connection. However, only 18.49% households were satisfied with the existing system of water supply services. About 60.63% households reported the existing system was not reliable. From the total about 99.37% sampled households preferred to get the improved services. Concerning the responsibility for water provision, 66.88% households said the local government was the responsible body to provide water supply services.

Responses of the household on WTP suggested that 93.75% of respondents expressed their positive WTP for the proposed schemes. Only 2.5% households were zero WTP. About 3.75% households were WTP for the provision of public taps. Responses of the household on initial bid price, the data revealed that 91.875% said 'Yes' to the first price that they were given and the rest refused and gave a lower bid than the initial price.

The regression result of Probit model revealed that seven variables significantly influenced the willingness of the household to pay for improved services. These are gender of the household head, house ownership, years of stay in the area,

sources of water, quantity of water used per day, time loss to fetch water from the existing source and initial bid price. While the results of Tobit model suggested that four variables significantly affect the amount of money individual spends on WTP. These variables are gender of the household head, level of education of the household head, level of satisfaction and initial bid price. The initial bid has a positive value and a significant effect on both the probability of saying 'Yes' to the proposed bid and to the amount of household WTP implying that an increase in the initial bid increases the likelihood that respondents are paying the proposed bid.

In this study, the mean MWTP was found to be 33 cents per jerrycan with a maximum amount of 2 Birr. By summing up the total WTP amount of each class interval, the total WTP of proposed scheme is found to be 763,869.75 cents per jerrycan. Thus, if the proposed improved water supply service is implemented the service provider as well as the society will be the benefit.

The overall result of the study revealed that more households are interested in the improvement of water supply services in Sodo town. Therefore, the local government should give due attention to the actual needs of the people and the service should be designed based on the socio-economic conditions and the WTP of the household.

5.2 Policy Implication

- In the study area, since the existing water supply system cannot satisfy the existing demand while water is available only on some days per week and some hours per day, individuals are forced to buy water from vendors and waste time in fetching water. However, if the water supply system is improved, households are willing to pay more than the existing tariff which is set by the water supply office of the town. This could lead to increased connection. As the number of connection rises, in turn, it leads to raise the revenue and the possibilities of financing new water supplies by increasing

the water tariff based on the willingness to pay bids and payments of the households.

- In order to keep the quality of water, the water supply office of the town adds chlorine to the water reservoirs by dropping system. Thus, the local government has to invest to launch the water purification process plant which will be to improve the welfare of the community.
- There are limited numbers of boreholes that can serve for the residents of the town which leads to insufficient provision of water to the community. Therefore, the number of boreholes should be increased by way of identifying the water potential areas to supply the water adequately to all the communities. Besides, only 2 reservoirs exist in the town, thus it would be necessary to increase the water storage container.
- In addition, the water supply office of the town needs to create awareness among the people to involve cost sharing aspects in community welfare development projects like water supply and sanitation.
- The empirical result showed that many variables were found to have influence on WTP of households. Thus, the water supply office of the town needs to consider those variables in designing the new scheme for improved system.
- Finally, further research is needed to observe changes over time with regard to WTP of households by using panel data since this study used a onetime cross-sectional data.

References

Adenike A. and B. Titus. 2009. Determinants of Willingness to Pay for Improved Water Supply in Osogbo Metropolis; Osun State, Nigeria. Research Journal of Social Sciences, Vol. 4; pp. 1-6.

Alebel Bayrou. 2002. Analyses of Affordability and Determinants of Willingness to Pay for Improved Water Service in Urban Areas, Strategy for Cost Recovery: A Case Study of Nazareth Town, Ethiopia.

Atsede Gihdey. 2010. Consumer Welfare Effects of Water Pricing in Ethiopia: The Case of Mekelle Town.

Banda, B. M., Farolfi, S., and Hassan, R. M. 2007. Estimating Water Demand for Domestic Use in Rural South Africa in Absence of Price Information, Water Policy, 9 (5): 513-528.

Biruk Gezahegne. 2003. Household Demand for Improved Sanitation Services: A Contingent Valuation Study on Addis Ababa, Ethiopia.

Casey J. F., J. R. Khan and R. Alexandre. 2006. Willingness to Pay for Improved Water Service in Manaus, Amazonas, Brazil. Ecological Economics Vol. 58 (2006), pp. 365 – 372.

Dessalegn C. 2012. Factors Determining Residential Water Demand in North Western Ethiopia, the case of Merawi a project paper presented to the faculty of the graduate school of Cornell University. Pp. 56-61.

Engel S., I. Maria and M. P. Useche. 2005. Improved Water Supply in Ghanaian Volta Basins: Who uses it and Who Participates in Community Decision Making? International Food Policy Research Institutes, Environment and Production Technology Discussion Paper 129.

Farolfi S., Mabugu, R. E., Ntshingila. 2006. Domestic Water uses and Values in Swaziland: A Contingent Valuation Analysis. Agrecon, 2006.

Goldblatt M. 1999. Assessing the Effective Demand for Improved Water Supplies in Informal Settlements: A Willingness to Pay Survey in Vlakfontein and Finetown, Johannesburg: Geoforum. 30(1): 27-4.

Gossaye Fanta. 2007. Households' Willingness to Pay for Improved Water Services in Debre-Zeit Town: Ethiopia.

Greene, W. H. 1993. *Econometric Analysis,* New York, Macmillan Publishing Company.

Gujarati, D. 2004. *Basic Econometrics:* 4th edition. New York McGraw-Hill Companies.

Harvey A. Peter. 2007. Cost Determination and Sustainable Financing for Rural Water Services in Sub-Saharan Africa.

Lado Cleophas. 1997. Economic Factor Influencing Sustainable Water Supply in Botswana.

Maddala G. S. 1983. *Limited Dependent and Qualitative Variables in Econometrics*, New York, Cambridge University Press.

Mbata, J. N. 2006. Estimating Household Willingness to Pay for Water Services in a Rural Economy: The Case of Kenya in Southern Botswana. Development Southern Africa Vol. 23, No. 1, March 2006, 29-44.

Medhine Fissha. 2006. Household Demand for Improved Water Service in Urban Areas: The Case of Addis Ababa, Ethiopia.

Merrett, S. 2002. Deconstructing Household's Willingness-to-pay for Water in Low Income Countries. Water Policy 4, 157-172.

Ntengwe, G. 2004. The Impact of Consumer Awareness of Water Sector Issues on Willingness to Pay and Cost Recovery in Zambia Physics and Chemistry of the Earth 29 (2004).

Pattanayak, S. K, Van den Berg, C., Chen Yang, J., and Van Houtven, G. 2006. The Use of Willingness to Pay Experiments: Estimating demand for piped water connections in Sri Lanka. World Bank Policy Research Working Paper 3818, January 2006.

Perman R., Ma Y, McGilvray J. and Common M. 2003. *Natural Resource and Environmental Economics:* Edinburgh, Longman, 3rd edition.

Raje, D. V, Dhobe, P. S., and Deshpande, A. W. 2002. Consumer's Willingness to pay more for Municipal Supplied Water: a case study Ecological Economics 42(3): 391-400.

Sodo Town Administration Office. 2012.

Sodo Water Supply Office. 2012.

Solomon G/Selassie. 2007. Households' Willingness to Pay for Environmental Practices: An Implication of Eco-Labeling for Leather Products in Ethiopia.

Titenberg and Lewis. 2007. *Environmental and Natural Resource Economics,* McGraw Company.

United Nations International Children (UNICEF) Annual Report. 2000.

Wendimu S. and W. Bekele. 2011. Determinants of individual Willingness to Pay for Quality Water Supply: The case of Wonji Shoa Sugar Estate, Ethiopia. *Journal of Ecology and the Natural Environment*, Vol. 3(15), pp. 474 – 480.

Whittington, D., Mu, X, Roche, R. 1990. Calculating the Value of Time Spent in Collecting Water: Some estimates from Ukunda, Kenya. World Development. Volume 18. No 2. Pp 269-280.

Whittington D., D. T. Lauria, A. M. Wright, K. Choe, J. A. Hughes and V. Swarna. 1993. Household Demand for Improved Sanitation Services in Kumasi, Ghana: A Contingent Valuation Study. Water Resource Research, Vol. 29 No.6, pp. 1539 – 1560.

Whittington, D. 1998. Administering Contingent Valuation Surveys in Developing Countries, World Development, Vol. 26, No. 1, pp. 21-30.

World Bank. 2011. available at http://web.worldbank.org/…/ETHIOPIAEXTN/0..contentMDK:20210185~pagePK:141137~piPK:141127~the SitePK: 295930, 00.html, Accessed on December, 2011.

World Health Organization (WHO) Annual Report. 2000.

Wolaita Zone Finance and Economic Development Office. 2012.

Yamane T. 1973. Statistics: An Introductory Analysis. New York: Harper and Row.

ECONOMIC VALUATION OF REDUCING UPLAND FOREST RESOURCES DEGRADATION TO IMPROVE SOIL AND WATER CONSERVATION SERVICES: The Case of Upland Forest Resources of Rekame Watershed, Halaba Special Woreda, SNNPR, Ethiopia

Keyiru Redi Kedir[1]

Abstract

In this study by using contingent valuation instrument an attempt was made to compute economic value of reducing upland forest resources degradation to improve soil and water conservation services in ETB and Labor Days contribution methods. The study is based on empirical data collected from 369 valid sample respondents living in the downstream communities vulnerable to the problems from the degraded upland forest area. Most respondents have given positive response for the project. In the study Probit and OLS models were used. Probit model was employed to estimate the parametric mean and aggregate WTP and also to determine factors affecting the WTP amounts from single bounded dichotomous choice format whereas OLS model was employed to determine factors affecting the maximum WTP amounts from the open ended question format. The mean WTP values were estimated using parametric and Non-Parametric approaches. The annual parametric mean WTP amounts were found to be ETB117.216 and 96.864 Labor days whereas the non-parametric mean WTP amounts were ETB110.4436 and 75.4478 Labor Days. Contrary to the mean WTP amounts from parametric approach, the mean WTP amounts from the non-parametric approach were from the households own feeling response and not affected by the disturbance term. Thus, the five years aggregate WTP amounts of this study were preferably ETB 6,951,871.2 and 4,749,060 Labor Days (equals ETB 56,988,720 by the conversion factor of 12.00ETB/worker/day). This shows

[1] Department of Economics, Hawassa University, Ethiopia, P.O.Box 05, Hawassa, Ethiopia
Mobile Telephone: +251-911-724272
E-mail:kheyiru85@gmail.com or amechom86@yahoo.com

that in rural areas labor days contribution is the most preferred over cash. From the Probit mode variables: age, income, education, family size, bid amount, landing holding, distance, degree of vulnerability, off-farm income and livestock have shown significant effects. From the OLS model variables: age, income, livestock, education, landholding, family size and bid amount have shown significant effect for both contribution methods. Almost all the explanatory variables have the same direction in both models. Moreover, higher WTP amounts are indicative of the households' willingness to reduce the upland forest resources degradation in the watershed system of Rekame. The estimated value represents only one part of the total economic values of the upland forest resources. There were no serious inconsistency problems between determinants from Probit and OLS models. This raises validity of this research work. Furthermore, integrating local communities' participation in reducing the upland forest resources degradation to improve soil and water conservation services is unquestionably essential.

Keywords: Economic Valuation, Contingent Valuation, Willingness to Pay (WTP), Probit Model, OLS Model.

1. Introduction

Healthy forests provide many ecological, social and economic contributions to the nation, simply by existing as natural ecosystems (Kolstad, 2000). Among others, forests provide benefits such as wood products, flood & erosion control, landslide control, prevention of land degradation & soil fertility loss, purification & regulation of air & water, carbon sequestration, & maintenance of biological diversity (Pereira, 1989; Lal, 1993).

Contrary to their massive importance, natural forests ecosystems are degrading in devastating manner mostly due to human-induced factors and causing frustrating loss of lives & resources (Robert, Sven, José and Campos, 2002). Though there are also many other factors to be raised, the non-marketable valuable attributes of forest ecosystem services are the major ones. Except for

timber & some non-timber products, most of the ecosystem services have no marketable values (John, 2009).

Environmental degradation can reduce welfare of the society through reduced quantity and quality of environmental resources, loss of long-term productivity, reduced future earning of the population, thereby jeopardizing economic development (WB, 1992). The recognition of these environmental problems brings the question of sustainable development, which is concerned with meeting the needs of present generation without compromising the needs of future generations into the picture (Georgiou, et al., 1997).

Moreover, forest ecosystem health in many parts of the world is deteriorating, in large because of an ever-expanding world population (Kolstad, 2000). On the other hand, depletion of forest resources and their degradation causes a threat to ecosystem diversity and a fundamental influence on the declining of standard of living of many households. As a result, ecosystem services of the forest resources are diminishing dramatically by causing a resultant out-of-hand effect on the general environment. Flash flooding observed in different parts of the country for the past few years causing loss of many lives & resources can be of crude evidence for these (EEPA, 1997).

Environmental resources such as forests play a key role in the livelihoods of local people in developing countries like Ethiopia, where there are plenty of mountainous landscapes. However, currently many dense forest resources are becoming history than observable facts despite the efforts made by the current government (Tadesse, 2008; Reusing, 1998). This is due to massive deforestation activities such as extensive allocation of forest lands for investors, population pressure, poverty, farm land expansion, resettlement, & open accessibility (EFAP, 1994). Moreover, in relation with some other factors rapid deforestation of natural forests, especially in upland areas, cause a high rate of flooding, soil erosion, sedimentation and other consequential problems

like biodiversity loss, land degradation, soil fertility as well as productivity loss and so on (Fredrik et al, 2004).

Above all, recently, it has been recognized that under-valuation or absence of valuation of the products and services of forests is one of the major factors for the degradation of forest resources (Nnaemeka and Chukwuemeka, 2008). Virgin forests are being cleared for the purpose of selling the standing timber as well as providing farmland (Kolstad, 2000). Therefore, estimating the total economic values of forests and understanding how plant resource use interacts with the incomes and welfare of rural households is a key step towards sustainable use and management of forest resources (Nnaemeka and Chukwuemeka, 2008).

Upland forest resource of Rekame watershed is located in Halaba Special Woreda, 19 km far away from Halaba Kulito town. It covers an area of 541 hectares. By now it is controlled and managed by Rekame Self-help Association (RSHA). The rural communities around Rekame upland forest area are renowned for their red pepper production for local and national markets like many of the rural areas in the Woreda. However, in these days there are plenty of problems they face due to degradation of the upland forest resources and hence its soil and water conservation services to the downhill local communities, mainly, by human induced factors (HSWARDO, 2012).

As reported by the Halaba Special Woreda agricultural and rural development office, before 1986 there were around eight water springs within the upland forest resource which sheds water for the area & various species of fauna. And there had been also different indigenous species of flora that serve the surrounding rural community in terms of watershed protection through controlled flood, soil erosion, sedimentation on farmlands and water ponds, maintained biodiversity & overall ecosystem conservation. However after 1986 due to the drought and poverty problems in different parts of the Woreda, an organization called 'Food for the Hungry' (FH) started dealing with such

problems. And hence it had helped many households to escape from the umbrella of food insecurity problem temporarily (Ibid).

Although the program has helped the people in the area to escape from food insecurity trap as a transitory bridge to pass through, it is blamed for its partial natural forest clearing & replacement activities & the subsequent problems of open access situation, overexploitation, and hence decline of the forest biodiversity, severe seasonal flooding, soil erosion and sedimentation problems (HSWARDO, 2012). Therefore, finding permanent solution for severe seasonal flooding, soil erosion and sedimentation which is caused by seasonal run-offs flowing from the degraded upland forest area towards the downstream communities and bringing back soil & water conservation services that the natural forest had been giving to them is incontrovertibly vital. In this context measuring the WTP of vulnerable rural households to reduce the upland forest resources degradation and hence bring back the lost soil and water conservation services is justifiable. Accordingly, the main objective of this study was estimating the economic value of reducing upland forest resources degradation to improve its potential to provide soil & water conservation services[2] for the downstream communities and understanding how wise use of natural forest resources interacts with the livelihoods and welfare of rural households are key steps towards sustainable resource management. Specific objectives are:

- To estimate parametric and non-parametric mean and aggregate WTP of households
- To identify determinants of households WTP

[2]In this study when we say 'soil and water conservation services', mainly, it is to mean that water regulation, soil protection, and sediment retention services that the downstream communities obtain from intact upland forest resources.

2. Theoretical and Empirical Literatures

2.1 Theoretical Literatures

2.1.1 Rationale and Role of Non-market Economic Valuation

According to Pearce and Markandya (1989) and Bergstrom (1990), the basic rationale for assigning economic values for non-marketed environmental benefits is that if they are omitted from appraisals, there is a strong risk that non-marketed goods will be under-supplied in the economy, and an equally strong risk that non-marketed bads will be over-supplied. Deciding how much of a good to supply, or how much of a bad to tolerate or abate, requires that the value of those goods and bads be brought into balance with the costs of providing the good (or the cost of reducing the bad). This balancing exercise involves some form of economic valuation activities on selected non-marketed environmental benefits (Mishan, 1988). These rationales and the use of valuation cannot be understood without first understanding the theoretical basis for economic valuation. Therefore, economic valuation refers to the assignment of money values to non-marketed assets, goods and services, where the money values have a particular and precise meaning (Krieger, 2001).

A forest resource can be used in many different ways. Each use can produce some on-site private, on-site public and global benefits, but obviously some trade-off between those benefits and the consequent opportunity costs for benefits foregone should also be considered (IIED, 1994). However, many forestry and environmental services values are not automatically reflected in market prices, mainly because their public nature involves at least some elements of *non-excludability* and/or *non-rivalry*[3] (Michael, 1995). Their inadequate recognition and underestimation at the local, regional, national and global level is declared to be one of the main reasons for the widespread failure to practice sustainable forest management, as well as for deforestation and the

[3] Non-excludability: difficulty or impossibility of excluding other individuals from the benefits of a given good or service; Non-rivalry: the consumption by one individual does not preclude consumption of the same good by one or more other individuals.

transfer of forests to other land uses (UNCED, 1992). However, the difficulty of valuing such goods and services should not preclude at least an attempt to measure these values and include them in decision-making, to the extent possible they need to be explicitly assessed, quantified and incorporated into the decision-making process as an input for sustainable forest use and management (Adams, 1993).

2.1.2 Economic Values of Forest Resources

There are several ways of classifying economic values of environmental resources. Freeman (1979), Freeman (1993) and Mitchell and Carson (1989) have presented classifications of resource benefits from environmental improvements perspectives. Total economic value is, perhaps, the most complete measure to express the full range of value of benefits of both tangible and intangible types (Merlo and Croitoru, 2005). Forest resources provide a variety of goods and services to the users are valued for their current or future benefits or welfare and are said to have use values & non-use values (Merlo and Croitoru, 2005; Krieger, 2001). The use values arise from the direct and indirect use of environmental resources (like forest) whereas, non-use values are values that arise from the mere existence of the resource, and they are not associated with any specific use of the resources (Verma, 2000).

2.1.3 Non-Market Economic Values Measuring Techniques

In the environmental economics literature we have different valuation methods of non-market environmental benefits. These valuation methods are usually divided into two: direct methods (stated preference) and indirect methods (revealed preference) (Hanley, et. al., 1997). Direct methods seek to infer individuals' preferences for environmental quality directly by asking them to state their preferences for the environment. Indirect methods seek to measure estimates of individuals' willingness to pay for environmental quality by observing their behavior in related markets (Harris, 2006).

2.1.3.1 Revealed Preference (Indirect Valuation) Methods

2.1.3.1.1 Travel Cost Method (TCM)

The method is based on the assumption that consumers' value environmental resource in terms of the cost of getting there, including all direct transport costs as well as the opportunity cost of time spent while travelling to the site (Hanley et.al, 2002; Khandke, et al. 2001). It depends on observing actual behavior rather than on answers to hypothetical questions (Loomis, 2005).

It measures the demand and the value of environmental assets. Particularly, it provides an opportunity to value the recreational opportunities provided by nature. The willingness to pay for visiting a recreational area may be estimated if there are enough data on how much money and time people spend for travelling to the area (Khandke, et al., 2001).

2.1.3.1.2 Hedonic Pricing Method (HPM)

HPM is commonly applied to variations in prices of marketable goods and services that reflect the value of local environmental resources. The price difference of marketable commodities, mainly, reflects the local environmental resources services (Birol et al, 2006). That is, based on the idea that environmental resources might play a role for property values, such as, disparity in housing prices between different locations with equal size. As a result, this method enables to extract the specific influence of an environmental amenity or risk from the market price of a good or service (Thomas and Callan, 2007; Hanley et.al, 2002).

2.1.3.2 Stated Preference (Direct Valuation) Methods

2.1.3.2.1 Choice Experiment Method (CEM)

A choice experiment is a highly structured method of data generation, relying on carefully designed experiment to reveal the factors that influence choices (Birol et al, 2006). In this method, individuals are given a hypothetical setting and asked to choose their preferred alternative among several alternatives in a

choice set. Each alternative is described by a number of attributes or characteristics by incorporating price as one of the attributes along with other attributes of importance (Colombo et al. 2005; Birol et al., 2006).

However, it is criticized for the more stringent assumptions that are not needed when using the CVM. Besides the application of choice experiment is expensive due to the need for thorough survey development (Birol et al, 2006).

2.1.3.2.2 Contingent Valuation Method (CVM)

Contingent valuation method is the most understandable approach to measure non-market environmental values through directly questioning individuals on their willingness-to-pay (WTP) (Mitchell and Carson, 1989). The term 'contingent' in CVM suggests that it is contingent on simulating a hypothetical market for the environmental good in question. This technique is referred to as a "stated preference" as it asks people to directly state their values (Rahim, 2008).

CVM directly infers values by using surveys to ask people their maximum willingness to pay (WTP) to avoid environmental risk and/or minimum willingness to accept compensation (WTA) to tolerate environmental bads (Henn, 2000; Myers, 1998). Unlike other methods, it generates both market and non-market values of environmental resources. The approach is particularly important in situations where there is no market information about people's preference to an item. Accordingly, it is widely used in valuing changes in environmental quality (Mitchell and Carson, 1989; Henn, 2000; Myers, 1998; Randall, 1987). Moreover, the technique has great flexibility, allowing valuation of a wider variety of non-market environmental goods and services than is possible with any of the indirect techniques (Carson and Hanemann, 2005). It is, in fact, the only method currently available for estimating nonuse values. In natural resources, contingent valuation studies generally derive values through the elicitation of respondents' willingness-to-pay to prevent injuries to natural resources or to restore injured natural resources (Duberstein and de Steiguer,

2004). It is believed that CVM helps to elicit individuals' preferences for the changes in the quantity or quality of nonmarket environmental resources which have the characteristics of *non-excludability* and *non-divisibility* (Perman et al, 2003; Birol et al, 2006; Steven, 2006).

CVM, despite its wide application, it suffers from a number of biases, such as hypothetical bias, information bias, strategic bias, sampling bias, starting point bias, instrumental bias, interviewers bias (Tisdell, 1993). However, well-designed and soundly executed CVM studies can provide high quality and policy relevant information (Whittington, 2002). Therefore, due to the advantages described and the feature of environmental benefit going to be measured, CVM is preferred and utilized for the analysis of this study.

2.2 Empirical Literature Review

Many research findings with CVM assured that conservation and/or reducing degradation of forest resources has many advantages. However, there are no many research works on upland forest resources soil and water conservation services in the context of Ethiopia that used contingent valuation method (CVM). Most of the research works accomplished by CVM were devoted to water resources and urban dry waste management. However, for the sake of methodological selection, the under stated studies are considered.

Nnaemeka, et al, (2008) with CVM analyzed the determinants of the WTP of households in forest communities for systematic management of community forests for NTFP conservation in the rainforest region of Nigeria. The WTP elicitation format used was dichotomous choice with open-ended follow-up questions. The analysis from a Tobit model showed that variables such as wealth category, occupation, number of years of schooling and number of females in a household were positively and significantly influenced WTP.

KHEE, et al, (unknown date) analyzed WTP of households for preservation and conservation of hill recreational and services values in Malaysia. The CVM

employed open ended question with OLS model. The study finds that hill preservation is important and the public is willingness to pay initiatives for initiatives to mitigate further degradation to this ecosystem. The three explanatory variables which have significant effect on WTP are the user of the hill, gender and household income.

Alemu (1997) applied CVM to community forestry in Ethiopia. For the survey, single-bounded dichotomous choice format with open ended follow-up questions were applied. The results proved that income, household size, distance of homestead to plantation, number of trees owned and sex of household head were important variables that explain WTP for the program. The results of the study suggested that community afforestation projects should consider household and site specific factors as determinants of success.

Fredrik et al., (2004) employed the CVM on community plantations project in the northern highlands of Ethiopia. The households WTP for a new plantation were elicited in two steps. First the respondents were asked a single-bounded dichotomous question about whether he or she would be willing to pay a specific sum of money for the establishment of the plantation. Close-ended question for a given threshold was followed by an open ended elicitation format. The result from probit model showed considerable variations between villages and analysis of bid functions showing underlying factors for the project success that can be used in project planning were made. Accordingly the responses of both spouses show that there are gender variations in the factors that affect the WTP for the bids. In the community where there is no plantation before, women were significantly interested than men for the new establishment. The study concluded that the cumulative WTP diverge significantly between villages ranging between 1,301Birr to 8285Birr per ha/year indicating the need for good selection methods in targeting such plantation interventions.

Zewdu & Yemisirach (unkown date) taking Netchsar National Park as a case, tried to measure people's (WTP) to protect the endangered environment and

identify its determinants. Using dichotomous choice (CVM), it was found that the local community was willing to protect the park. The results show that the means for the WTP are Birr 28.34 and Birr 57.07 per year per household; and its determinants are primary economic activity of the households, dependency ratio and distance from the park.

Tegegne (1999), by using CVM, measured WTP of individuals for environmental protection in terms of both ETB and labour days contribution in Sekota District, Northern Ethiopia. The results showed that labour contribution method is preferred to monetary method contribution method. Education, age, sex and family size are the major determining factors for the WTP in labour days.

Therefore, the above stated literatures assure that CVM is the most practical valuation method for the valuation of non-marketable environmental resource attributes. As a result, here on this study it is utilized as a major method to quantify rural households WTP for reducing upland forest resource degradation to improve its soil and water conservation services they obtain.

3 Research Methodology

3.1 Description of the Study Area

Halaba Special Woreda is one of the special Woreda's' in the SNNPR. It is located within the southern rift valley of Ethiopia. It is placed between Lake Shalla and Bilate River. The Woreda's capital, Halaba Kulito, is located 315 km south of Addis Ababa and about 85 km southwest of (SNNPR) state capital of Hawassa, along the main road to Arbaminch. The upland forest resource is found in the upper tip of Rekame watershed, 19km away from the woreda's capital town, Halaba Kulito. The total area of the upland forest is estimated to be 541 hectare.

3.2 Data Sources, Methods of Collection, Sampling Procedure and Sample Size

Though CVM research acquires most of its data from primary data sources, secondary data sources are also utilized, which include the data collected from books, documents and reports. The primary data is collected through duly prepared and pretested questionnaire using face to face interview of sample households. Face-to-face CVM survey with fully-structured questionnaire is the most appropriate method in rural areas where illiteracy and many other factors are pervasive.

CV scenario and fully structured questionnaire was designed for the sample respondents. In addition, focus group discussions (FGD) to assess economic status (paying ability) and key informant interview to generate qualitative information were used. Sample households were asked two consecutive questions on the CV scenario. Primarily, close-ended questions (Yes/No) for a fixed amount of bid value; and then the open-ended question which extracts the maximum WTP amounts in terms of ETB and in labor days contribution method.

In this study, a multi-stage sampling technique was applied to select the required type of sample respondents. Firstly, out of the 79 PAs in the Woreda, 27 PAs that are found in the Rekame watershed system and exposed for recurrent flood, soil erosion and sedimentation problems from the degraded upland forest resource area of Rekame watershed are purposively selected. Secondly, the selected 27 PAs are stratified into two depending on their degree of vulnerability to seasonal flooding, soil erosion and sedimentation problems in collaboration with the Woreda's agricultural & rural development office. Thirdly, from each stratum three representative PAs are selected randomly (i.e. a total of six PAs on aggregate). Finally, in order to give equal chance for the population of each PA, probability proportional to size random sampling technique was employed. The total sample size from the six representative PAs is selected by using the theories of Cochran (1977) and Enanoria (2007), which were 369.

3.3 Methods of Data Analysis

Both descriptive statistics and econometric models were used in the study. The descriptive statistics include mean, percentage and frequency of the willing and non-willing respondents for the proposed project. In addition, the analysis of survey responses obtained from single bounded and open-ended questions formats requires different econometric models (FAO Corporate Document Repository, 2007). Accordingly, the under specified econometrics models were used:

3.3.1 Specification of Econometric Model for the Single-Bounded Survey Responses

in the case of single bounded dichotomous choice, the random components of preferences cannot be known by the researcher rather he can only make probability statement of '**yes**' or '**no'** responses. As a result, the probability that the respondent says '**yes**' is the probability that the respondent thinks that he/she is better-off by the proposed improvement program. For individual i the probability can be formed as:

$$P(Yes = 1) = [U^1(Yj - \beta_i^*, Xj, \varepsilon^1 j) > U^0(Yj, Xj, \varepsilon^0 j)]. \quad \textbf{(1)}$$

This probability statement provides an intuitive basis to analyze binary responses. Therefore, for dichotomous (yes/no) responses to the single bounded bid amount (βi*) neither the multiple linear regression model nor the tobit model is appropriate to estimate WTP function (Gujirati, 2004; Hill, et al., 1997). However, this can be solved by using a more sophisticated model, such as, probit and logit (Amemiya, 1981; Johanson and Dinardo, 1997).

Probit model follows normal cumulative distribution whereas logit model follows logistic cumulative distribution. That is, the conditional probability approaches zero or one at a slower rate in logit than in probit (Gujirati, 2004).

The choice between the Probit and the Logit model is only for mathematical convenience. Assuming the normal cumulative distribution following Cameron and Quiggin, (1994), the Probit model can be expressed as follows:

$$Y_i^* = \beta' Xi + \varepsilon i \quad \textbf{(2)}$$

$$yi=1 \text{ if } Y^*i \geq \beta^* \text{ and } yi=0 \text{ if } Y^*i < \beta^*. \quad \textbf{(3)}$$

Where: Y*i unobservable households' actual WTP for the improvement, β' is vector of unknown parameters of the model, Xi is vector of explanatory variables, yi is discrete response of the respondents for the WTP bid amount, β^* is the bid value assigned arbitrarily to the i^{th} respondent and εi is unobservable random component distributed N (0, σ).

The basic reason behind running probit regression is to calculate parametric mean WTP, aggregate WTP, and allow inclusion of influence of respondents' socio-economic factors and the disturbance term into the WTP function. Therefore, the mean willingness to pay (μ) was calculated using the formula (Haab and Mconnell, 2002) with the data obtained from probit regression for both contribution methods. Accordingly, the equation is written as:

$$\mu = -\frac{\alpha}{\beta} \quad \textbf{(4)}$$

Where, μ is parametric mean WTP, $\boldsymbol{\alpha}$ is coefficient of the constant term from multivariate probit model regression whereas $\boldsymbol{\beta}$ is a coefficient for the amount of the bid that the respondent was asked to pay.

3.3.2 Specification of Econometric Model for the Open-ended Survey Responses

In this case the use of binary response models such as the Probit or the Logit is not appropriate. As a result, censored Tobit model when discrete response for the dependent variable takes non-negative values with some zeros or OLS model if the discrete response for the dependent variable takes none zero positive numbers is more appropriate (Siglman and Zeng 1999). The survey result showed that for the open-ended question respondents expressed maximum WTP amount that exceeds zero for both contribution methods. Accordingly, OLS model is selected and utilized for analyzing the determinants of individuals' maximum willingness to pay for the proposed project. The general OLS models are defined as follows for each type of contribution methods:

OLS model for ETB contribution method

$$WTP = \beta o + \beta_1 SEX + \beta_2 MARSTAT + \beta_3 INCOMEH + \beta_4 TLU + \beta_5 EDUNAHH + \beta_6 HEDUNAH + \beta_7 FAMSIZE + \beta_8 BIDCASH + \beta_9 LANDHOLD + \beta_{10} DISTANCE + \beta_{11} DEGVUL + \beta_{12} MEMSHIP + \beta_{13} PARTCON + \beta_{14} OFFINCOM$$

OLS model for Labor Days contribution method

$$WTP = \beta o + \beta_1 SEX + \beta_2 MARSTAT + \beta_3 INCOMEH + \beta_4 TLU + \beta_5 EDUNAHH + \beta_6 HEDUNAH + \beta_7 FAMSIZE + \beta_8 BIDLABOR + \beta_9 LANDHOLD + \beta_{10} DISTANCE + \beta_{11} DEGVUL + \beta_{12} MEMSHIP + \beta_{13} PARTCON + \beta_{14} OFFINCOM$$

The variables in the model are defined in Appendix 5.

For the open ended contingent valuation survey responses the non-parametric mean WTP and nonparametric aggregate WTP for the total households in the study area is calculated by using the following formula (FAO Corporate Document Repository, 2007)

$$\text{Mean\_WTP} = \frac{\sum_i (\text{MWTPi}) * (\text{ni})}{\text{N}} \quad \textbf{(5)}$$

Where, MWTP = Mean willingness for the whole households surrounding the resource, MWTPi = i^{th} individual mean WTP, ni = number of households that are willing to pay the i^{th} amount and N = total number of households within the resource area.

Prior to the analysis of results from both models, all the necessary tests were made to detect if there are severe problems of multicollinearity and hetroscedasticity and there were no serious problems.

According to the findings of various studies on economic valuation of non-marketable environmental resources, the working hypotheses were structured (Appendix 5).

4 Results and Discussion

This section deals with the analysis of the surveyed data which are mainly obtained by using the contingent valuation survey instrument. Interpretation of the analytical findings was done by using both descriptive and econometric analysis.

The contribution of households is considered in ETB and labor days contribution methods. Considering both payment vehicles adds some steps on the development of a payment for non-market environmental services.

4.1 Descriptive Results

The sex composition shows that 244(66%) respondents were males whereas the rest 125(34%) were females for both types of contribution ways. From these 363(98%) of the respondents were the household heads themselves, whereas the rest 6(2%) of the respondents were other working members of the household. This might be assumed to increase the reliability of the response

provided that the rural household head knows and manages most of the household income and resources.

With regard to age, from a total of 369 valid responses the average age of the respondents was about 38.26 years with minimum and maximum ages being 21 and 68 years, respectively. The respective averages for willing and non-willing households for the pre-set cash bid value were 37.47and 39.90years, whereas for the pre-set labour bid value the respective averages were 37.44 and 40.06 years. That is, younger household heads were more willing to pay than the elder heads. However, the mean age difference between willing and non-willing was not statistically significant for both contribution methods.

Moreover, variable age was expected to have adverse impact on the valuation of soil & water conservation services from the reduced upland forest resources degradation. This is because, since investments on environment take longer to reply, aged respondents are expected to contribute smaller relative to the younger ones. That is, as age rises the willingness to contribute of the respondent falls. And hence age of the respondent has negative relationship with the level of willingness to contribute/pay for reducing upland forest resources degradation to improve its services of soil & water conservation (Table 1).

Table 1: Distribution of non-willing respondents across age categories

Age category	WTP (in ETB)		WTP (in labor days)	
	Non-willing (N=120)		Non-willing (N=109)	
	Frequency	Percentage	Frequency	Percentage
18-29	35	29.2	35	32
>=30	85	70.8	74	68
Aggregate	120	100	109	100

Source: Computed from own survey data, 2012.

From 369 sampled households, a total of 1935 family members were recorded with a minimum of 1 person and a maximum of 11 persons per household. The mean family size for the total data set was 5.22, approximately, which was equal to the national average of 5.2 persons (CSA, 1995). For the bid value contribution which was asked in terms of cash the respective average family size for willing and non-willing respondents were 5.66 and 4.36.However, for the bid value which was requested in terms of labour days, the respective averages for willing and no-willing sample respondents were 5.6 and 4.3. That is, respondents having larger family size were more willing to contribute than respondents having smaller family size for the proposed project. The mean difference between willing and non-willing respondents is statistically significant at 1% level of significance for both types of contribution methods

Education increases households' ability to get, process, and use information in their day to day livelihood activities (Asrat et al., 2004). As a result, educational achievement was considered as major variable which determine the probability of rural households WTP for reducing upland forest resources degradation and hence improve its soil and water conservation services. For the purpose of isolation of the impact of 'education' of the representative household head & members within, it was analyzed in two groups. These are the highest educational achievement within the household by a member and educational achievement by the household head himself.

Education level of household heads ranged from illiterate to Grade 10, with a mean value of 0.474, which means that the majority of the respondents were illiterate and primary school attendants (Table 2). About 215(58.3%) of the respondents were illiterate, 153(41.5%) respondents were primary school attendants (in grades 1 to 6 including those who were attending informal education and who can read and write). Only one sample respondent has completed secondary school (grade 10). As a result, on aggregate about 99.8% of the respondents were illiterate and primary school attendants. This made the survey very difficult and to some extent demands more effort and intensive

enumerator training, given that it was contingent valuation survey which needs high level of understanding about the hypothetical market scenario (Table 2).
The greatest educational level attained within the household members ranged from illiterate to grade 12 + 3 (first degree), with a mean value of grade 4.66. Approximately, 23% of households were illiterate (there is no any household member attending or previously attended school), 40% had at least one household member attending primary school (in grades 1 to 6), 24.4% had a household member in grade 7 to 9, and 10% from grade 10, 11 & 12. About 1.5% of the households have at least one family member who had attended or completed 10 + 3 (college diploma) and only 1.1% of the households have at least one family member who had completed 12+3 (first-degree). These figures could have changed if only the household head with education was considered by ignoring educated family members.

Table 2: Summary of household head and members within educational achievement

Variables	Educational status	Respondents			Percentage	Summary
		Male	Female	Total		
Education achievement household head	Illiterate	146	69	215	58.3	Obs. 369 Mean 0.474 Min. 0 Max. 10 Std. dev. 0.78
	Informal & Primary school	97	56	153	41.5	
	Secondary school	1	-	1	0.2	
	Tertiary school			-	-	
	Total			**369**	**100**	
Highest Educational Achievement within Household	Illiterate	62	27	89	24.3	Obs. 369 Mean 4.6 Min. 0 Max. 12+3 Std. dev. 3.86
	Informal & Primary school	93	52	145	39.3	
	Secondary school	81	45	126	34	
	Tertiary school	8	1	9	2.4	
	Total			**369**	**100**	

Source: Own survey data, 2012

The total land holding of sampled respondents was also expected to have positive effect on the level of willingness to contribute for reducing the upland forest resources degradation to bring back its soil & water conservation services. Moreover, since the fate of downstream cultivable land has strong link with the upland forest resources, those respondents who have large land holding were expected to pay higher for the proposed project. Accordingly, the minimum and the maximum land holding of the sampled respondents were registered as 0.25 and 2.85 hectare, respectively. The total sum of land holding of the 369 sample respondents was 518.875 ha. However, approximately, the average land holding status of sample households was 1.4 ha (Table 3).

Table 3: Distribution of willing & non-willing respondents across different size of land holding

Land holding category (in ha)	Respondents	Response for the pre-set bid-value in cash		Response for the pre-set bid-value in person days	
		Willing	Non-willing	Willing	Non-willing
0.00 – 1.00	180	74 (41%)	106 (59%)	83 (36%)	97 (54%)
1.01 – 2.00	86	75 (87%)	11 (13%)	77 (89.5%)	9 (10.5%)
2.01 – 2.875	103	100 (97%)	3 (3%)	100 (97%)	3 (3%)
Aggregate	369	249	120	260	109

Source: Survey data, 2012

From Table 3 above, we can observe that when the trend of land holding increases from one category to the other, the rate of willingness to contribute of sample respondents also rises for both cash and labor day contribution methods. Contrarily, when the size of land holding increases, the rate of non-willing respondents for the proposed environmental change decreases steadily for both cash and labor day contributions. Therefore, the assumed direct relationship between size of land holding and the probability of accepting the pre-set bid-value was justified by the obtained data. Moreover, there is statistically significant average land holding difference between willing and

non-willing respondents at 1% level of significance for both contribution methods.

The income data which was obtained from the sampled respondents is analyzed by categorizing households into four income groups: annual income group of below 10,000ETB, between 10,000 and 24,999ETB, between 25,000 and 49,999ETB, and 50,000ETB or more. The minimum and maximum annual incomes that the sampled rural households' have obtained are recorded as 1,548 ETB and 54,589 ETB, respectively. The respondents' willingness to contribute is directly related to their annual income. Accordingly, lower annual income respondents were found to have lesser willingness to contribute. For the contribution in ETB, out of 120 non-willing respondents, about 113(94.2%) of the respondents were found in the income group less than or equal to ETB 10,000. However, there was no non-willing respondent for the pre-established cash bid value from the income category of ETB 50,000 or above.

Table 4: Distribution of willing & non-willing respondents across income categories

Annual Income Category (in ETB)	Respondents	Willing and Non-willing Response Across Income Categories							
		In ETB (N=369)				In Person Days (N=369)			
		Willing	Share (%) from willing (N=249)	Non-willing	Share (%) from non-willing (N=120)	willing	Share (%) from willing (N=260)	Non-willing	Share (%) from non-willing (N=109)
<10,000	215	102	41	113	94	113	43.4	102	93.6
10,000 - 24,999	79	79	31.6	0	0	79	30.3	0	0
25,000 - 49,999	69	62	25	7	6	62	24	7	6.4
≥ 50,000	6	6	2.4	0	0	6	2.3	0	0
Overall	**369**	**249**	**100**	**120**	**100**	**260**	**100**	**109**	**100**

Source: Computed from own survey data, (2012)

On the other hand, for contribution in terms of person days, out of 109 non-willing respondents, about 102(93.6%) were found to be below annual income of 10,000 ETB, whereas only 7(6.4%) of the respondents are found in the income group of 25,000 and 49,999 ETB. However, there was no non-willing respondent for the proposed person days bid value for the income categories of 10,000-24,999 and 50,000 ETB or above. The results for both contribution methods were in line with the expectation. When income increases, the probability of willingness to contribute the pre-set bid amount also increases.

Households WTP response for alternative contribution methods is explained as follows. With regard to single bounded response, of the 369 sample respondents, about 249(67.5%) and 120(32.5%) were found to be willing and non-willing to pay for the pre-established random bid value in terms of cash (ETB), respectively. On the other hand, about 260(70.5%) and 109(29.5%) were willing and non-willing to contribute the pre-established random bid value in terms of labor days, respectively.

Table 5: Descriptive summary of sample respondents WTP of pre-set random bid value

Contribution Methods & Response		Frequency	Mean	Std. Dev.	Min	Max
ETB	Willing	249	0.675	0.469	0	1
	non-willing	120	0.325	0.469	0	1
Total Obs.		**369**				
Labour Days	Willing	260	0.705	0.456	0	1
	non-willing	109	0.295	0.456	0	1
Total Obs.		**369**				

Source: Computed from own survey data, (2012)

However, with regard to maximum WTP from the open-ended questions of both contribution methods, all of the 369 respondents have decided to contribute at least a value which is above zero to assist for reducing upland

forest resource degradation for the sake of obtaining improved soil and water conservation services from it.

4.2 Econometrics Model Results

4.2.1 Households' Parametric Mean & Aggregate WTP from the Single-Bounded Dichotomous

The Single-bounded contingent valuation model (i.e. probit model) is used to estimate the parametric mean & aggregate willingness-to-pay for both types of contributions. To estimate the parametric mean WTP amounts, two independent models were run - a bivariate model (i.e. WTP against the preset bid amount) and a multivariate model (i.e. WTP against all explanatory variables). The results from the two models were compared and the results from the second model were preferred. The reason is that results obtained from the second model with multivariate will increase accuracy of the required value and incorporates marginal effect of all variables (Cameron and Quiggin 1994). Therefore, the mean willingness to pay (μ) was calculated using the formula of (Haab and Mconnell, 2002) (See equation 4).

Table 6: Multivariate probit regression results to compute parametric mean & aggregate WTP

Parameter estimates from multivariate probit model regression in ETB				**Parameter estimates from multivariate probit model regression in Labor Days**			
Variable	**Coeff.**	**Robust Std. Error**	**Z**	**Variable**	**Coeff.**	**Robust Std. Error**	**Z**
Bid cash	-0.5562054	0.1327	-4.19	Bid labor	-1.214772	0.2636	-4.61
Constant	1.358126	0.7391	1.84	Constant	2.451485	0.8039	3.05
Observations		369		Observations		369	
Wald chi2(15)		129.31		Wald chi2(15)		143.71	
Prob > chi2		0.0000		Prob > chi2		0.0000	
Pseudo R^2		0.7577		Pseudo R^2		0.6790	

Source: from own data computation, 2012

By using equation-4and coefficients in Table 6, the parametric mean WTP for reducing the upland forest resource degradation to improve soil and water conservation services from the single bounded probit regression for ETB contribution was estimated as 2.442ETB per week, whereas for the contribution in Labor Days was 2.018 Labor days per week per household. Therefore, the estimated values for alternative contribution methods from the single bounded response are summarized in Table 7.

Table 7: Summary of parametric mean and aggregate WTP in different periods of payment

Period of Payment	Contribution Methods		
	ETB	Labor Days	Conversion to ETB by the conversion factor 12ETB/DAY
Mean WTP per week	2.442	2.018	24.216
Mean WTP per month	9.768	8.072	96.864
Mean WTP per annum	117.216	96.864	1162.368
Aggregate WTP per annum	1,475,632.224	1,219,420.896	14,633,050.752
Mean WTP per five years	586.08	484.32	5811.84
Aggregate WTP per five years	**7,378,161.12**	**6,097,104.48**	**73,165,253.76**

Source: own survey data, (2012)

Contribution in terms of labor days was much higher than the contribution in terms of ETB for proposed improvement in environmental quality.[4] This might be because rural people have shortage of cash and use their crop and livestock production for home consumption and hence give lower WTP in these types of contribution projects. Whereas, labor is relatively cheap in rural areas and because of the existence of disguised unemployment within household, they were willing to contribute more in labor. This was in line with the foundation of Solomon J. (2004).

[4] In the study area the minimum wage rate for unskilled labor was 12.00 ETB per day during survey time (personal communication)

4.2.2 Households Non-Parametric Mean & Aggregate WTP from the Open-Ended

In the open ended questions the sampled households were given a chance to state the maximum amount they would like to pay for improved soil and water conservation services from reducing the upland forest resources degradation. Accordingly, all interviewed households stated the amount of money or labor days which was above zero.

To make the aggregation using the non-parametric mean WTP, first the class boundaries for maximum WTP were considered. From the total respondents, it was found that the vote for the resource improvement ranged from ETB 0.5 to ETB 9.00, which was computed from per week WTP of the survey instrument proposed for five years. On the other hand, for the WTP in Labor Days it ranged from 0.25 to 3.00 Labor Days per week. By using the basic **Surge's rule** of statistics, classes of the respondents WTP were calculated using equation 6 below:

$$\text{Classes} - \text{Required}(K) = 1 + 3.322 * (\text{Log}\ {}^{N}_{10}). \quad \textbf{(6)}$$

Where, K = number of WTP classes required, & N = the number of sampled respondents. Accordingly, the number of WTP classes required was approximated to be 10. However, the width of the class can be computed using the **ratio of range to class**. Since range is the difference between the upper limit of WTP and the lower limit of WTP, the respective width values for both contribution methods are 0.9 ETB and 0.3 Labor Days (as presented in column-1 of Appendix 1 and Appendix 2). The class mark average WTP amount shows the average WTP in both contribution methods within each class of intervals (column-2, 3, 4 of Appendix 1 and Appendix 2).

Total number of households (column-7) is obtained by taking the product of the sample households proportion (%) falling in that boundary and the whole

household size enclosed in the study area (i.e. 12,589). To find out each class of intervals non-parametric total WTP (column-8) the following formula was applied.

$$\text{Class Intervals NonParametric Aggregate WTP} = \text{MWTPi} * \text{ni} \quad \textbf{(7)}$$

Where: MWTPi = i^{th} class interval mean WTP (column-4) and ni = number (proportion) of total households willing to pay that amount (column-7). Therefore, the annual non-parametric aggregate WTP amount was computed by equation-8 below:

$$\text{Total Households NonParametric Aggregate WTP} = \sum_{i=1}^{10}(\text{MWTPi} * \text{ni}) \quad \textbf{(8)}$$

Where: $\sum_{i=1}^{10}(\text{MWTPi} * \text{ni})$ = the summation of each class of intervals non-parametric aggregate WTP under column-8 inannex1 & annex2, which equals 1,390,374.24 ETB and 949,812 labor days per annum. From these values, the five years non-parametric aggregate WTP amounts for the contribution methods of ETB and labor days are ETB 6,951,871.2 and 4,749,060 labor days, respectively.

However, the general (all inclusive) non-parametric mean WTP amounts of the total households were estimated by using equation-9 of (FAO Corporate Document Repository, 2007) below:

$$\text{Total Households NonParametric MWTP} = \frac{\sum_{i=1}^{10}(\text{MWTPi}*\text{ni})}{\text{N}} \quad \textbf{(9)}$$

Where, MWTP = Mean willingness for the whole households incorporated in the study, MWTPi = i^{th} class interval's mean WTP (column 4) in Appendix 1 and Appendix 2, ni = number (proportion) of total households that are willing to pay the i^{th} amount and N = total number of households incorporated in the study (i.e. 12,589). Accordingly, from the equation, total households non-parametric

mean WTP amounts are ETB110.443581 ≈ ETB110.4436 and 75.4477719 ≈ 75.4578 labor days per annum per household (Table 8).

Table 8: Summary of non-parametric mean and aggregate WTP in different periods of payment

Period of Payment	Contribution Methods		
	ETB	Labor Days	Conversion to ETB by the conversion factor 12ETB/DAY
Mean WTP per week	2.301	1.572	18.862
Mean WTP per month	9.204	6.287	75.448
Mean WTP per annum	110.444	75.448	905.373
Aggregate WTP per annum	1,390,374.24	949,812	11,397,744
Mean WTP per five years	552.218	377.239	4,526.866
Aggregate WTP per five years	**6,951,871.2**	**4,749,060**	**56,988,720**

Source: own survey data, (2012)

As a result, for this study area the WTP amount expressed in labor days is much higher than the WTP in ETB. This might be due to cash constraint, labor abundance and disguised unemployment which are pervasive in rural areas of developing countries.

Therefore, in rural areas, for such type of projects contribution in labor days are the most preferred contribution method to cash (ETB). This finding is consistent with the findings of Solomon (2004).

4.2.3 Multivariate Analysis of Determinants of Households' WTP

The respondents mean WTP for the improved soil and water conservation services from reducing the upland forest resources degradation of Rekame watershed was influenced by a number of socio-economic and demographic factors. As it was described in the methodology section for the econometric analysis multivariate probit and OLS models were used. Probit model was

employed to analyze factors that determine households' WTP for single bounded dichotomous choice survey responses, whereas OLS model was used to analyze factors that determine households' maximum WTP for the open ended response. Moreover, results from the two models helped to detect if there is any severe discrepancy between determinants across probit and OLS models.

4.2.3.1 Multivariate Probit Model Analysis of Determinants of Households WTP

Measure of goodness of fit tells about the explanatory power of the models. Without any complicated computation, STATA statistical software regression easily provided the Pseudo R^2value of the two models. Accordingly, goodness of fit of the two models was reported as 0.7577 and 0.6790 for ETB and Labor days probit models. That is, this result indicates that our probit model for the WTP in cash explains about 75.77% of the variation, whereas the probit model for the WTP in labor days explains about 67.9% of the variation (Appendix 3).

For ETB probit model, *age of the respondent(AGE-), income of the household(INCOMEH+), educational achievement of household head(EDUNAHH+), highest educational achievement within household(HEDUNAH+), family size(FAMSIZE+), pre-set bid amount in cash(BIDCASH-), land holding(LANDHOLD+), distance from the upland forest resource(DISTANCE-), degree of vulnerability of the household(DEGVUL+),* and *off-farm income status of the household(OFFINCOM-)* have shown significant effect with the expected signs. However, *sex of the respondent(SEX), marital status(MARSTAT), livestock holding in terms of tropical livestock unit(TLU) &households participation experience in conservation activities(PARTCON)*have shown unexpected negative sign; but insignificant. Household's *membership status in the existing upland forest resource association (MEMSHIP)* has shown the expected negative sign but insignificant (Appendix 3).

For labor days probit model, *age of the respondent(AGE-), income of the respondent(INCOMEH+), livestock holding in terms of tropical livestock unit(TLU-), educational achievement of household head(EDUNAHH+), highest educational achievement within household(HEDUNAH+), family size(FAMSIZE+), pre-set bid amount in labor days(BIDLABOR-), landholding(LANDHOLD+), distance from the upland forest resource(DISTANCE-),* and *degree of vulnerability of the household (DEGVUL+)* have shown significant effect. However, *sex of the respondent (SEX), marital status(MARSTAT), & households participation experience in conservation activities(PARTCON)* have shown unexpected negative sign; but insignificant. Household's *membership status in the existing upland forest resource association (MEMSHIP)* and *off-farm income status of the household(OFFINCOM)* have shown the expected negative sign but insignificant (Appendix 3).

When we compare the results from the two probit models, all the explanatory variables have the same direction for both contribution methods. However, *livestock holding in terms of tropical livestock unit(TLU)* is significant only in Labor days probit model, whereas *off-farm income status of the household(OFFINCOM)* is significant only in ETB probit model (Appendix 3).

4.2.3.2 Multivariate OLS Model Analysis of Determinants of Households WTP

For ETB OLS model, *age of the respondent*(AGE-), *income of the household*(INCOMEH+),*livestock holding in terms of tropical livestock unit*(TLU-), *highest educational achievement within household*(HEDUNAH+), family size(FAMSIZE+), *land holding*(LANDHOLD+), *pre-set bid amount in cash*(BIDCASH+), *degree of vulnerability of the household*(DEGVUL+), and *membership status in the existing upland forest resource association*(MEMSHIP-) have shown significant effect up on level of willingness to pay whereas the remaining six variables (i.e. *sex of the respondent(SEX), marital status(MARSTAT), educational achievement of household head(EDUNAHH), distance from the upland forest resource(DISTANCE)*, *households participation*

experience in conservation activities(PARTCON) and off-farm income status of the household(OFFINCOM)) have shown insignificant effect (Appendix 4).

On the other hand, for labor days OLS model, *age of the respondent*(AGE-), *income of the household*(INCOMEH+), *livestock holding in terms of tropical livestock unit* (TLU-), *highest educational achievement within household*(HEDUNAH+), family size(FAMSIZE+), *land holding* (LANDHOLD+), and *pre-set bid amount in labor days*(BIDLABOR+) have shown significant effect on the dependent variable (WTP) whereas eight variables (i.e. *sex of the respondent(SEX), marital status(MARSTAT), educational achievement of household head(EDUNAHH), distance from the upland forest resource(DISTANCE), degree of vulnerability of the household(DEGVUL), household's membership status in the existing upland forest resource association(MEMSHIP), participation experience in conservation activities(PARTCON) and off-farm income status of the household(OFFINCOM)*) have shown insignificant effect (Appendix 4).

In both ETB and labor days multivariate OLS models all the variables have the same direction. The only differences are *degree of vulnerability of the household* (DEGVUL) and *membership status of the household in the existing upland forest resource association(MEMSHIP)* having significant effect only on ETB. In addition, when we compare multivariate probit and OLS models of both contribution methods, all the explanatory variables have the same direction except *participation experience in conservation activities*(PARTCON), but insignificant in both models (Appendix 3 and Appendix 4).

5 Conclusion and Recommendations

5.1 Conclusion

The valuation result reveals that households have a positive willingness to pay to ensure the improved soil and water conservation services by reducing the upland forest resource degradation. Their maximum WTP amount is one of the

indicators that the upland forest resources degradation is increasing and the resultant loss of soil and water conservation services from year to year. Therefore, their willingness to contribute in support of the proposed improvement can be used as potential revenue.

For the contribution method in ETB, the estimated five years aggregate WTP amounts from the annual aggregate WTP of parametric and non-parametric approaches are ETB 7,378,161.12 and ETB 6,951,871.2, respectively. On the other hand, the estimated five years aggregate WTP amounts of parametric and non-parametric approaches were 6,097,104.48 and 4,749,060 Labor days, respectively. When we project the five years aggregate WTP amounts by unskilled worker local minimum wage rate of (ETB 12.00/day), the respective five years parametric and non-parametric aggregate WTP amounts were ETB 73,165,253.76 and ETB 56,988,720. This shows that as the contribution in Labor Days by far more valuable than the contribution in ETB for such kinds of projects in rural areas. This might be due to excess family labor (disguised unemployment) and cash constraint.

Unlike parametric approach, there is no high risk of 'spill-over' effect for the estimation from non-parametric approach. As a result, the aggregate WTP amounts for this resource improvement project are preferably estimated by extrapolating the non-parametric mean WTP amounts. Accordingly, the five years non-parametric aggregate WTP amounts are ETB 6,951,871.2 and 4,749,060 work days. And the converted 4,749,060 Labor Days amount in ETB equals ETB 56,988,720.

Identification of major variables that determine households WTP amounts for the project helps to make more realistic valuation of the resource and hence to enable adjustments that are pro to the local communities demand. For the multivariate probit regression, variables AGE, BID, DISTANCE INCOME, EDUNAHH, HEDUNAH, FAMSIZE, LANDHOLD and DEGVUL have shown significant effect on households participation decision (WTP) in both

contribution methods. TLU has shown significant effect only on labor days multivariate probit regression whereas OFFINCOM has shown significant effect only on ETB multivariate regression. On the other hand, for the multivariate OLS regression variables AGE, INCOMEH, TLU, HEDUNAH, FAMSIZE, LANDHOLD and BID have shown significant effect for both contribution methods. However, DEGVUL and MEMSHIP have significant effect only on ETB multivariate OLS regression.

As a comparison, almost all the explanatory variables in both models (Probit and OLS) for both contribution methods have shown the same direction except PARTCON. Therefore, these can be an illustration for as there is no serious inconsistency problem between the results from the two multivariate models.

5.2 Recommendations

Majority of the sample respondents realized that the upland forest resources of Rekame watershed is highly degraded, mainly, due to human activities and hence increase in environmental problems. Therefore, incorporating participation of the communities in rural areas in conservation of the resource is very important to achieve the proposed improvement.

The conventional management (existing upland forest resource management) could not reduce the upland forest resources degradation as the decisions thus far made on this resource management poorly incorporated the non-market economic value of the resource. Therefore, the decision-makers should incorporate the non-market economic value (soil and water conservation services value) of the upland forest resource as one of the major inputs for implementation of an integrated upland forest resources improvement and protection.

In the study area contribution in Labor Days is more preferred to cash. Thus, conservation activities proposed by government or non-governmental

organizations should have to consider the participation of households in terms of Labor Day contribution than cash while designing upland forest resources improving projects. Moreover, major determining factors of rural households' decision on environmental resources conservation should have to be duly examined prior to implementation.

Furthermore, the estimated value represents only the soil and water conservation services values of the resource; the other values like wood products, recreational, carbon sequestration and cultural values of the upland forest resources have not been estimated in this study. Therefore, it is important to estimate all the values (both use and non-use values) that give total economic value (TEV) of the resource for policies aimed at efficient and sustainable management of the upland forest resources of Rekame watershed.

References

Adams, J. (1993). The emperor's old clothes: The curious comeback of cost benefit analysis. Environmental Values, 2(3): 247–260.

Alemu, M. (1997). "Valuation of community forestry in Ethiopia: A contingent Valuation study of rural households". EEU working papers, Gothenburg University, Sweden.

Amemiya, T. (1981). Qualitative Response Models: A survey. *Journal of Economic Literature* 19, 1483-1536.

Asrat, P., Belay, K. and Hamito, D. (2004). Determinants of Farmers' Willingness to Pay for soil Conservation Practices in the Southern Highlands of Ethiopia. Land Degradation and Development 15, 423-438.

Bergstrom, J. C. (1990). "Concepts and Measures of the Economic Value of Environmental Quality: A Review," *Journal of Environmental Management*, 31(3), 215–228.

Birol, E., Karousakis, K., Koundouri, P. (2006). Using economic valuation techniques to inform water resources management: A survey and critical appraisal of vailable techniques and an application. J. Science of the Total Environment 365, 105-122.

Carson, R. T., and Hanemann, W. M. (2005). "Contingent Valuation" in: Handbook of Environmental Economics (**2**): 862-868

Cameron A. T. and J. Quiggin. (1994). Estimation using contingent valuation data from a dichotomous choice with follow-up questionnaire. Discussion Paper, no. 653. Department of Economics, UCLA. Edition, economics series.

Central Statistical Agency (CSA). (1995). Report on Land Utilization, statistical bulletin 132, Addis Ababa, Central Statistical Authority, Addis Ababa (CSA).

Colombo, S., Hanley, N and Calatrava-Requena, J. (2005). Designing Policy for Reducing the Off-farm Effects of Soil Erosion Using Choice Experiments. J. Agric. Econ. 56, 81-95.

Duberstein, J. N., and De Steiguer J. E. (2004). Contingent Valuation and Watershed Management: A Review of Past Uses and Possible Future Applications. School of Renewable Natural Resources, University of Arizona. Tucson, U.S.A

Enanoria, W. (2007). Sample Size Estimation. Center for Infectious Diseases Preparedness. University of California.

EFAP. (1994). Ethiopia Forest Action Program. Final Report. MoNRDEP. EFAP

Ethiopian Environmental Protection Authority and Ministry of Economic Development and Cooperation (EEPA) (1997). The Federal Democratic Republic of Ethiopia Environmental Policy. Addis Ababa, Ethiopia.

FAO. (2007). Corporate documents repository "Applications of the Contingent Valuation Method in developing countries – PDF notes. http://www/fao.org/DOCREP/003/X8955e/X8955e03.htm

Fredrik, C., Gunnar, K., Alemu, M. (2004). Contingent valuation of community plantations in Ethiopia: a look into value elicitation formats and intra-household preference variations. Working Papers in Economics no. 151. Department of Economics, Gothenburg University, Sweden.

Freeman, A. M. (1993). The Measurement of Environmental and Resource Values: Theory and Methods. Resources for the Future, Washington, DC.

Freeman, A. M. (1979). *The Benefits of environmental improvement: Theory and Practice.* Baltimore: The Johns Hopkins University Press for resources for the future Inc.

Georgiou, S., Whittington, D., Pearce, D., & Moran, D. (1997). Economic Values and the Environment in the Developing World. Edward Elgar, Cheltenham, UK.

Gujirati D. (2004). *Basic econometrics*, 2nd edition. New York McGraw Hill international

Haab, T. C and McConnell K. E. (2002). *Valuing Environmental and Natural Resources': The Econometrics of Non-Market Valuation*. Edward Elgar Publishing, Northampton.

Halaba Special Woreda Agricultural & Rural Development Office (HSWARDO). (2012). Annual Report. Halaba Kulito, Ethiopia.

Hanley, N., Wright, R. E., Koop, G. (2002). Modeling recreation demand using choice experiments: rock climbing in Scotland. Environmental and Resource Economics 22, 449–466.

Hanley, N., Shogren J. and White B. (1997). *Environmental Economics in Theory and Practice*, Macmillan Press Ltd, London.

Harris, J. M. (2006). *Environmental and Natural Resource Economics: A Contemporary Approach*. Houghton Mifflin Company, New York.

Henn, P. (2000). User Benefits of Urban Agriculture in Havana, Cuba: An Application of the Contingent Valuation Method. A Thesis Presented to the Faculty of Graduate Studies, McGill University.

Hill, C., Griffiths, W. and Judge, G. (1997). Undergraduate econometrics, John Wiley and Sons, Inc. Printed in USA.

IIED. (1994). Economic evaluation of tropical forest land use options: A review of methodology and applications. London, International Institute for Environment and Development, Environmental Economics Program.

Johanson, J. and Dinardo, J. (1997). *Econometric Methods*, Fourth edition. Printed in Singapore.

John, T. (2009). Economic Benefits of Forest Restoration In the Signal Peak Assessment Area, Gila National Forest: Phase I: Framework for Analysis. Prepared for Restoration Technologies group. Center for sustainable Economy 1704-B Llano Street, Suite 194 Santa Fe, New Mexico 87505 (505) 986-1163.

Khandke, K., Peterson, K., Booth, B., and Holladay, S. (2001). Contingent valuation and land use patterns: An application to the Enore River Watershed in Upstate South Carolina. A paper presented at the Southern Regional Science Association in Austin, Texas.

Khee, P. C., Hoong, T. C. and Ying, N. P. (unknown date). A Contingent Valuation Estimation of Hill Recreational and Services Values in Malaysia.

Kolstad, C. D. (2000). *Environmental Economics*. Oxford, Oxford University Press.

Krieger, D. J. (2001).The Economic Values of Forest Ecosystem Services: A Review. The Wilderness society, 1615 M Street, NW, Washington, D.C. 20036.

Lal, R. (1993). Challenges in agriculture and forest hydrology in the humid tropics. In: Bonnell, M., Hufschmidt, M., Gladwell, J. (Eds.), *Hydrology and Water Management in the Humid Tropics*. UNESCO/Cambridge University Press, Cambridge, UK.

Loomis, J. (2005). Economic Values without Prices: The Importance of Nonmarket Values and Valuation for Informing Public Policy Debates. The magazine of food, farm, and resource issues. A publication of the American Agricultural Economics Association.

Merlo M. and Croitoru L. (2005). Valuing Mediterranean Forests: Towards Total Economic Value, CABI Publishing.

Michael, S. G. (1995). Economic valuation of the multiple use of forests: The case of Bwindi Impenetrable National Park (BINP), Uganda. University of Edinburgh, Scotland. (MSc dissertation)

Mishan, E. J. (1988). *Cost-Benefit Analysis*. Fourth edition. London: Unwin Hyman.

Mitchell, R. C. and Carson, R. T. (1989) Using surveys to value public goods: the contingent valuation method. Washington, DC: Resource for the Future.

Myers, J. (1998). The Cost of Pollution: A Survey of Valuation Methods and their Uses for Policy. World Wildlife Fund, Macroeconomic Program Office. Available at: www.assets.panda.org/download/pollute.pdf

Nnaemeka, A. C. and Chukwuemeka, E. O. (2008). Willingness to Pay for Systematic Management of Community Forests for Conservation of Non-Timber Forest Products In Nigeria's Rainforest Region: Implications for poverty alleviation. Centre for Entrepreneurship and Development Research and Department of Agricultural Economics, University of Nigeria Nsukka, Nigeria.

Pearce, D. W., and Markandya, A. (1989): Environmental Policy Benefits: Monetary Valuation. OECD, Paris.

Pereira, H., (1989). *Policy and Practice in the Management of Tropical Watersheds*. Westview Press, Boulder.

Perman, R., Yue Ma, McGilvray, J. and Common, M. (2003). *Natural Resource and Environmental Economics*. 3rd edition. Pearson Higher Education, under the Addison Wesley imprint.

Rahim, K. A. (2008). Economic Valuation of the Goods and Services of Coastal Habitats: Non-Market Valuation Techniques. Samut Songkram Province, Thailand.

Randall, A. (1987). *Resource Economics: An Economic Approach to Natural Resource and Environmental Policy*. 2nd ed. New York: John Wiley.

Reusing, M. (1998). Monitoring of Natural High Forests in Ethiopia. Addis Ababa, Federal Ministry of Agriculture (MoA), Gesellschaft für Technische Zusammenarbeit (GTZ).

Robert, N., Sven W., José J., and Campos A. (2002). "Forest ecosystem services: can they pay our way out of deforestation?" A discussion paper prepared for the GEF. New York.

Siglman, L. and Zeng L. (1999). Analyzing censored and sample selected data with Tobit and Heckit models, the George Washington University.

Steven, C. H. (2006). *Environmental and Natural Resources Economics: Theory, Policy, and the Sustainable Society*. 3rd ed. New York, USA. M.E. Sharpe, Inc.

Solomon J. (2004). Contingent valuation of multi-purpose tree resources: the case of Arsi Zone (Ethiopia). M.Sc thesis Department of Economics, Addis Ababa University.

Tadesse, K. (2008). Integrated Assessment of ecosystem services and stakeholder analysis of Abijata-Shalla Lakes National Park, Ethiopia. M.Sc. Thesis in Environmental Sciences, Wegeningen University. The Netherlands.

Tegegne, G/Egziabher. (1999). Willingness to Pay for Environmental Protection: An Application of Contingent Valuation Method (CVM) in Sekota District, Northern Ethiopia. *Ethiopian Journal of Agricultural Economics*, V.3 No.1

Thomas, J. and Callan, S. (2007). *Environmental Economics.* Cengage Learning India private limited, New Delhi.

UNCED. (1992). Agenda 21: Program of action for sustainable development and Rio Declaration. New York, United Nations.

Verma, M. (2000). 'Economic Valuation of Forests of Himachal Pradesh', (mimeo), Indian Institute of Forest Management, Bhopal.

Whittington, D. (2002) Improving the Performance of Contingent Valuation studies in Developing Countries, Environmental and Resource Economics 22: pp.323-367, 2002. Kluwer Academic publishes printed in the Netherlands.

World Bank. (1992). World Development Report. Washington, D.C.

Zewdu, B. & Yemesrach, A. (unknown date). Willingness-To-Pay for Protecting Endangered Environments: The Case of Nechsar National Park. Addis Ababa, Ethiopia.

APPENDICES

Appendix 1: Non-parametric aggregate WTP amounts and expected revenue for the resource improvement plan for the WTP in ETB

Class Boundary of WTP (ETB)	Average WTP of the Class per week (Class marks) (in ETB)	Average WTP of the Class per month (Class marks) (in ETB)	Average WTP of the Class per Annum (Class marks) (in ETB)	Sample Distribution (in No. & proportion)		Total No. of HHs in the area	Total WTP per Annum (ETB)	Sample HHs WTP at least that amount (in No. & Proportion)		Total HHs WTP at least that amount (in No.)	Total Revenue per annum (in ETB)
(1)	(2)	(3) [(2)x4]	(4) [(3)x12]	(5) No.	(6) %	(7) [(6)x (11)	(8) [(4)x(7)]	(9) No.	(10) %	(11) No.	(12) [(10)x(11)]
0.00 - 0.90	0.50	2.00	24.00	79	21.40	2,695	64,680.00	369	100	12589	302,136.00
0.91 - 1.80	1.14	4.56	54.72	132	35.77	4,503	246,404.16	290	78.60	9895	541,454.40
1.81 - 2.70	2.27	9.08	108.96	60	16.26	2,047	223,041.12	158	42.82	5391	587,403.36
2.71 - 3.60	3.21	12.84	154.08	28	7.59	956	147,300.48	98	26.56	3344	515,243.52
3.61 - 4.50	4.25	17.00	204.00	16	4.34	546	111,384.00	70	18.97	2388	487,152.00
4.51 - 5.40	5.00	20.00	240.00	8	2.17	273	65,520.00	54	14.63	1842	442,080.00
5.41 - 6.30	5.81	23.24	278.88	16	4.34	546	152,268.48	46	12.47	1570	437,841.60
6.31 - 7.20	7.00	28.00	336.00	13	3.52	443	148,848.00	30	8.13	1023	343,728.00
7.21 - 8.10	8.00	32.00	384.00	12	3.25	409	157,056.00	17	4.61	580	222,720.00
8.11 - 9.00	9.00	36.00	432.00	5	1.36	171	73,872.00	5	1.36	171	73,872.00
Total	-	-	-	**369**	**100**	**12,589**	**1,390,374.24**	-	-	-	-

Source: computed from own survey data, 2012

Appendix 2: Non-parametric aggregate WTP amounts and expected revenue for the resource improvement plan for the WTP in Labour Days

Class Boundary of WTP	Average WTP of the Class per week	Average WTP of the Class per month	Average WTP of the Class per Annum	Sample Distribution		Total No. of HHs	Total WTP per Annum	Sample HHs WTP at least that amount		Total HHs WTP at least that amount	Total Labour Days Contributed per Annum
(1) Labour Days	(2) Labour Days	(3) Labour Days	(4) Labour Days	(5) No.	(6) %	(7) No.	(8) Labour Days	(9) No.	(10) %	(11) No.	(12) Labour Days
0.00 - 0.30	0.25	1.00	12.00	10	2.71	341	4,092	369	100	12,589	151,068.00
0.31 – 0.60	0.50	2.00	24.00	81	21.95	2,763	66,312	359	97.29	12,248	293,952.00
0.61 – 0.90	0.75	3.00	36.00	10	2.71	341	12,276	278	75.34	9,485	341,460.00
0.91 – 1.20	1.00	4.00	48.00	50	13.55	1,706	81,888	268	72.63	9,143	438,864.00
1.21 – 1.50	1.40	5.60	67.20	54	14.63	1,842	123,782.40	218	59.08	7,438	499,833.60
1.51 – 1.80	1.75	7.00	84.00	23	6.23	784	65,856	164	44.45	5,596	470,064.00
1.81 – 2.10	2.00	8.00	96.00	11	2.98	375	36,000	141	38.21	4,810	461,760.00
2.11 – 2.40	2.25	9.00	108.00	28	7.60	957	103,356.00	130	35.23	4,435	478,980.00
2.41 – 2.70	2.50	10.00	120.00	43	11.65	1,467	176,040.00	102	27.64	3,480	417,600.00
2.71 – 3.00	2.90	11.6	139.20	59	15.99	2,013	280,209.60	59	15.99	2,013	280,209.60
Total	-	-	-	**369**	**100**	**12,589**	**949,812**	-	-	-	-

Source: computed from own survey data, 2012

Appendix 3: Determinants of WTP from multivariate probit regression for reducing upland forest resources degradation to improve soil and water conservation services

Probit Regression Model 1 Estimated parameters and marginal effects of WTP in ETB					Probit Regression Model 2 Estimated parameters and marginal effects of WTP in Labour Days				
Variables (1)	**Coefficients (2)**	**Marginal Effects (3)**	**Robust Std. Error of marginal effects (4)**	**P-value (5)**	**Variables (6)**	**Coefficients (7)**	**Marginal Effects (8)**	**Robust Std. Error of marginal effects (9)**	**P-value (10)**
SEX [a]	-0.2462787	-0.0165375	0.0230307	0.421	SEX [a]	-0.1548454	-0.0178725	0.0310145	0.547
AGE	-0.0941796	-0.006768	0.0025491	0.000***	AGE	-0.0764522	-0.009162	0.0025101	0.000***
MARSTAT [a]	-0.0219132	-0.0015594	0.0192364	0.936	MARSTAT [a]	-0.0662709	-0.0077474	0.0287113	0.792
INCOMEH	0.000088	0.00000632	0.00000241	0.000***	INCOMEH	0.0000912	0.0000109	0.00000306	0.000***
TLU	-0.109066	-0.0078378	0.0076427	0.355	TLU	-0.1802149	-0.0215968	0.0102984	0.065*
EDUNAHH	3.625951	0.2605711	0.0947975	0.000***	EDUNAHH	1.752744	0.210047	0.0561745	0.000***
HEDUNAH	0.2488977	0.0178865	0.00728	0.000***	HEDUNAH	0.2156128	0.0258388	0.0075516	0.000***
FAMSIZE	0.3193217	0.0229474	0.011213	0.000***	FAMSIZE	0.2458198	0.0294588	0.0127844	0.001***
BIDCASH	-0.5562054	-0.0399705	0.0202115	0.000***	BIDLABOR	-1.214772	-0.145577	0.050802	0.000***
LANDHOLD	1.097793	0.0788905	0.0360714	0.000***	LANDHOLD	0.8665018	0.1038407	0.0402476	0.000***
DISTANCE [a]	-0.8949591	-0.044622	0.0224904	0.003***	DISTANCE [a]	-0.6991886	-0.0641373	0.0269448	0.011**
DEGVUL [a]	0.7114853	0.076731	0.0521985	0.039**	DEGVUL [a]	0.6581293	0.1065389	0.0573656	0.023**
MEMSHIP [a]	-0.0701351	-0.0050826	0.0215995	0.815	MEMSHIP [a]	-0.2647455	-0.0327984	0.0329276	0.328
PARTCON [a]	-0.1171229	-0.0082055	0.0204108	0.684	PARTCON [a]	-0.2146555	-0.0247965	0.0284629	0.381
OFFINCOM [a]	-2.302878	-0.3420736	0.087493	0.000***	OFFINCOM[a]	-0.4186803	-0.0552346	0.0544893	0.300
_CONSTANT	1.358126	-	-	0.066	_CONSTANT	2.451485	-	-	0.002
Observations	= 369				Observations	= 369			
Pseudo R^2	= 0.7577				Pseudo R^2	= 0.6790			

Appendix 4: Linear (OLS) regression results for determinants of maximum WTP in open-ended format

Linear Regression Model 1 Estimated parameters coefficients of WTP in ETB				Linear Regression Model 2 Estimated parameters coefficients of WTP in Labour Days			
Variables (1)	**Coefficients (2)**	**Robust Std. Error (3)**	**P-value (4)**	**Variables (5)**	**Coefficients (6)**	**Robust Std. Error (7)**	**P-value (8)**
SEX [a]	-0.212955	0.0990094	0.132	SEX [a]	-0.0878436	0.0573021	0.126
AGE	-0.0158336	0.0050596	0.002***	AGE	-0.0077483	0.0028528	0.007***
MARSTAT [a]	-0.0953887	0.095375	0.318	MARSTAT [a]	-0.061212	0.0583408	0.295
INCOMEH	0.0000322	3.96e-06	0.000***	INCOMEH	0.0000201	02.40e-06	0.000***
TLU	-0.1001691	0.0314309	0.002***	TLU	-0.0601236	0.0190371	0.002***
EDUNAHH	0.027559	0.0728934	0.706	EDUNAHH	0.0215682	0.0433923	0.619
HEDUNAH	0.0727467	0.016349	0.000***	HEDUNAH	0.0540915	0.0082399	0.000***
FAMSIZE	0.0650505	0.0278112	0.020**	FAMSIZE	0.0581559	0.0156641	0.000***
BIDCASH	0.4953117	0.0440759	0.000***	BIDLABOR	0.610007	0.050614	0.000***
LANDHOLD	0.424732	0.0868817	0.000***	LANDHOLD	0.2111523	0.0468097	0.000***
DISTANCE [a]	-0.0054859	0.1091772	0.960	DISTANCE [a]	-0.0454254	0.0587292	0.440
DEGVUL [a]	0.2490162	0.1226248	0.043**	DEGVUL [a]	0.0932755	0.0669548	0.164
MEMSHIP [a]	-0.1559704	0.0838787	0.064*	MEMSHIP [a]	-0.0790419	0.0508074	0.121
PARTCON [a]	0.0196326	0.0848048	0.817	PARTCON [a]	0.0304144	0.0502515	0.545
OFFINCOM [a]	-0.1470112	0.0936627	0.117	OFFINCOM [a]	-0.0409169	0.0572442	0.475
_CONSTANT	0.1771435	0.2468907	0.474	_CONSTANT	-0.1955363	0.163202	0.232
Sample size = 369				Sample size = 369			
R-squared = 0.7447				R-squared = 0.7487			

*** Significant at 1%level of significance

** Significant at 5%level of significance

* Significant at 10%level of significance

([a]) Is for discrete change of dummy variable from 0 to 1

Appendix 5: Description of variables used in multivariate probit and OLS regressions of determinants of WTP

Variable name	Description	Measure	Expected effect on WTP	
			In ETB	In Labor Days
SEX	Sex of the respondent	5 0 = Female	+	+
AGE	Age of the respondent	Age in years	-	-
MARSTAT	Marital status of the respondent	1 = Married 0 = Unmarried	+	+
INCOMEH	Income of the respondent	Annual income in ETB	+	+
TLU	Livestock holding of the respondent	Total livestock holding in TLU	+	+
EDUNAH	Educational achievement of the household head	grades achieved in numbers	+	+
HEDUNAH	Highest educational achievement in the household	Grades achieved in numbers	+	+
FAMSIZE	Number of family members in the household	Family size in numbers	+	+
BIDCASH	Pre-set bid value assigned in cash	Pre-set bid value in ETB	-	-
BIDLABOUR	Pre-set bid value assigned in Labour Days	Pre-set bid value in Labour Days	-	-
LANDHOLD	Size of the land holding by the respondent	Land size in hectare	+	+
DISTANCE	Respondent's homestead/farm distance from the upland forest area	1 = > 1km 0 = $\leq$ 1km	-	-
DEGVUL	Degree of vulnerability of the respondent	1 = High 0 = Moderate	+	+
MEMSHIP	Membership status of the respondent in the existing forest association	1 = Member 0 = Non-member	-	-
PARTCON	Respondent's participation history in conservation	1 = participated 0 = not participated	+	+
OFFINCOM	Off-farm income obtaining status of the respondent	1 = obtain 0 = not obtain	+/-	+/-

Source: Own survey data, (2012)

THE IMPACT OF INFORMATION COMMUNICATION TECHNOLOGY ON THE ECONOMIC DEVELOPMENT OF ETHIOPIA: *A Dynamic Computable General Equilibrium Approach*

Mitiku Kebede[1]

Abstract

ICT is a basic infrastructure and a gateway to the economic transformation of a country. This study tried to show the contribution of ICT to the economy of Ethiopia using a Dynamic Computable General Equilibrium (DCGE) model. In this study, two dimensions were used as a proxy to measure the impact of first, capital investment on ICT and second, its productivity effect. Four simulations were used for the analysis. Simulation1, financing of investment through a combination of foreign and domestic saving. Simulation 2, deals with financing investment only through foreign saving. Both simulations do not increase productivity. Third, simulation increases the productivity of the sectors without changing the investment rate the last, combined domestic and foreign saving with increment in productivity.

The first two simulations have a very low increment in the economy while the last two resulted in producing significant change. For instance simulation 1 and 2 resulted in a 0.07% and 0.01% change in GDP from the base respectively, while simulation 3 and 4 resulted in 1.1% and 1.07% change from the base in the order. There is a positive change on every macroeconomic variable in the last two simulations and the first two simulations produce little or stagnant effect which shows productivity is the decisive economic factor. The income and expenditure of households changed positively on every simulation. Generally, due to the increased ICT investment, there is a positive change in GDP that will be increased by the impact of productivity. ICT plays a cooperative rather than competitive role with other infrastructures. The inevitable truth is, without increase in productivity, investment by itself almost equals with doing nothing.

[1] MSc, Hawassa University
Tel.0916075980; e-mail: Mitekeni@gmail.com

1. Introduction

According to the International Telecommunication Union (ITU), the ICT devices and services useful for improving efficiency and accessing the information include radio, television, telephone, both fixed and mobile, personal computers, and the Internet. The first three are often considered as old ICT devices while the latter three are considered as new ICT devices. In the manufacturing domain, computer aided manufacturing equipment is calculated using ICT. In addition to this, software is sometimes considered separately from computer and Internet as an independent category to get more detailed implication.

"ICT" covers a diversity of ICT products –goods and services – that are primarily intended to fulfill or enable the function of information processing and communication by electronic means, including transmission and display (OECD, 2009a). These can be broadly grouped into ICT equipment, such as computers and peripherals, communication equipment, consumer electronics and components; manufacturing services for ICT equipment; business and productivity software and licensing services; information technology consultancy and services; telecommunication services; and other ICT services. Components of ICT are also present in a variety of non-ICT products, such as scientific and medical equipment, motor vehicles and manufacturing equipment. (OECD, 2009b)

The significance of information communication technology has a multifaceted dimension. Its impact on different sectors of the economy, its societal implications and its influence in politics has made ICT an indispensable part of human activity.

Recently, the concept of Information Communication Technology for Development (ICT4D) has been gaining acceptance in different parts of the world, especially, in developing countries. A good example of the impact of ICT

is the availability better market price information for farmers in Ghana using their association ESOKO. The same is true for Ethiopia through the Ethiopian Commodity Exchange (ECX). A community based website developed in the Philippines is used for the promotion of local products. In Senegal, Manobi (a French private telecommunications company) uses Wireless Application Protocol (WAP) which enables mobile phones to obtain up-to-date market prices for Senegalese fruit and vegetable farmers. This contribution of ICT to pro-poor growth shows how the governments of developing countries use ICT to strengthen their economy.

In Ethiopia the total number of ICT customers reached 18.28 million by the end of June 2012,(telegeography.com, 2012) and by the end of 2015 there is a plan to increase that number to 64.4 million (MoFED, 2010). However the private sector is hindered from investing in the ICT sector. Moreover, high import tariffs on ICT equipment makes it too costly to be purchased easily. Despite these facts, the Ethiopian Communications Sector has seen substantial growth from a low base over the last five years as a result of a massive investment through a vendor financing loan agreement with China's Zhongxing Telecom Corporation (ZTE) worth US$1.5 billion (Lishan, 2010). Moreover, according to the business plan of Ethio-telecom, the government is planning to broaden its scope of investment in this sector between 2011 and 2015 using around $2.5 billion.

The sector being a government monopoly since its establishment in 1952, to the question of efficiency has become a critical issue both for local and international users. Therefore, questions such as what is the impact of investing on the ICT sector? How should the country finance the investment? Does the country need the involvement of the private sector or not? What will be the impact of the increment of ICT investment on the country's GDP, trade balance, factors income and other macroeconomic variables? How does the ICT sector be pro poor in its essence? What is its relationship with productivity? These are some of the questions to be discussed in this study.

The paper will analyze the impact of investing in ICT on different macroeconomic variables, and assesses the efficient ways of financing the investment. It attempts to show the contribution of ICT to achieve the Growth and Transformation Plan and the impact of the private sector in the ICT investment. It also investigates the relationship between Total Factor Productivity growth and the policy implications of investment on the ICT sector.

2. Literature Review

2.1 Theoretical Literature Review

Many economists such as (Jorgenson & Stiroh, 1995;, Mansell & When, 1998; Pohjola, 2000; and 2001) argue that ICT has a positive direct and indirect impact on the productivity. They suggest that the accumulation of ICT capital stock improves labour productivity which is a direct effect. There are also indirect effects through the use of ICT in other sectors. Generally they divide the impact as: ICT production- the production process of ICT goods that provide inputs to ICT production, and ICT as capital input- which implies the use of computers and information technology as an input in other industries resulting in capital deepening and a rise in labour productivity, and lastly, ICT as a special capital input- where ICT generates spill over effect which sometimes exceed the direct returns to ICT capital.

Robert Solow, the Nobel Laureate Economist, on the contrary, says, “you can see the computer age everywhere but not in the productivity statistics” (Dedrick and Kraemer, 2001). This states that ICT has no part in improving productivity. His main argument is that ICT produces the so called labor saving or skilled biased effect through the displacement of some unskilled labor due to either reduction or elimination. In addition, ICT could create some negative impacts for the growth and developing countries. In fact the developed countries will have more competitive advantages raising their domination on global world. ICT facilitates the opening new markets for the developed countries at the expense of the developing countries.

If someone wants to know the difference information and communication technologies make, it is simply trying to live without them. Nevertheless, illustrating the impacts of ICT statistically is far from simple for several reasons. According to UNICTAD (2011), the availability of a number of different ICTs, with different impacts in different contexts and countries, and the characteristics of ICT as a general-purpose technology make what is meant by “impact" very difficult to illustrate.

The contribution of ICT to pro-poor growth has always remained controversial. Economists have various views on pro-poor growth and how it should be defined. Some refer to it as growth that result in a significant poverty reduction, thereby benefiting the poor and improving their access to opportunities (OECD 2001). Pro-poor growth is the type of growth that enables the poor to actively participate in economic activity and benefit proportionally more than the non-poor from overall income increase. ICT services can enhance the pro-poor value of traditional infrastructure: for instance, roads can open up access to markets for farmers, and the use of phones can then enable them to select markets more efficiently and conduct remote transactions. ICTs can reduce transaction costs and play a role in combating the risk of the ill-informed poor (Morawczynski and Ngwenyama, 2007). Bhatangar (2005), on the other hand, notes that access to basic services includes health, education, water, and infrastructure (roads, telecommunication and electricity) which require large investments and ICT diverts resources and attention away from more basic needs. Moreover, factors related with the installation and adaptation time, direct costs, implementation barriers including the knowhow and the risk and uncertainty in relation to security are the obstacles for investment in the ICT sector.

2.2 Empirical Literature

ICT has revolutionized the global economy with changes in different economic activities. Experience has proved that given the proper infrastructure, ICT can

be an enabler for socioeconomic development. Examples from the developed world where significant ICT investments had major impacts include increasing GDP by 7.8 %, 8.0%, 8.3%, 8.4%, in the United States, United Kingdom, Singapore and Australia, respectively. All such developments were linked with improved productivity (Kodakanchi et al, 2006). This indicates that the impact of ICT basically relies on its productivity effect. However, increased investments in ICT without the involvement of other socioeconomic factors may not improve growth in developing nations (Mbarika et al, 2003). Dedrick Kraemer (2001) also concluded that the growth in IT investment is correlated with productivity growth, but the level of IT investment (measured as % of GDP) was not correlated with productivity growth when applied in 43 countries between 1985 and 1995. This conclusion gives us a clue that investment does not necessarily lead to the desired productivity.

In 2008, the World Bank conducted an econometric analysis across 120 countries to investigate the impact of higher penetration of broadband and other ICTs on economic growth (the average growth rate of per capita GDP) between 1980 and 2006 (World Bank, 2009). It estimated that impacts were somewhat greater in developing countries than in developed countries. With respect of the ICT sector in low-income countries, telecommunication services might offer the greatest opportunities for employment creation (UNCTAD, 2010). Daveri (2000), by using data from 18 OECD and European Union (EU) countries from 1992 to 1997, found that IT added to GDP growth in the 1990s for all countries studied.

Pohjola (2001) examined 39 countries, with data from 1990 to 1995, and concluded that IT investment showed 80% gross returns for OECD countries, but developing countries did not experience significant returns. This is not the only evidence that ICT has a significant impact in the economy of countries. Even though there are some studies by researchers like Mingat & Winter (2002) that indicate the negative impact of ICT, and its insignificant productivity effect, many of the researches conducted on the impact of ICT show its positive

contribution to the economic development of both developed and developing nations. The question then will be not on the direction rather on the magnitude of the effect.

ICT has become an integral part of Ethiopia's development plans over the last decade, both in the previous Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) and the recent Growth and Transformation Plan (GTP). The country faces a substantial gap between interest in ICT and the policy and regulatory instruments available to enable its development. The government of Ethiopia planned to achieve a 11.2% and 14.9% GDP growth in the middle and high growth scenarios using ICT as a gateway to the plan (5th Annual ICT Exhibition, 2012). The government strategies include: Human resource development, information communication technology, legal system and security, support for the E-Governance with the information communication technology and use of ICT for research and development.

3. Research Methodology

This paper aims to demonstrate the impact of ICT its return, performance and implications for the economy of Ethiopia. Data from Ethio-Telecom, the Economic Development and Research Institute, Central Statistics Agency and the Ministry of Finance and Economic Development are utilized as basic sources of data for the research.

There are many methodologies to be used to compute the impact of information and communication technology on the economy of a certain country. These include: analytical techniques, case studies, administrative data, panel studies and controlled experiments. However, the main analytical techniques used to measure the impacts of ICT are econometric regression techniques, growth accounting and input-output analysis. (OECD, 2001, 2004). This study uses the Computable General Equilibrium model (CGE) as its basic

method of analysis. CGE model has appeared as a platform suitable for modeling the enabling role of ICT technology in an economy. Since ICT, by its nature, has very wide implication on different sectors of the economy, using CGE model to catch its effects has become common. A holistic treatment of a new, general-purpose technology such as ICT is not, however, widely discussed in CGE literatures in general to the best of the knowledge of this researcher there is no research conducted on the ICT sector using CGE model in the case of Ethiopia.

3.1 The Basic SAM structure used in CGE model

The basic SAM structure has the following accounts**:**

Activity Account

The activity accounts show the value of commodities (goods and services) produced by each activity and the cost of inputs into each production activity consisting of intermediate input purchases along with payments to primary factors of production.

Commodity Account

Commodity accounts show the components of total supply in value terms (domestic production, imports, indirect taxes and marketing margins) and total demand (intermediate input use, final consumption, investment demand, government consumption and exports).

Factor Account

Factor accounts describe the sources of factor income and how these factor payments are further distributed to the various institutions in the economy.

Institution Account

The institution account summarizes payments among government, households, enterprises, and the rest of the world.

The factors of production account

The factors of production account report payments to factors from activities in the domestic economy and the rest of the world and distribution of their income to different institutions on the row and column. The Ethiopian SAM consists of four types of labor: administrative workers, professional workers, unskilled workers and skilled workers and one capital/land account (EDRI, 2009).

The savings-investment (S-I) account

The savings-investment (S-I) account should be seen as representing the "loanable funds" market. The account collects savings from various sources (government, private, and foreign) and spends the accumulated savings on capital goods. The SAM provides no information about who "owns" the capital goods or in which sectors they are installed. Investment demand in the SAM is by sector of origin, not sector of destination, so the SAM cannot provide information about changes in sectoral capital stocks, or their valuation (EDRI, 2009).

The SAM incorporates the three macro balances: government deficit, trade deficit, and savings-investment balance. The SAM does not include an asset account. Therefore, any macro relationship in this framework will be in flow terms (EDRI, 2009).

3.2 System Constraints and Macroeconomic Closure

Equilibrium in the goods market requires the equality of demand for commodities and supply. Aggregate demand for a good comprises of consumption spending, investment spending, and export and transaction services demand. Supply in turn includes both domestic production and imported commodities. Equilibrium is attained through the endogenous interaction of domestic and foreign prices, and the effect that shifts in relative

prices have on sectoral production and employment, and hence institutional incomes and demand (Thurlow, 2004).

The equilibrium condition of factor demand and supply is reliant on how the relationship between factor supply and wages is defined.

$$\sum_{a \in A} QF_{fa} = \overline{QFS_f} \qquad \textbf{(1)}$$

Where, $\overline{QFS_f}$ represents quantity supplied of factor f.

This fixed $\overline{QFS_f}$ is dependent on the closure rule. It works if factors are fully employed, otherwise not. In the above specification, all demand variables are flexible and supply is held fixed, the economy-wide wage, *Factor wage(WF)* , plays the market clearing role in a setting with perfect factor mobility across activities. Therefore the equilibrium depends on the relationship between wages and factor supply.

Even though there are lots of deviations in the assumption of the CGE model, in this paper, the researcher tried to make the model closer to Ethiopia's situation. It is assumed that land is fully employed and mobile across sectors; and capital and skilled labor are fully employed and activity specific. Here full employment of land, capital and skilled labor imply the fixation of their quantity.

In developing countries, since there is a wide room for semi skilled and unskilled labor to be unemployed, we assume it is freely mobile and unemployed. So its employment is flexible; and wages are fixed in real terms and supply adjusts itself to match demand. The mobility of unskilled labor and land across sectors implies that they can be employed in different activities whereas immobility of capital and skilled labor across sectors implies it is

activity specific and sector-specific. Wages adjust to ensure that demand for capital and skilled labor is equal total supply for capital and skilled labor.

For saving investment balance-the critical difference between the various constraints available for the savings-investment balance lies in whether savings are assumed to be investment-driven or whether investment is considered to be savings-driven (Thurlow et al, 2002).

$$\sum_{i \in INSDNG} MPS_i.(1 - TINS_i).YI_i + GSAV + EXR.\overline{FSAV} = \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c \quad \textbf{(2)}$$

Where, $qdst_c$ represents the quantity of stock changes

Accordingly, the sum of savings from the government, domestic non-government institutions and the Rest of the World (ROW) are equated with the sum of fixed investment and stock change. To cater for imbalance, the S-I balance also has an optional addendum in 'WALRAS' which is valued at zero if the model is in equilibrium (balanced).

Concerning the macro variables, there are three macro balances: Government balance, external balance and saving investment balance. The closure where the direct tax rates are held fixed and government saving is flexible (thus, the change of this variable will balance the government account) is used.

The consumer price index is chosen as the numéraire such that all prices in the model are relative to the weighted unit price of households' initial consumption bundle. The model is also homogenous of degree zero in prices, implying that a doubling of all prices does not alter the real allocation of resources.

For external balance: exchange rate is flexible, closure is chosen because foreign saving is one of the options to finance the ICT investment. So, it should be held fixed so that we will shock it by amount of finance required for the

investment. The mathematical formulation of the current account balance (which is expressed in foreign currency) is given as:

$$\sum_{c \in CM} pwm_c.QM_c + \sum_{f \in F} trnsfr_{rowf} = \sum_{c \in CE} pwe_c.QE_c + \sum_{i \in INSD} trnsfr_{irow} + \overline{FSAV} \quad \textbf{(3)}$$

Where, $\overline{FSAV}$ denotes foreign saving (in foreign currency unit). According to the above equation, import spending plus factor transfers to the ROW must equal the sum of export earning, institutional transfers from the ROW and foreign savings. Therefore, real exchange rate plays the role of equilibrating the current account balance.

3.3 Specification of the Dynamic Model

The impact of policy-changes basically includes dynamic aspects, such as the inter-temporal effects of changes in investment and the rate of capital accumulation. In order to investigate in more detail the relationship between policy-changes and factor accumulation the static model is extended to a dynamic recursive model. In the extended part of the model labor supply will be determined exogenously (updated by the population growth rate, i.e. as population grows, the total labor supply increases at the same rate) while capital accumulation is determined endogenously. In a given time period the total available capital is determined by the previous period's capital stock and investment spending. Then new capital will be distributed among sectors based on each sector's initial share of aggregate capital income (Ermias et al, 2011).

This study originally uses the 2005/06 Ethiopian Development Research Institute (EDRI 2009) data. As the current structure of the Ethiopian economy is different from 2005/06 on which the existing SAM is based, the SAM was updated for this particular study to 2009/10 by the following procedure. The dynamic CGE model is used to simulate the growth of the Ethiopian economy based on actual economic developments from 2005/06–2009/10. The resulting

solution is a new, balanced SAM for 2009/10. The projected 2009/10 SAM and GDP were then converted to current prices (Ermias, et al, 2011).

3.4 Limitations of CGE Models

CGE models rest on a series of critical assumptions which limit their suitability for analysis. The first one is the assumption that economies are in equilibrium, which is inherent to a CGE model, is fragile and over-simplistic.

Second, many CGE models rely on neo-classical assumptions of perfect competition and production functions characterized by constant returns to scale and hence the use of neo-classical assumptions might be inapplicable to some. Moreover, static CGE models are unable to model the long-run development process of economies. This requires the development of dynamic CGE models. Nevertheless, the issue of dynamics does not only confront CGE models but macroeconomic models as well. In addition, the data and parameter values used are sometimes questionable. CGE models are criticized on the grounds of data quality to the extent that less developed countries (LDCs) do not generally have reliable data and most of the parameter values (i.e. elasticities) are at best guesses and are not based on appropriate econometric studies.

4. Results and Analysis

Most of the simulations we use in this study come from the research conducted by the Ethiopian Development Research Institute (EDRI) and the International Food Policy Research Institute (IFPRI). They computed the amount of domestic and foreign savings needed to finance the Growth and Transformation Plan in the medium growth and high growth scenarios, which targeted to have 11.2% and 14.9% average GDP growth rates every year, respectively.

The government needs either 21.8% average domestic saving growth rate or 22.1% average foreign saving growth rate to achieve the medium growth scenario, and it will require either 31% average growth rate of domestic saving or 31% average foreign saving growth rate to achieve the high growth scenario. Moreover, the average productivity growth should increase from 4.9% at the base year to 5.8% in the medium growth scenario and to 7.6% for the high growth scenario. Using these simulations as a bench mark, we will analyze the next four scenarios (MoFED, 2010)

In the SAM, it is difficult to know from which sector the investment comes. But in this study, the SAM is redesigned in such way that it will show the economic impact of the increment of investment on the ICT sector separately. That is, in the common SAM, when there is an increase in investment, the investment will be divided into different sectors by a certain common ratio and then its impact will be seen.

But now, what is done is, first to separate the ICT investment from non ICT investments and then keeping other conditions constant, we will analyze what will happen in the economy if investment on ICT increases.

4.1 Definitions of Scenarios and Simulations

Simulation 0: **The Base Year Scenario**

This is a scenario where the previous economic situation continues. It is used when there is no policy shock. It serves as a yardstick for further policy analysis. Thus, the result of the base line simulation will be used as a spring board value so as to compare and contrast the values of different variables after the policy shocks. The year 2009 is used as a base year and this study assumes the same scenario continues for year 2010 and the shock starts in 2011. By this period, the domestic and foreign saving rates are 4% and 6%, respectively.

Based on this calculation, to meet the target, average increase in investment every year should be around 18.2%. Between 2005 and 2010, the government invested around $ 1.5 billion through vendor financing loan agreement from Chinese Telecom Company called Zhongxing Telecom Corporation (ZTE).

Simulation 1: Increase in Investment on the ICT Sector (Using both Domestic and Foreign Saving)

Table 1: Capital expenditure plan of Ethio-Telecom from 2010/11 to 2014/15

Year	2010	2011	2012	2013	2014	2015
Amount in million Birr	*5250	11941	9935	9101	8397	8165
% change each year	_	127.45%	-16.8%	-%8.4	-8.4%	-2.8%

Source: The Business Plan of Ethio-Telecom_2010-2015 and Own Calculation

* For 2010, the researcher used the average capital expenditure from 2005-2009.

The lion's share was for installation processes in rural areas and reports shows that almost all the investment is taken care of by the government. From 2011-2015, the capital investment is expected to be Birr 45.539 billion that is around $2.5 billion. According to MoFED (2010), the government planned to increase the fixed line, the mobile phone and the internet subscribers from 1.2, 7.6 and 0.2 million respectively, in the base year, 2010, to 8.6, 64.4 and 17.17 million in that order in 2015. It also has a plan to increase the mobile phone subscribers' density per 100 from 1.5 people to 8.5 people and the telephone service coverage in 5km from 49.3% to 90%.

To achieve the targeted investment of 18.2%, using the medium growth scenario as a yardstick and assuming that foreign saving will increase by 22.8% every year, and then domestic saving should increase by 8%. This assumption takes the plan of Ethio-telecom into consideration because it basically aimed to finance its capital expenditure through foreign saving. Therefore, in the first scenario, we will see the impact of this investment plan on the economy of the country assuming that there will be no change in the productivity of production sectors.

Simulation 2: Financing the Investment Totally Using Foreign Investment

In our second simulation we will see what happens if the government tries to fully finance its expenditure using foreign saving, keeping the domestic saving fixed. Since the country basically relies on foreign saving for the sake of financing the ICT sector, it is not too far from the reality if we assume that the country could finance the ICT investment through foreign saving.

In this case, to finance the 18.2% need for the investment, we need 35% foreign saving, a little more than the average foreign saving requirement in the high growth scenario which is 31%. In this scenario also we will not change the productivity of firms for ease of comparison with the previous simulation.

Simulation 3: Increase in Productivity without Increase in Investment

By the widespread nature of the Information and Communication Technology the factor productivity of the industrial and service sectors will increase because ICT has a positive externality effect. (Jorgenson & Stiroh, 1995). Total factor productivity or multifactor productivity refers to the effects of any variable different from the labor, capital and intermediate inputs affecting the production process. Since ICT is among these variables, increase in its supply plays a positive role in increasing productivity of the industrial and service sectors. In case of Ethiopia, infrastructure contributes 53% of total factor productivity of firms. (Foster et al, 2010).

In terms of the sectoral productivity effect, ICT mainly and directly affects the industrial and service sectors and it will have an indirect and/or spillover effect on the agricultural sector. To analyze this productivity effect of ICT, we need a sector specific data on productivity. However, to the maximum knowledge of this researcher, there is no such data available in the case of Ethiopia. Therefore, we should look for a proxy country. For this case, Mali is suitable to be our proxy because it shares many geographical and economic characteristics with Ethiopia. For instance, both countries are among the least developing in Africa. Geographically, both are land locked. 80% of the people in each country

are predominantly engaged in agricultural activities and the contribution of agriculture to GDP in each of them is more than 40%.

The GDP Purchasing Power parity per capita, i.e., the value of all final goods and services produced within the country in a given year divided by the average (or midyear) population for the same year, for Mali stands at $1128 being 168th and for Ethiopia at $ 1093 being 169th (World Bank, 2011) The same is also reported by the yearly book of IMF. Even though the telecommunication sector of Mali has been privatized since 2000, the sector is currently led by the France Telecom Company and the same is true for Ethiopia.

Since more than half of Tele concentration is around the capital cities, both of them focus on rural development and are investing largely on it. In both countries the rate of mobile telephone growth is greater than 95%. According to the International Telecommunications Union (2008), the rate of internet users in both countries is below 0.5%. By ITU report, Ethiopia and Mali score 0.1 and 0.09, respectively, with the scale measurement of 1 as the highest ICT access so that they are categorized under low access to ICT category. Therefore we can use the productivity elasticity of Mali on the ICT sector to analyze the case of Ethiopia. In Mali, the productivity elasticity of the agriculture, industry and service sectors on average is, 0.5%, 0.5% and 1%, respectively. (Estache, et al 2007).

Simulation 4 Increase both In Investment and Productivity

The fourth simulation assumes what will be the combined effect if the economy experiences both increment in investment by 18.2% and productivity using the case of Mali, i.e, if the agriculture grows by 0.5%, the industries by 0.5% and service sector by 1%. In all cases we assume that government consumption is fixed.

4.2 Interpretation of Results

4.2.1 Effects on Macroeconomic variables

In Table 2, the summary of simulation results of major macroeconomic variables in comparison to the base line simulation is given. These variables are real GDP at factor cost (GDPFC2) and real GDP at market price (GDPMP), absorption (ABSORP), fixed investment (FIXINV), private consumption (PRVCON), government consumption (GOVCON), real exports, real imports and the real exchange rate (REXR)

Table 2: The impact on the macroeconomic variables

	Initial	Sim 0	Sim 1	Sim 2	Sim 3	Sim 4
ABSORP	*457.74*	*9.4*	*9.55*	*9.61*	*10.35*	*10.4*
PRVCON	338.61	8.61	8.6	8.69	9.53	9.42
FIXINV	*85.49*	*13.5*	*14.17*	*14.17*	*14.77*	*15.36*
GOVCON	31.82	5.7	5.7	5.7	5.7	5.7
EXPORTS	*52.14*	*19.8*	*19.74*	*19.36*	*21.81*	*21.65*
IMPORTS	-126.51	11.95	12.15	12.24	13.13	13.26
GDPMP	*383.36*	*10.28*	*10.37*	*10.33*	*11.37*	*11.35*
GDPFC2	354.95	10.4	10.47	10.41	11.5	11.47
REXR	*78*	*-0.1*	*-0.2*	*-0.4*	*-0.1*	*-0.3*

Source: own calculation

In simulation 1: Investment is financed by both domestic and foreign savings, the absorption rate increased by 0.15% from the base due to the fact that even though the private consumption declined, the fixed investment has shown a significant improvement. Since this investment will be financed from the increased domestic saving, private consumption will decline by 0.01% from the base simulation.

On the other hand, due to the appreciation of the domestic currency to 0.2%, mainly by the intrusion of foreign currency into the economy, export rate declined from 19.8% to 19.74% and the import rate increased from 11.95% to

12.15%. Generally, GDP at market price and the GDP at factor cost increased by 0.09% and 0.07%, respectively, from the base.

In simulation 2, Where the investment is fully financed by foreign savings, the economy faces the worst scenario. Since there is much inflow of money from abroad, the absorption, private consumption and fixed investment rates will increase by 0.06%, 0.09% and 0.67%, respectively. However there will be a serious appreciation of the domestic currency by 0.4%. This in fact leads to the decline in export by 0.44% and the increment in import by 0.29%, which is even greater than Simulation 1. That in turn will affect the net export negatively widening the gap in the trade balance. There is no change in the rate of fixed investment. Even though GDP at market price and GDP at factor cost deviate positively from the base by 0.05% and 0.01%, in that order. It is even less than that of simulation 1 by 0.04% and 0.07%, respectively.

Simulation 3: The impact of productivity in the economy has an astonishing result. The improvement in the economy emerges from the improvement in productivity.

It is assumed that this improvement of productivity comes from situations like efficient use of the working hour, trainings to upgrade the performance of workers, reduced unemployment, better working environments, by learning more efficient, updated and easy ways of ICT applications and better security in the country. We assume the combination of these situations bring the productivity. Taking Mali as our standard, TFP will increase by 0.5% both in agriculture and industrial sectors and by 1% in the service sector. This has a very impressive result than the rest of the simulations almost in all dimensions.

The improvement in production leads to more supply and demand. That is why the domestic absorption has increased from the base by 0.95%. Since there is more household income there will be more consumption and in our simulation private consumption increased by 0.92%.

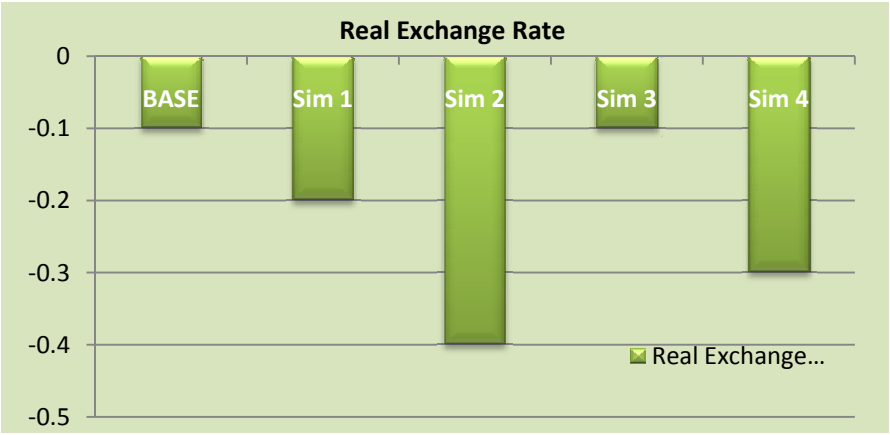
The increase in productivity in every sector attracts more investment every year. Both export and import will rise due to improvement of production on exportable commodities and increase in demand for imported goods by 2% and 1.18%. Moreover, since the real exchange rate is equal with the base, due to absence of inflow of foreign currency, it will be in favor of export so that the trade balance and the GDP will improve.

Simulation 4: This is the combination of investment, domestic and foreign saving, and productivity. The economy faces the increment in investment by 18.2% every year plus the increment in productivity of the sectors as mentioned above. One may expect a very high increment in GDP compared to simulation 3. Nonetheless, the massive growth in import will lead to the deterioration of the trade balance and the reduction of GDP. Import will grow more than any other time. Besides, the domestic financing will reduce the private consumption, which hinders the GDP growth as a component. In fact, due to the flow of foreign saving from abroad there will be high absorption and fixed investment that is greater than the previous simulation by 0.05% and 0.59%, respectively. Due to high appreciation of the domestic currency, which is 20% greater than simulations 1 and 3, import will be favored. At the end of the day, even though there is a high growth in GDP both at factor cost and market price, it ends up being lower than simulation 3 growing by 11.47% and 11.35%, respectively.

4.2.2 Effect on the Real Exchange Rate

Real exchange rate is an exchange rate that is adjusted to inflation. There are lots of factors that may cause the appreciation or depreciation of the domestic currency. In our simulations, the basic shock is the inflow of foreign currency into the economy that directly leads to the appreciation of the domestic currency.

Figure 1: The effect on exchange rate



In simulation 1, foreign saving started to increase by 22.1% every year from 6% at the base. This will lead to the appreciation of domestic currency by 0.1% from the base. In simulation 2, there is more foreign saving than in simulation 1; foreign saving is increased to 35% from the base 6% to finance the investment alone. This will lead to the appreciation of domestic currency from 0.1% to 0.4%. In simulation 3, there is not any intrusion of foreign currency into the economy. The fourth simulation, on the other hand, has the second largest appreciation, 0.3%, next to simulation 2. This is partially because of the increase in foreign saving and partially due to a high rate of increase in export in comparison with simulation 1 and the rate of import increment which will attract more foreign currency into the country that further aggravates the appreciation of the domestic currency.

5. Recommendations

As can be seen from the simulation results, though there is a difference in magnitude, the economy experiences a positive impact from investment in ICT. If the government wants to get the maximum positive impact from the sector, it should inevitably involve itself in looking for mechanisms to improve the productivity of factors. The outcomes of the simulation indicate that without

increases in productivity, investment by itself almost equals nothing. If there is stagnation in productivity, investment ends to be a mere installation of equipment and a future burden when financed from foreign direct investment.

On the other hand, it is better for the government to finance its capital expenses through domestic saving than through foreign saving unless it wants to increase the consumption expenditure of households because financing through foreign saving results in much appreciation of domestic currency and decline in export. It has also the lowest sectoral impact and the return to factors of production will be lower and the debt will be a burden to be paid by the coming generation.

To ensure food security, generate rural employment, promote and facilitate the development of a globally competitive agro-business industry, acquire information on weather forecasting, farming productivity and access to national and international market prices, the government should empower farmers to employ modern and up-to-date ICT.

But the government alone may not be able to finance the capital investment. We have also seen that trying to finance such kind of investment using foreign saving diminishes the growth rate of the economy.

This implies that domestic private investors should take part in the investment with a policy of gradual introduction of competition. In the industrial sector, for instance, to develop a viable knowledge-based ICT production and development industry, to increase the efficiency of the operations of the industrial sector, to improve the range of products produced, to enable the sector to make an increasing contribution to export earnings and supply the domestic market at competitive prices, ICT plays an indispensable role. However, the installation process and the step to upgrade productivity need a coordinated effort from government and the private sector.

The Ethiopian communications market has seen significant improvements, but it has been of a very low base and it still faces considerable challenges. Therefore, to develop a competitive high value-added service sector in general and that of communication in particular, highly skilled and experienced manpower should be available to deal with complex ICT networks, market regulation and policy issues and to implement large socio-technical projects like the "Schoolnet" and "Woredanet". Moreover, the quality of service provision should be of high standard to cope with the competition arising from the external world.

References

Annabi, N., Cockburn, J. and Decluwe, B. (2004). "A sequential Dynamic CGE Model for Poverty Analysis" *Applied Energy,* 86, pp. 388–396

Antonio Estache, Jean-François Perrault, and Luc Savard. (2007). Impact of Infrastructure Spending in Mali: A CGE Modeling Approach Cahier de recherche / Working Paper 07-24

Bhatnagar, S. (2005) ICT Investments in Developing Countries: An Impact Assessment Study, Information Technology in Developing Countries, Newsletter of the IFIP Working Group 9.4, 15, 2, 1-8..

Checchi, R. M, Hsieh, J. J. P. A and Straub, D. W. (2003). Public IT Policies in Less Developed Countries: A Critical Assessment of the Literature and a Reference Framework, *Journal of Global Information Technology Management*, 6, 4, 45-64.

Daveri F. (2000). Is growth an Information Technology story in Europe too? IGIER Working Paper, No.168

Dedrick, J., Kraemer, K. L. (2001). The Productivity Paradox: Is it Resolved? Is There a New One? What Does It All Mean for Managers?

Dos Santos, B. L. (1991). Justifying Investments in New Information Technologies, *Journal of Management Information Systems*, 7, 4, 71-89.

Ermias Engida, Seneshaw Tameru, Eyasu Tsehaye, Dario Debowicz, Paul Dorosh, and Sherman Robinson. (2011). Ethiopia's Growth and Transformation Plan: A Computable General Equilibrium Analysis of Alternative Financing Options: Available from http://www.ifpri.org/sites/default/files/publications/esspwp30.pdf

Ethiopian Development Research Institute Ethiopia. (2009). Input Output Table & Social Accounting Matrix, December

FAO. (2003). WTO Agreement on Agriculture: The Implementation Experience - Developing Country Case Studies (Rome: Food and Agriculture Organization).

Foster Vivien and Morella Elvira. (2010). Ethiopia's Infrastructure: A Continental Perspective, Washington, DC 20433 USA

Gholami, R, Moshiri, S. and Lee, S. Y. T. (2004). ICT and Productivity of the Manufacturing Industries in Iran, *Electronic Journal of Information Systems in Developing Countries*, 19, 4, 1-19.

International Telecommunication Union. (2008). ITU Digital Access Index: World's First Global ICT Ranking Education and Affordability Key to Boosting New Technology Adoption.

Available from www.en.wikipedia.org/wiki/international_telecommunication_union

Jorgenson, D. W., and K. Stiroh. (1995). Computers and growth. Economics of Innovation and New Technology 3:295-316.

Kodakanchi, V., Abuelyaman E., Kuofie, M. H. S and Qaddour, J. (2006). An Economic Development Model for IT in Developing Countries, *Electronic Journal of Information Systems in Developing Countries*, 28, 7, 1-9.

Lishan Adam. (2010). Ethiopia ICT Sector Performance Review 2009/2010 *Volume Two, Policy Paper 9.*

Lofgren, H., Harris, R. L., Robinson, S. With EL-Said, M. And Thomas, M. (2002). A Standard Computable General Equilibrium (CGE) Model in GAMS, Microcomputers in Policy Research, 5. International Food Policy Research Institute, Washington DC.

Mansell, R. and U. Wehn (eds.) (1998). *Knowledge Societies: Information Technology for Sustainable Development,* Oxford: Oxford University Press.

Mbarika, V.W, Kah Muhammadou, M. O., Musa, P. F., Meso, P. and Warren, J. (2003). Predictors of Growth of Teledensity in Developing Countries: A Focus on Middle and Low-Income Countries, *Electronic Journal of Information Systems in Developing Countries*,

Mingat A. & Winter C. (2002): L'éducation pour tous en 2015, Finance et développement, FMI, pp 32-35, Mars.

Ministry of Finance and Economic Development (MoFED). Growth and Transformation Plan (GTP) 2010/11-2014/15 of The Federal Democratic Republic of Ethiopia (2010), Addis Ababa

Morawczynski, O. and Ngwenyama, O. (2007). Unraveling the Impact of Investments in ICT, Education and Health of Development: An Analysis of Archival Data of Five West African Countries Using Regression Splines, *Electronic Journal of Information Systems in Developing Countries*, 29, 5, 1-15.

OECD. (2001). Measuring Productivity: Measurement of Aggregate and Industry-Level Productivity Growth. Available from http://www.oecd.org/dataoecd/59/29/2352458.pdf.

OECD. (2004). The Economic Impact of ICT, Measurement, Evidence and Implications. Available from http://www.oecd.org/bookshop?pub=922004051P1.

OECD. (2009a). Guide to Measuring the Information Society. Available from www.oecd.org/sti/measuring-infoeconomy/guide.

OECD. (2009b). Measuring the Relationship between ICT and the Environment. Available from http://www.oecd.org/dataoecd/32/50/43539507.pdf

Palstev, S. (2004). "Moving from Static to Dynamic General Equilibrium Economic Models", MIT Technical Notes on No.4

Pohjola, M. (2000). Information Technology and Economic Growth: A Cross-Country Analysis. WIDER/ UNU Working Paper series: WP173, January 2000.

Pohjola, M. (ed.) (2001). Information Technology, Productivity and Economic Growth: *International Evidence and Implications for Economic Growth*. Oxford University Press April 2001.

Roztocki N and Weistroffer H. R. (2004). Evaluating Information Technology Investments in Emerging Economies Using Activity-Based Costing, *Electronic Journal of Information Systems in Developing Countries*, 19, 2, 1-6.

Roztocki, N., Pick, J. and Navarrete, C. (2004). IT Investments in Developing Countries: Editorial Introduction, *Electronic Journal of Information Systems in Developing Countries*, 19, 1, 1-3. Network Development: Role of Regulators. Pp. 141-176.

Strassmann, P. A. (1985). Information Payoff: The Transformation of Work in the Electronic *Age*, Free Press, New York.

Thurlow, J. (2004) A Dynamic Computable General Equilibrium (CGE) Model for South Africa: Extending the Static IFPRI Model Working Paper 1-2004.

UNCTAD. (2010). Information Economy Report 2010: ICTs, Enterprises and Poverty Alleviation. United Nations. New York and Geneva. Available from http://www.unctad.org/ier2010.

Weill P., Subramani, M. and Bradbent, M. (2002). Building IT Infrastructure for Strategic Agility, *MIT Sloan Management Review*, 44, 1, 57-65.

World Bank. (2009). Information and Communication Technologies for Development: Extending Reach and Increasing Impact. Available from http://go.worldbank.org/NATLOH7HV0

World Bank. (2011). List of countries by GDP (PPP) per capita, Available from www.en.wikepedia.org/wiki/List_of_countries_by_GDP_(PPP)percapita

Appendices

Appendix 1: Change in Factor income

	INITIAL	BASE	Ict	fsav	pro	invpro
flab-sk	20.48	7.07	7.1	7.07	6.45	6.35
flab-ss	57.05	10.3	10.5	10.34	11.3	11.31
flab-un	39.4	10.3	10.36	10.34	11.22	11.13
flab-ag-hc	32.69	9.18	9.13	9.14	10.01	9.85
flab-ag-ho	7.96	10.64	10.58	10.58	11.55	11.37
flab-ag-dp	12.24	9.02	8.98	8.97	9.84	9.69
flab-ag-pa	4.2	9.09	9.05	9.06	9.98	9.82
fcap	110.32	9.83	10.09	10.01	10.75	10.88
flnd-hc	21.63	11.12	11.08	11.04	12.21	11.99
flnd-ho	6.31	11.86	11.8	11.72	13.01	12.78
flnd-dp	7.02	11.08	11.04	11	12.22	11.99
flnd-pa	4.8	9.6	9.57	9.56	10.68	10.48
fliv-hc	17.33	11.72	11.48	11.73	12.51	12.47
fliv-ho	5.36	11.91	11.66	11.92	12.71	12.67
fliv-dp	5.92	11.88	11.63	11.89	12.68	12.64
fliv-pa	2.24	11.95	11.71	11.97	12.76	12.72

Appendix 2: Change in Households income

	INITIAL	BASE	ict	fsav	pro	invpro
hh-hc-pr	29.505	9.743	9.686	9.709	10.613	10.483
hh-hc-np	109.91	9.798	9.868	9.843	10.694	10.661
hh-ho-pr	15.67	10.321	10.34	10.318	11.252	11.169
hh-ho-np	42.786	10.174	10.293	10.234	11.113	11.108
hh-dp-pr	18.033	9.76	9.752	9.757	10.65	10.558
hh-dp-np	41.009	9.877	9.973	9.936	10.79	10.772
hh-pa-pr	3.782	9.73	9.699	9.722	10.668	10.547
hh-pa-np	19.532	9.844	9.925	9.898	10.782	10.748
hh-nf-pr	6.941	9.582	9.759	9.676	10.431	10.459
hh-nf-np	47.838	9.002	9.163	9.088	9.603	9.626
hh-lu-pr	3.826	9.043	9.209	9.13	9.81	9.835
hh-lu-np	35.539	8.086	8.237	8.162	8.572	8.596

Appendix 3: Consumption Expenditure

	INITIAL	BASE	ict	fsav	pro	invpro
flab-sk	20.48	7.07	7.1	7.07	6.45	6.35
flab-ss	57.05	10.3	10.5	10.34	11.3	11.31
flab-un	39.4	10.3	10.36	10.34	11.22	11.13
flab-ag-hc	32.69	9.18	9.13	9.14	10.01	9.85
flab-ag-ho	7.96	10.64	10.58	10.58	11.55	11.37
flab-ag-dp	12.24	9.02	8.98	8.97	9.84	9.69
flab-ag-pa	4.2	9.09	9.05	9.06	9.98	9.82
fcap	110.32	9.83	10.09	10.01	10.75	10.88
flnd-hc	21.63	11.12	11.08	11.04	12.21	11.99
flnd-ho	6.31	11.86	11.8	11.72	13.01	12.78
flnd-dp	7.02	11.08	11.04	11	12.22	11.99
flnd-pa	4.8	9.6	9.57	9.56	10.68	10.48
fliv-hc	17.33	11.72	11.48	11.73	12.51	12.47
fliv-ho	5.36	11.91	11.66	11.92	12.71	12.67
fliv-dp	5.92	11.88	11.63	11.89	12.68	12.64
fliv-pa	2.24	11.95	11.71	11.97	12.76	12.72

TOBIT ANALYSES OF IMPROVED LOCAL SEED SYSTEM (ILSS) ADOPTION AND ITS MARKETING: The Case of Wheat in Meskan and Sodo Woredas, Gurage Zone

Shimelis Araya [1]

Abstract

This study determines decision variables which significantly constrain farmers' adoption of improved local seed system (ILSS) and seeks to analyze farmers' level of participation in seed marketing in Meskan and Sodo woredas of Gurage zone. Primary data were obtained using structured interview from 130 respondents. Descriptive and econometric (Tobit model) methods were employed to analyze the data. The descriptive analysis reveals that on average education, age, gender, farm size, livestock ownership, household labor, access to training, credit, off–farm activities, and market distance were found to be statistically associated with adoption behavior of farmers. Empirical estimates reveal that, intensity of adoption was influenced by age, market distance, farm size, livestock ownership and having experience in seed production. Farmers evaluate the formal seed supply system with local seed system in providing seed at the right quantity, time and quality and they were in favor of the later. Thus, giving emphasis for farmers–based seed production and marketing system as an alternative seed source has paramount importance in satisfying the seed demands of smallholder farmers. But, majority of seed producing farmers in the study areas have complained that they received low prices for their produce. Farmers should be assisted to establish linkages in effective seed marketing arrangements in their local areas and they should be consulted in the determination of price for their produce.

Key words*:* Adoption, Local Seed, Seed Market, Tobit Model

[1] Department of Economics, Hawassa University, Ethiopia, P.O. Box 05, Hawassa, Ethiopia, Tel.: +251 925 53 48 56
Email Address: araya.gedam@gmail.com

1. Introduction

Agricultural production is the main source of income and food for a large share of the world's population. But, the limited level of agricultural markets development, inefficient seed systems and poor management of crop genetic resources lie at the heart of food insecurity problem especially in the Sub-Saharan Africa (Godfrey and Bahiigwa, 1999; Samuel and Sharp, 2008). Similarly, the rate of use of improved seed in the region is at a very low level (CTA, 1999; Ndjeunga *et al.,* 2000; Kibiby *et al.,* 2001). One reason might be poor genetic resources management and limited development of local seed markets (Rohrbach, 2003).

According to many recent studies (World Bank, 2005; Diao and Pratt, 2006; Byerlee *et al.,* 2007; Spielman *et al.,* 2011), any strategy slashing food insecurity problems and in turn poverty must focus on generating rapid investment and increasing productivity in the agricultural sector. Growth in staple crops is given a priority because of its superior capacity in affecting production and consumption choices of the rural people. To this end, a vibrant seed system that provides the required amount and quality seeds at the right time to meet the demands of smallholder farmers is an essential and instrumental for continued economic and social development.

Broader framing of seed systems has appeared more in conceptual and empirical discussions of Sperling (2000) and Weltzien and von Brocke (2001). The seed systems can either be formal or informal. Formal systems are externally regulated through the application of rules and regulations (Jones *et al.*, 2006; Abebe *et al.,* 2011) whereas the informal seed system operates under non–formal law regulated set–up and characterized by farmer to farmer seed exchange, semi-structured, and usually deal with low quality and smaller quantities of seed exchange (Sperling and Cooper, 2003; Abebe *et al.,* 2011).

The government of Ethiopia adopts various interventions to reduce the extent of food insecurity and poverty at national and household level under the millennium development goals (MDGs) by 2015. In 1992, the government established the agricultural development- led industrialization (ADLI) strategy, which emphasized on the role of the agricultural sector as a catalyst for immediate food security improvement and long- term and broad economic growth (Diao and Pratt, 2006). The Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) and the Growth and Transformation Plan (GTP), Ethiopia's strategic frameworks for 2005/06 - 2009/10 and 2010/11 - 2014/15 respectively rely on a massive push to accelerate growth. This is to be achieved mainly by commercialization of agriculture based on supporting the intensification of marketable farm products (PASDEP, 2005; GTP, 2010).

Within the framework of ADLI strategy, the government mostly tries to boost crop yields through the delivery of improved seeds and other inputs using the formal sector (Byerlee *et al.,* 2007; Abebe *et al*., 2011; Dawit, 2011a). About 80 - 90% seed used by Ethiopian smallholders' farmers is saved on–farm, borrowed, or purchased locally. This indicates the share and use of improved seed is only around 10% (Abdissa, *et al.,* 2001; Yonas *et al*, 2008; Dawit and Tripp, 2010). For smallholder farmers, the biggest constraints are high seed prices and late delivery, exacerbated by poor rural infrastructure making it hard to reach farmers in remote villages to access improved seed and other agricultural inputs (Abdissa, *et al.,* 2001; Thijssen *et al.,* 2008; Dawit, 2011a).

In Ethiopia, the share and use of improved seed is only around 10% (Spielman *et al.,* 2011). The remaining is covered by the informal sector or purchased locally (Yonas *et al*, 2008). The formal system started five decades ago as an ad hoc extension activity by academic and crop research institutions (Getinet *et al.,* 2001; Dawit *et al.,* 2011a). This leads to the establishment of the Ethiopian Seed Enterprise (ESE) in 1979. Since then, the ESE has remained the main seed producer and supplier of seed (Abebe *et al.,* 2011). But ESE was satisfying only 3% of the nation’s demand (Table 1. below). The informal sector, on the other

hand, is incapable of producing quality seed even though acquired relatively at low prices (Jones *et al.,* 2006; Sahlu *et al*., 2008). The need to improve the seed system is more critical. That means, access by farming households to adequate quantities of good quality seeds of the desired type at the right time and reasonable price is central element (Dawit and Tripp, 2010; Dawit, 2011b).

Table 1: Area Planted with improved Seeds in Ethiopia (2005/2006)

Crops	Total Area (ha)	Area covered with	
		Ha in improved Seed	Percent (%)
Cereals	8, 463, 080	335, 369	4.0
Pulses	1, 378, 939	5, 025	0.4
Oil Crops	740, 847	4, 056	0.6
Vegetables	95, 194	559	0.6
Root Crops	188,917	2, 114	1.1
Others (temporary)	97, 677	102	0.1
Total	10, 964, 654	347, 225	3.2

Source: Central Statistical Authority (CSA), 2007

The capacity of the formal seed sector is limited to supply the national wide demand and thus imposes high costs on farmers (Yonas *et al*, 2008; Dawit and Tripp, 2010). On the other hand, the informal sector which includes farm saved seeds, seed exchanges among farmers through unorganized local market and other social networks, is incapable of producing improved seed even though acquired relatively at low prices (Jones *et al.,* 2006; Sahlu *et al*., 2008; Thijssen *et al*., 2008; Abebe *et al*., 2011).

Recently, improved local seed system (ILSS) with the aim of overcoming the weakness of the formal seed sector has been adopted to gain locally availability of improved seed on a sustainable basis in various parts of the country. By the support of development partners for the growth of business–oriented seed enterprises, Ediget Seed Production and Marketing Union (ESPMU), which was established by 15 seed production and marketing cooperatives in Guraghe and Silite Zones of South Nations Nationalities and Peoples Region (SNNPR) in 2009 with 60% of cooperatives were in the former (Dawit, 2011b). Mareko, Meskan

and Sodo are the three administrative woredas in Gurage Zone where the nine cooperatives were based.

This effort increases access of improved seed to farmers within the shortest time and low cost. To increase locally availability of improved seeds, the system needs to be scaled–up. But, identifying the factors that determine farmers' adoption of improved local seed production and assessing the seed marketing system is not well studied in these woredas. Therefore, this study mainly intends to identify the determinants of smallholder farmers' adoption of improved local wheat seed production system and assesses the improved local seed market situation in Meskan and Sodo Woredas of Gurage Zone. The information will assist to extend seed producers involvement and extension specialists to develop suitable means for farmers' access to improved seed.

2. Literature Review

2.1 The Seed System

The term seed system represents the entire complex organization ranging from processing and development to marketing of seed in any country. That means, at minimum, the industry has four components: 1) plant breeding research 2) seed production and multiplication, 3) processing and storage, and 4) marketing and distribution. The system's overall performance depends on the efficiency of each component. Seed system participants may be relatively few or many, predominantly public or private depending upon the farmers that the system serves (Maredia *et al.,* 1999; Abdissa *et al.,* 2001).

The seed systems can be either a formal or a local/informal/farmers' based seed system. Both systems are operating simultaneously in many developing countries and difficult to demarcate boundary between the two. The organization of the formal seed system was set up with the principal goal of diffusing quality seed of improved varieties developed by formal breeding programs. The principal source of materials for formal breeding programs are the *ex situ* (original) collections of gene banks that are maintained by farmers (Almekinders, 2000; Sperling and Cooper, 2003).

The formal system has been relatively successful for well–endowed, high–potential areas, but much less successful in more variable and marginal areas. The system had lacked understanding about what farmers in these areas need, developing only few, genetically uniform products (Almekinders, 2000; Bishaw *et al.,* 2008). On the other hand, the informal (local) seed system operates under non- formal law regulated set–up and characterized by farmer to farmer seed exchange. It is characterized by traditional, semi-structured, operate at the individual community level, uses a wide range of exchange mechanisms, and usually deal with small quantities of seed often demanded by farmers (Abebe *et al.,* 2011).

In Africa, the majority of farmers mainly get seeds from informal channels. These channels contribute about 90-100% of seed supply depending on the type of crop. As a result, the informal sector remains the major supplier of seed of local varieties for many crops grown by smallholder farmers. Thus, farmers can produce high quality seed provided they have access to initial improved seed stocks and are trained in seed production practices. Improving farmer - based seed production schemes and revitalizing informal seed supply for local crops and varieties is crucial for the development of the seed sector in any country. It is therefore important to give due recognition to the informal sector a low - cost source of seed, and to use it as a vehicle for providing resource - poor farmers with improved seed of modern varieties at affordable prices (Kibiby *et al.,* 2001; Setimela *et al.,* 2004; Thijssen, *et al.,* 2008).

Links between the informal and formal seed system are then established to develop a favorable environment for smallholder farmers to get in to the seed business. The recognition of the strengths of farmers' seed systems and their complementary with the formal system should be taken as a starting point for transforming the smallholder farmers group into market oriented seed enterprise (business) dedicated to the production of seed of improved varieties. The replacement of local grain used as seed with better quality

produced by local farmers will make the benefit huge in terms of income generation and accessibility of locally adapted improved seed at a low cost.

2.2 Theoretical and Empirical Foundations of Adoption

Essentially adoption is a process that involves learning about the improved technologies overtime. In the work of Feder *et al.,* (1985) adoption can be defined *as* giving up old production techniques and applying new or modern ones. Such acceptance of new technologies by farmers will contribute to the improvement of the economic condition of households. Much scholarly interest on adoption falls in two categories: the decision to adopt, and intensity of adoption. Decision of adoption is about how the farmer perceives use of the new technology whereas the intensity of adoption refers to the level of use of a given technology. Intensity of adoption studies not only the decision to use but also how much to apply that is often more important. It shows level of resource allocation to the new technology (Kaliba *et* al., 2000; Abera, 2008).

Studies show that different factors significantly determine adoption in Ethiopia. The most important variables considered in adoption studies were gender, education, and age of household heads, household labor, farm size, livestock asset, engaging in off–farm activities, frequent extension contact, access to road and market center, access to credit and training on agricultural technologies among others were found to be significant in influencing adoption (Mulugeta *et al.* 2001; Abdissa *et al.,* 2001; Million and Belay 2004; Abera, 2008; Sinafikeh *et al*. 2009; Alemitu 2011).

3. Research Methodology

3.1 Study Area, Sampling Procedure and Data Source

The study was conducted in Meskan and Sodo woredas of Gurage zone, which is one of the 14 administrative zones in Southern Nations, Nationalities, and People's Regional State (SNNPRS), Ethiopia. Meskan and Sodo are neighboring woredas and administratively divided into 40 and 55 kebeles and population

size of having 165,101 and 151,870 with a population density of 369 and 172 people/km^2 respectively (BoFED, 2009). A multi–stage sampling technique was used to select sample of farmers. A total sample size of 130 households was interviewed. The study made use of both qualitative study and structured interviews to collect data. Descriptive statistics was mainly used to analyze the functioning of the local seed market situation in the study areas.

Limited dependent variable models (LDVM) are often used in adoption studies. Among these models, Tobit model is very important aspect of analyzing intensity of adoption because it is not only the choice or decision to use but also how much to apply that is often more important. It has been popular in handling such a situation and employed to analyze determinants of intensity of adoption in this study. The general formulation of the censored regression (Tobit) model is:

$$Y_i^* = X'\beta + \varepsilon_i \ ,$$
$$Y_i = Y_i^* \quad \text{if} \quad X'\beta + \varepsilon_i > 0$$
$$Y_i = 0 \quad \text{if} \quad X'\beta + \varepsilon_i \leq 0$$

Where ε_i is interpreted as the collection of all unobservable variables that affect adoption and normally and independently (NID) with zero mean and a constant variance, and β is the parameters to be estimated. It is assumed that Y_i and X_i are observed for *i* = 1, 2, 3,…, n but Y_i^* are unobservable if $Y_i^* \leq 0$. Given the conceptual presentation of Tobit, the empirical model used in this study is given as:

Adoption or $Y_i = \beta_0 + \beta_1 GEN + \beta_2 AGE + \beta_3 EDU + \beta_4 EXP + \beta_5 FARMSIZ + \beta_6 TLU + \beta_7 LABOR + \beta_8 OFF + \beta_9 TRAIN + \beta_{10} MOB + \beta_{11} DISM + \beta_{12} DISR + \beta_{13} CRE + \beta_{14} WOR + \varepsilon$

The variables in the model are defined as follows; GEN = gender of the farmer, AGE = age of the household heads, EDU = years of formal education of household heads, EXP = number of year(s) spent as seed producer, FARMSIZ = amount of cropped land (size of farm land), TLU = number of livestock in tropical units, LABOR = household labor size, OFF = availability of off-farm income generating activities, TRAIN = household's access to training on seed production, MOB = farmer's ownership of mobile phone, DISM = distance to local market center, DISR = distance to all-weather roads, CRE = access to credit resource, and WOR = woreda dummy (1= sodo woreda, and 0 = otherwise). According to the findings of various studies on the adoption literatures complementing with economic theory (conceptual model of adoption) and the researcher's knowledge of the farming systems of the study areas, the working hypotheses was structured as follows:

Table 2: Formulation of Hypotheses

Dependent Variable	**Unit/type**	**Description**
Intensity of adoption	land in ha	Amount of land allocated for improved seed production
Explanatory variables		
Variable	***Unit/type***	***Expected sign***
Age of household head	number of years	+/-
Gender of household head	1 if male, and 0 if not	+
Experience on Seed Production	number of years	+
Education of household heads	Education in Years	+/-
Land (farm size)	hectare	+
Off–farm income	1 if off-farm income, 0 if not	+/-
Livestock Ownership	Total Livestock Unit (TLU)	+
Household Labor	number of active labor force	+
Distance from Market center	kilometers	-
Distance from all weather road	kilometers	-
Access to credit	1 if the hh take credit, 0 if not	+
Training	1 if yes, 0 if not	+
Mobile	1 if mobile ownership, 0 if not	+
Woreda_dummy	1 if Sodo woreda, 0 if Meskan	+

4. Results and Discussion

This section presents the survey data and interpretation of the analytical findings. Initially, descriptive analysis of the characteristics of the sample households was discussed. T–tests and chi–square test were used to test the existence of any statistically verifiable difference between seed–producers and non-producers. In addition, the existing seed delivery system and the seed market situation in study areas were analyzed before going to the Tobit analyses.

Table 3: Data Description (Continuous Variables)

Variables	Adoption Status	Meskan Woreda (D. Tuto)			Sodo Woreda (W. Geferssa)		
		Mean	Std. dev	t- value	Mean	Std. dev	t-value
Age	Adopters	37.07	9.63	0.597	38.68	10.78	-2.57**
	Non adopt	35.59	7.89		46.14	12.01	(p= 0.012)
Education	Adopters	6.93	4.92	7.38***	5.24	3.24	5.89***
	Non adopt	0.91	1.53	(p = 0.000)	1.34	2.24	(p = 0.000)
Farm size	Adopters	1.042	0.397	6.79***	2.034	0.75	3.84***
	Non adopt	0.525	0.193	0.000)	1.315	0.74	(p = 0.000)
Household labor	Adopters	4.47	1.46	2.13**	4.60	1.94	2.87***
	Non adopt	3.52	1.50	(p = 0.037)	3.43	1.42	(p = 0.005)
Livestock	Adopters	3.96	2.17	4.73***	7.73	4.15	5.60***
	Non adopt	1.82	1.25	(p = 0.000)	3.40	2.30	(p = 0.000)
Mkt Distance	Adopters	3.67	0.49	- 4.97***	11.39	8.45	- 0.162
	Non adopt	5.43	1.34	(p = 0.000)	11.70	7.39	
Road Distance	Adopters	0.79	0.63	-7.35***	0.58	0.69	- 0.504
	Non adopt	3.38	1.28	(p= 0.000)	0.70	1.06	

Source: Computed from survey data

The t-test and chi-square test result (in Annex 1) shows that education (in both), age (in Sodo), and gender (in Meskan) of households are associated with adoption. Discussion with informant in Meskan woreda revealed that because of labor intensive system of seed production males were highly favored to involve. On average land ownership, availability of household labor, and livestock ownership were significantly associated with adoption behavior in both woredas. Participation in off–farm activities significantly associated with adoption decision of farmers in Meskan woreda. Farmers' access to nearest market center and roads (in Meskan), mobile (in both woredas) is directly related with adoption decision.

4.1 Farmers' Evaluation of the Existing (Formal) and Improved Local Seed System

Seed must reach the farmer at the right time, right place, right amount, and of the highest economic quality to increase agricultural productivity. In the formal system, seed demand is estimated by asking demands of individual farmers and then seed allocated to each *Kebele* in the woreda. Farmers respond that sometimes they purchase varieties which are not adaptable to their agro–ecology. Farmers were asked for their perception about the performance of the existing system in addressing their choice in terms of amount, quality and timely requirement.

The survey result (presented on Table 4 above) shows that among the seed producers group 80%, 53% and 86.7% of farmers in Meskan woreda and 72%, 64% and 84% of sampled farmers in Sodo woreda perceived that they were dissatisfied on the amount of seed they get, quality and timing of delivery respectively. In general, there is no significant difference between seed producers and non–producers' evaluation on the inefficiency of the formal seed delivery system. On the contrary, the survey result indicate that, 87% and 76% of seed producers in Meskan and Sodo woreda respectively responded that they strongly agree on the capacity of the farmers to produce quality seed.

Only 5% of non–producer farmers in Sodo woreda have no confidence on the quality of wheat seed produced by their neighbors.

Table 4: Farmers Evaluation of Existing Seed Delivery System

Evaluation Parameters		Farmers Group	Percentage	
			Meskan	Sodo
Right Quantity	YES	Seed Producers	20.0	28.0
		Non Producers	4.3	13.6
	NO	Seed Producers	80.0	72.0
		Non – Producers	95.7	86.4
Right Quality	YES	Seed Producers	46.7	36.0
		Non Producers	15.2	31.8
	NO	Seed Producers	53.3	64.0
		Non – Producers	84.8	68.2
Right Time	YES	Seed Producers	13.3	16.0
		Non Producers	13.0	13.6
	NO	Seed Producers	86.7	84.0
		Non – Producers	87.0	86.4

Source: Computed from survey data

4.2 Improved Local Wheat Seed Market situation in the Study Area

Information obtained in discussion with seed producers revealed that although the number of seed producers and amount produced increased in both woredas since 2009, the collection or recovery rate of seed, the determination of price, and the lack of clarity and transparency in the allocation of profits and financial benefits to members of the cooperatives have remained unresolved issues in the system.

In the discussion it was revealed that the ESE/SSE through the Woreda Agricultural Office (WAO) contracted farmers to produce wheat seeds of different varieties by organizing in cooperatives by taking in to account their

adjacent (neighboring) plots in order to produce quality seed. For this purpose, Zerfeya and Wudiget, which are the two seed producers' cooperatives (SPCs) established in Meskan and Sodo woredas respectively. The Woreda Agricultural Office usually fix the purchase price of improved seed produced by members of the cooperatives locally at a 15% above the prevailing grain price at harvest.

These cooperatives are organized in order to alleviate problem of market for member seed producers and supplying to other farmers with seeds of required quality at reasonable price that adapted to the local area. But, the lack of understanding and implementing long–term business plans, the SPCs develop dependency on public services in areas of business. The marketing linkage with the local seed demander (non–adopters) was poor. This increases improved seed insecurity of non–members, narrows the market size and shrinks the profitability of member farmers. Seed Producer cooperatives for the lack of transparency blame the functioning of the seed market and the process of pricing of the public sector. Only 18% of seed producers respond that the selling price is attractive.

4.3 Econometric Analysis

In the previous section, the descriptive analysis identifies factors affecting the adoption of improved local wheat seed production system. But, it is not enough to stimulate policy actions unless the relative influence of each factor is known for priority based intervention. The econometric analysis addresses the study of major determinants that affect the intensity of adoption. The intensity of adoption in this study is measured in the amount of crop land in hectare allocated for improved seed production. Before running the model, explanatory variables were checked for problems of multicollinearity, hetroskedasticity, and endogeneity. No problems in the data were observed.

The maximum likelihood estimates of coefficients and significant levels are presented in Table 5 below. The chi–square goodness–of–fit test statistics of

the model show that the model fits the data with significance at 1% level. This shows that the independent variables are relevant in explaining the farmers' decision to intensify adoption. Test (t-test) of the parameter estimates indicates that the decision to adopt is mainly influenced by five variables: age, farm size, livestock ownership, distance from the nearest market center, and experience in local seed production. The interpretation of the coefficients is not as straight forward as in ordinary least square (OLS) regression analysis and to this end, the marginal effect of explanatory variables was estimated (found in the sixth column).

Table 5: Maximum Likelihood Estimates of Tobit Model

Variables	Coef.	Std. Err.	t	P–value	Marginal effects
Constant	- 0.436	0.335	- 1.30	0.196	-
GEN	0.076	0.186	0.41	0.682	0.063
AGE	- 0.012	0. 006	- 2.05	0.043**	- 0.010
EDU	0.004	0.015	0.25	0.805	0.003
EXP	0.204	0.045	4.58	0.000***	0.170
OFF	0.033	0.127	0.26	0.797	0.028
FARMSIZ	0.365	0.087	4.19	0.000***	0.304
TLU	0.044	0.014	3.21	0.002***	0.037
LABOR	0.016	0.033	0.49	0.627	0.013
TRAIN	0.071	0.117	0.61	0.546	0.059
MOB	0.098	0.137	0.71	0.476	0.081
DISM	- 0.026	0.013	- 2.00	0.048 **	- 0.022
DISR	- 0.047	0.061	- 0.78	0.439	- 0.039
CRE	0.109	0.104	1.05	0.296	0.091
WOR	- 0.059	0.127	- 0.46	0.644	- 0.049
Log likelihood = -14.201654			Number of obs = 130		
			LR chi^2 (14) = 184.49		
Uncensored Observations = 40			Prob > chi^2 = 0.0000		
Left - censored Observations = 90			Pseudo R^2 = 0.8666		

***and ** are significant at 1% and 5% respectively.

The coefficient of age was negative and significant at 5% level. This implies that younger households are found to be better adopters. The result satisfies a

priori expectation. Moreover, a one year increase in the age of the household head reduces the amount of land allocated for seed production by 0.01 hectare. This is consistent with findings of Abera (2008).

Livestock ownership has been documented in various studies to be an important factor in technology adoption (Abera, 2008; Asfaw *et al.,* 2011). This finding also supports previous studies and the coefficient of the variable agrees with the *priori* expectation and significant at 1% level. A one unit increases in livestock ownership increases adoption intensity by 0.037 hectare. In addition, farm size was also significant at 1% level and positive in explaining the intensity of adoption. For a unit increase in farm size, adoption intensity increased by 0.304 hectare.

The distance of the household from the nearest input and output market center found to be negatively explaining the intensity of adoption at 5% level of significance. A unit distance increase into local market center reduces intensity of adoption by 0.022 hectare. The report of finding of Alemitu (2011) agrees with the finding of this study. Finally, for every additional year the farmer spent as seed producer, the intensity of adoption increased by 0.170 hectare. The result satisfies a *prior* expectation. Because one cannot rule out the possibility that households have learnt by their experience.

5. Conclusion and Recommendations

In Ethiopia, the adoption of modern agricultural technologies by smallholder farmers that constitute the overwhelming majority in the sector is low. This study has examined the major determinants which affect smallholders' adoption of improved local wheat seed production and assesses their participation in seed marketing system in Meskan and Sodo woredas of Gurage Zone. A total of 130 respondents consisting of adopters and non - adopters were interviewed. Econometric analysis of decision variables reveal that age,

farm size, livestock, distance to market center and seed production experience are statistically significant variables influencing the intensity of adoption.

Farmers who have access to training on agricultural technologies and credit services (in Sodo woreda) are significantly associated with adoption decision. Similarly, experience on seed production activities helps to acquire knowledge and information on seed production. All these imply two major things: farmers do have liquidity problems so that a need for financial capacity building; and information is a key factor for technology adoption. Finally, farmers perceived that local seed system provides seed at the right amount and time of seed needed.

The results obtained from this study can be used to show some intervention areas, even if a more detailed study of area coverage and depth is required to arrive at conclusive policy recommendations. Improved seed has to be made available to farmers on a continuing basis. For the new entrants, emphasis on facilitating linkages with experienced farmers should intensify adoption. Giving emphasis for farmers-based seed production and marketing system as an alternative seed source has paramount importance in satisfying the seed demands of smallholder farmers. In addition, farmers should be assisted to establish linkages in effective seed marketing arrangements in their local areas. This enabled farmers to handle the responsibility of their own seed marketing without the intervention of the public.

References

Abdissa, G., A. Girma, H. Verkuijl and M. Mwangi. (2001). Farmers' maize seed systems in Western Oromia, Ethiopia. Mexico, D. F.: International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO).

Abebe, A. and Lijalem K. (2011). Recent Development in seed systems of Ethiopia. In (eds) Dawit, *et al.* (2011). Improving Farmers Access to Seed. EIAR - JICA Cooperation FRG II Project Empowering Farmers' Innovation Series No. 1

Abera, H. B. (2008). Adoption of improved teff and wheat production technologies in crop - livestock mixed systems in northern and western Shewa zones of Ethiopia, thesis, University of Pretoria.

Alemitu, M. (2011). Factors affecting adoption of improved haricot bean varieties and associated agronomic practices in Dale woreda, SNNPRS. Hawassa University

Asfaw, S., B. Shiferaw, F. Simtowe, and M. Gebretsadik. (2011). Agricultural technology adoption, seed access constraints and commercialization in Ethiopia. *Journal of Development and Agricultural Economics* Vol. 3(9), pp. 436 – 447

BoFED. (2009). Regional Statistical Abstract: Coordination Bureau of Finance and Economic Development. Hawassa, SNNPRS, Ethiopia

CSA. (2007). Reports on area and production for major crops, 2000–2007. Central Statistical Authority. Addis Ababa, Ethiopia

CTA (Technical Center for Agricultural and Rural Cooperation). (1999). The role of smallholder farmers in seed production system. Report and recommendation of study visit to Zimbabwe, 15-26 February 1999

Dawit, A. (2011a). The Political Economy of Ethiopian Cereal Seed Systems: State Control, Market Liberalization and Decentralization. Future Agricultures Consortium (FAC), Policy Brief 048

_____ (2011b). Farmer-Based Seed Multiplication in the Ethiopian Seed System: Approaches, Priorities and Performance. FAC Working Paper 036.

Dawit, A. and R. Tripp. (2010). Seed System Potential of Ethiopia: Constraints and Opportunities for Enhancing the Seed Sector. IFPRI Working Paper, International Food Policy Research Institute.

Feder, G., R. E. Just and D. Zilberman. (1985). Adoption of agricultural innovation in developing countries: A survey. Economic Development & Cultural Change, 33: 255

Getinet, G., D. Gurmu and S. Gudissa. (2001). Focus on Seed Programs: The Ethiopian Seed. NSIA, Addis Ababa, Ethiopia

Godfrey, B. and A. Bahiigwa. (1999). Household Food Security in Uganda: An Empirical Analysis. Economic Policy Research Center. Kampala, Uganda

Jones, R., P. Audi, S. Bekele, and E. Gwata. (2006). Production and Marketing of Kabuli Chickpea Seeds in Ethiopia: Experiences from Ada District. Submitted to the project for improving productivity and market success of Ethiopian farmers, ICRISAT, Nairobi, Kenya

Kaliba, A. R. M., H. Verkuijl, and W. Mwangi. (2000). Factors affecting Adoption of Improved Maize Seeds and Use of Inorganic Fertilizer for Maize Production in the Intermediate and Lowland Zones of Tanzania. Journal of Agricultural and Applied Economics, 32, 1 (April 2000): 35 - 47

Kibiby, J. M., T. Flavianus, A. M. Magayane. (2001). Existing mechanisms for smallholders seed production and disseminations in Tanzania: A case of SUA B/C CRSP. Bean/ Cowpea Collaborative Research Support Program - East Africa Proceedings: Bean Seed Workshop. Arusha, Tanzania January 12 – 14, 2001

Million, T., and K. Belay. (2004). Determinants of fertilizer use in Gununo area, Ethiopia. PP 21 - 31. In Tesfaye Zegeye, Legesse Dadi and Dawit Alemu (eds). Proceedings of Agricultural Technology Evaluation Adoption and Marketing. Workshop held to discuss results of 1998 - 2002, August 6 -8, 2002.

Mulugeta, E., B. Kassa and D. Legesse. (2001). Determinants of Adoption of Soil Conservation Measures in Central Highlands of Ethiopia. The case of three districts of North Shewa. Agrecon, Vol. 40, No 3.

Ndjeunga, J., Anand Kumar, K., and Ntare, B. R. (2000). Comparative analysis of seed systems in Niger and Senegal. Working Paper Series no. 3. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi - Arid Tropics

Rohrbach, D., Minde, I. J., and Howard, J. (2003). Looking beyond national boundaries: Regional harmonization of seed policies, laws and regulations. Elsevier Ltd, Food policy 28 (2003) 317 – 333

Sahlu, Y., Simane, B. and Bishaw, Z. (2008). The Farmer - Based Seed Production and Marketing Schemes: Lessons Learnt 'in M. Thijssen, Z. Bishaw, A. Beshir, and W. de Boef (eds), Farmers, Seeds and Varieties: Supporting Informal Seed Supply in Ethiopia. Wageningen: Wageningen International'.

Samuel, G. and K. Sharp. (2008). Commercialization of smallholder agriculture in selected *Tef*- growing areas of Ethiopia. Future Agricultures Consortium (FAC) discussion paper 006

Sinafikeh, A., Y. Mahmud, F. Carlsson, and W. Edilegnaw. (2009). Farmers' Preferences for Crop Variety Traits: Lessons for On - Farm Conservation and Technology Adoption. School of Business, Economics and Law, University of Gothenburg. Working Papers in Economics No 357

Sperling, L. and H. D. Cooper. (2003). Understanding seed systems and seed security. In *Improving the effectiveness and sustainability of seed relief*. Proceedings of a stakeholders' workshop, Rome, 26 – 28, 2003. Food and Agriculture Organization (FAO), Rome

Spielman, J. D., K. Dawit, and A. Dawit. (2011). Seed, Fertilizer, and Agricultural Extension in Ethiopia. Development Strategy and Governance Division, International Food Policy Research Institute (IFPRI) - Ethiopia Strategy Support Program II (ESSP II), Ethiopia. ESSP II Working Paper 020

Weltzien, E., and von Brocke. (2001). Seed systems and their potential for innovation: Conceptual framework for analysis. [In] Sperling, L. (Ed.). Targeting seed aid and seed system interventions: Strengthening small farmer seed systems in East and central Africa. Proceedings of a workshop held in Kampala, Uganda, 21 - 24 June 2000, Kampala CIAT.

Yonas, S., S. Belay, and Z. Bishaw. (2008). Farmer - based seed production and marketing scheme: lessons learnt. In Thijssen,M., Z. Bishaw, A. Beshir and W. de Boef (eds), Farmers, Seeds, and Varieties: Supporting Informal Seed Supply in Ethiopia, Wageningen: Wagningen International: 23

Annex. 1: Description of Data for Discrete Variables

Variables	Adoption		Meskan (D. Tuto)			Sodo (W. Geferssa)		
			%	χ^2	Phi Cramer's	%	χ^2	Phi Cramer's
Gender	Adopters	Male	100			92.0		
		Female	0.0			8.0		
	Non adopters	Male	71.7			81.8		
		Female	28.3	5.39**	0.297	18.2	1.334	0.139
Off–farm	Adopters	Yes	46.7			12.0		
		No	53.3			88.0		
	Non adopters	Yes	2.2			9.1		
		No	97.8	19.65***	0.568	90.9	0.148	0.046
Training Access	Adopters	Yes	66.7			84.0		
		No	33.3			16.0		
	Non adopters	Yes	97.8			18.2		
		No	2.2	2.08	0.451	81.8	28.35***	0.641
Credit Access	Adopters	Yes	33.3			80.0		
		No	66.7			20.0		
	Non adopters	Yes	26.1			38.6		
		No	73.9	2.97*	0.221	61.4	10.97***	0.399
Mobile Ownership	Adopters	Yes	66.7			100.0		
		No	33.3			0.0		
	Non adopters	Yes	15.2	14.90***	0.494	79.5	5.88**	0.292
		No	84.8			20.5		

Source: Computed from survey data

ASSESSMENT OF VULNERABILITY TO POVERTY
(The case of Wolaita and Dawuro Zones)

Yohannes Hailu, Daniel Fitigu, TadeleTafese[1]

Abstract

A household's observed poverty level is an ex-post measure of a household's well-being. But poverty is a stochastic phenomenon implying that the current poverty level of a household may not necessarily be a good guide to the household's expected poverty in the future. Hence, in thinking about ex ante poverty prevention interventions, the critical need is to go beyond a classifying of who is currently poor and who is not, to an assessment of households' vulnerability to poverty. Therefore, this study is primarily intended to examine the extent of poverty and vulnerability in Wolaita and Dawuro zones, which existing studies neglected it. The data for this research is mainly based on the cross sectional primary data collected from 165 households selected from the two zones using a two stage sampling. We use the Foster-Greer-Thorbecke (FGT) poverty measures in order to measure the ex-post poverty and we make use of the Chaudhuri (2003) vulnerability measures that uses a three step Feasible Generalized Least Squares (3FGLS) to estimate ex ante poverty. Despite substantial efforts to reduce poverty over all the country, the study found that a considerable proportion of households is found poor (56%) and vulnerable (62%) in both zones. Both measures of poverty have been found to vary between different population segments. Moreover, the fraction of the population that faces risk of poverty is considerably greater than the fraction that is observed to be poor implying a considerable proportion of currently non poor (62%) will face risk of poverty. The study also shows that the majority of the household vulnerability to poverty emanates from the low endowments of households residing in the two zones.

Keywords: Poverty, Vulnerability to poverty, Wolaita zone, Dawuro zone,

[1] MSc, Economics Department, College of Business and Economics, Wolaita Sodo University. SNNP, Sodo Town
Tel. 0914766418 Tadeleth@yahoo.com

1. Introduction

The world today confronts many socio-economic problems. Poverty, among others, is a pervasive reality of the world that requires an urgent solution. Poverty, the greatest challenge of the world in the 21st century, in a multi-dimensional reality. Out of the total population of the world, around 1.2 billion people lead their lives obtaining less than $ 1 a day (World Bank, 2012).

Africa in general and the Sub-saharan Africa in particular is a region with economic performance worse than those other regions. The World Bank noted 2000 reported that the great majority of Africans live on barely $ 0.65 a day and this number is decreasing relentlessly. In both real income and access to social services, people in Sub-Saharan Africa are among the poorest in the world. Although urban poverty is substantial and appears to be growing, the rural poor account for 80% of African poverty. Almost half of the populations living in this region, according to UNDP report in 2006, live on less than $ 1 a day.

Ethiopia is one of the world's poorest country by any standard. The World Bank report 2006 indicate that 23% of the people survives on less than $ 1 a day.

The study of poverty in general focuses on those who has currently poor or were poor in the past because poverty can be measured ex-post. This approaches its own merit. By using actual data one may measure the effects of past public intervention on the extent of poverty and it allows us to identify whose poverty needs to be alleviated. However, governments are typically more interested in the second approach that measures those who are expected to be poor ex-ante. Thus, according to Chaudhuri, Jalan and Suryahadi (2002), the crucial need for an appropriate forward looking anti-poverty intervention is an assessment of household's vulnerability to poverty. As to Decon (2001), a household is vulnerable to poverty if it is likely to be poor in the future, that is ex ante poverty that measures "exposure to poverty rather than the poverty outcome itself".

Poverty particularly at zonal and Woreda levels has been given less attention on the research and development agenda of Ethiopia and there are only a few studies conducted on poverty. Previous studies conducted at national level in Ethiopia gave more emphasis on the measures of poverty in an ex-post approach. Although, important to have an insight on how poverty is widespread and its consequences, they are unable to predict how many individuals or household will be exposed to poverty. Between one year and next many people may move in and/out of poverty and there will be lack of conclusive information to know who will be poor next year since measures of who is poor now are imperfect guides to predict who will be poor next year.

The general objective of this study is to assess vulnerability to poverty in Wolaita and Dawuro zones. More specifically, the study will verify whether policy measures undertaken so far have a significant impact on the poor, determine the extent of vulnerability to poverty, examine the effects of drought and assess the sources of vulnerability to poverty.

2. Review of Related Literature

2,1 Theoretical Literature

2.1.1 Concepts and Measures of Poverty

There is no consensus on the definition of poverty. Poverty is a multifaceted concept affecting many human conditions including physical, moral and psychological factors. As a result, poverty remains difficult to be defined in a similar fashion and there are considerable differences in measuring and perceiving poverty in general. World Bank, 1990, has defined poverty as “the inability to attain minimum standards of living. Poverty has been conceived as the situation that is believed to exist if people lack the means to satisfy their basic needs such as food , shelter and clothes”(World Bank,1990). Five dimensions of poverty have been distinguished by Chambers (1988):

- 'Poverty proper' is a lack of adequate income or assets to generate income;
- Physical weakness due to under- nutrition, sickness or disability;
- Physical or social isolation due to peripheral location, lack of access to goods and services, ignorance or illiteracy;
- Vulnerability to crisis and the risk of becoming even poorer; and
- Powerlessness within existing social, economic, political and cultural structures

We are concerned in this study only with 'poverty proper' since money's metric poverty measures probably provide the best single objective proxy for poverty status. Ravallion described poverty in a given society is said to exist when one or more persons of the society is/are unable to attain a minimum reasonable standard of material wellbeing (Ravallion,1992) while Sen ,on the other hand, defined poverty as "a matter of deprivation".

Sen's definition of poverty is related to the freedom of a person to choose his\her functioning in order to satisfy a minimum level of wellbeing brought about by a set of attributes (Sen, 1985, Bigsten *et al*, 2005, Thorbecke, 2005).

As Ravallion clearly put, poverty can be structural, i.e. it can be chronic or transient. Chronic poverty according to him is defined as a persistence or permanent socio-economic deprivation linked to various factors such as limited productive resources, lack of skill, endemic socio-political and cultural factors and gender. The latter, on the other hand, is defined as transitory or temporary and is linked to natural and manmade disasters (Ravallion, 1992).

To put it in other words, poverty for an individual or a household in a narrow sense is defined as a state of having an income or consumption level below a certain standard usually known as the poverty line. In spite of difficulties for measurement, the measure of welfare is total income or consumption

(Ravallion, 1998) but in practice researchers employ these measures as a convenient measure of welfare.

It is agreed in general that low income or consumption is a symptom to poverty. Economic definition of poverty has so far proved easy to measure and has provided an essential tool for grasping the general patterns of deprivation and causes of poverty.

2.1.1.1 Monetary indicators of poverty

When estimating poverty using monetary measures, one may have a choice between using income or consumption as the indicator of wellbeing. Most analysts argue that, provided the information on consumption obtained from a household survey is detailed enough, consumption will be a better indicator of poverty measurement than income.

We need to measure the standard of living by estimating or measuring what and how much individuals or households consume (Deaton, and Case, 1988:1). We will also ignore the consumption of public goods and the value of leisure time following the conventional approach (Ravallion, 1992:7).Thus a person's standard of living is taken to depend on current consumption of privately supplied goods, from own production and the imputed rent from owner occupied ones.

There are, of course, several conceptual and pragmatic reasons for preferring per capita consumption expenditures over income as a measure of welfare and the most important reasons is that consumption expenditure is usually more reliably reported and more stable than income, especially among the poor(Ravallion, 1992:13). For better understanding considers the following reasons why consumption expenditure is preferred:

i. *Consumption is a better outcome indicator than income*

Actual consumption is more closely related to a person's well-being in the sense defined above, that is, of having enough to meet current basic needs. On the other hand, income is only one of the elements that will allow consumption of goods; others include questions of access and availability.

ii. Consumption may be better measured than income.

In poor agrarian economies, incomes for rural households may fluctuate during the year, according to the harvest cycle. In urban economies with large informal sectors, income flows may also be erratic. This implies a potential difficulty for households in correctly recalling their income, in which case the information on income derived from the survey may be of low quality. In estimating agrarian income, an additional difficulty is excluding the inputs purchased for agricultural production from the farmer's revenues. Finally, large shares of income are not monetized if households consume their own production or exchange it for other goods, and it might be difficult to price them. Estimating consumption has its own difficulties, but it may be more reliable if the consumption module in the household survey is well designed.

iii. Consumption may better reflect a household's actual standard of living and ability to meet basic needs.

Consumption expenditures reflect not only the goods and services that a household can command based on its current income, but also whether that household can access credit markets or household savings at times when current income is low or even negative, perhaps because of seasonal variation, harvest failure, or other circumstances that cause income to fluctuate widely.

One should not be dogmatic, however, about using consumption data for poverty measurement. The use of income as a poverty measurement may have its own advantages. For example, measuring poverty by income allows for a distinction to be made between sources of income. When such distinctions can be made, income may be more easily compared with data from other sources,

such as wages, thereby providing a check on the quality of data in the household survey. Finally, for some surveys consumption or expenditure data might not be collected.

When both income and consumption are available, the analyst may want to compute poverty measures with both indicators and compare the results. A simple way of testing the sensitivity of the results to the choice of consumption or income (or to any other choice) entails computing a transition matrix. To construct a transition matrix, divide the population into a number of groups—for example, 10deciles, each representing 10 percent of the population, from the poorest 10 percent to the richest 10percent. Each household belongs to only one decile for each indicator, but some households may belong to one decile for income and another for consumption, in which case many households would not(Hentschel and Lanjouw 1996).

2.1.1.2 Non-monetary indicators of poverty

Although poverty has been traditionally measured in monetary terms, it has many other dimensions. Poverty is associated not only with insufficient income or consumption but also with insufficient outcomes with respect to health, nutrition, and literacy, and with deficient social relations, insecurity, and low self-esteem and powerlessness. In some cases it is feasible to apply the tools that have been developed for monetary poverty measurement to nonmonetary indicators of well-being. Applying the tools of poverty measurement to non-monetary indicators requires the feasibility of comparing the value of the nonmonetary indicator for a given individual or household to a threshold, or "poverty line" under which it can be said that the individual or household is not able to meet basic needs (Aline Coudouel, 2006).

Whether one chooses income or consumption, it is typically necessary to aggregate information provided at the household or individual level for many sources of income or consumption in the survey. This aggregation is a complex

process. Some adjustments might be necessary to ensure that the aggregation process leads to the desired measures. Most adjustments require access to good information, particularly on prices, which might be unavailable. Complicated adjustments may also limit the understanding some users will have of the poverty analysis and the use they will be able to make of it.

2.1.1.3 Basic guidelines for aggregation are as follows:

a) Adjust for differences in needs between households and intra-household inequalities.

Households of different sizes and composition have different needs, which are not easily to reflected in poverty Measures. Two crucial decisions are necessary. First, should adjustments be made to reflect the age of the household members-adults and children and perhaps their gender? Second, should households of different sizes be treated differently to reflect the fact that larger households may be able to purchase goods in bulk at cheaper rates and to economize on the purchase of some products, especially consumer durables?

Adjustments of basic needs for different age groups and by gender and economies of scale (adjustments for household size) are required. The analyst may want to test for the impact of the choice of equivalence scales and economies of scale on poverty measures and for the validity of conclusions made regarding comparison of these measures between household groups. If feasible, the analyst may also want to investigate the magnitude of intra household inequalities.

b) Adjust for differences in prices across regions and at different points in time.

The cost of basic needs might vary between areas and over time. Expenditure and income data are proxies for the real level of household welfare. Nominal expenditures or incomes need to be made comparable in spatial terms by

adjusting for different price levels in different parts of the country. The more diverse and vast a country, the more important the spatial adjustments (factors of diversity include the degree of rural–urban integration, remoteness of areas, and so on). Adjustments are sometimes needed over time and within a given survey. For example, the relative degree of inflation could be important during data collection, making it significant whether a household is interviewed at the beginning or the end of the data collection period. Once regional price indexes or inflation data are available, adjustments can be made in two ways: (1) apply spatial and time deflators to the income or consumption of each household and compare them against a single poverty line, or (2) compute one poverty line for each region and date.

c) Exclude input and investment expenditure.

Care must be taken not to interpret spending on inputs into household production, including outlays for tools or other inputs like fertilizer, water, or seed in agricultural production, as spending for consumption or as income. If we included spending on inputs in the consumption or income aggregate, we would overstate the actual welfare levels achieved by households.

d) Impute missing price and quantity information.

Not all households provide information on the various income or consumption sources available in a survey. In the case of consumption, when information is lacking on the amounts and prices of the goods known to be consumed by the household, these data may need to be estimated (imputed). One of the most common imputations is for owner-occupied housing, that is, a hypothetical rental value for those households not paying rent. In the case of income, when it is known that household members are working, an imputation may also be needed if no labor earnings are reported.

e) Adjust for rationing.

When constructing a consumption aggregate, even if prices are available for each household in the survey, it is important to keep in mind that markets may

be rationed. In other words, there may be restrictions on the quantities available for purchase—for example, for public water or electricity services. In such cases, the price paid by the consumer is lower than his or her marginal utility from consumption, and yet the latter is the yardstick for measuring welfare levels. If possible, the shadow price of the goods consumed should be estimated.

f) Check whether adjustments for under-reporting can be made.

In some regions of the world such as Latin America, it is often a common practice to adjust income or consumption for under-reporting in the surveys. There is a presumption of underreporting when the mean income (or consumption) in the surveys is below that suggested in the disposable income or private consumption information available in the national accounts aggregates. Underreporting tends to be more severe when poverty measures are based on income instead of consumption. Before adjusting household income or consumption estimates for underreporting, however, it is necessary to carefully examine the reliability of the national accounts data. Furthermore, adjustments generally make very strong assumptions about the structure of underreporting across households (for instance, that each household declares income or consumption to the same degree). Such assumptions must be carefully reviewed.

2.1.1.4 Choosing and estimating a poverty line

Once an aggregate income, consumption, or nonmonetary measure is defined at the household or individual level, the next step is to define one or more poverty lines. Poverty lines are cutoff points separating the poor from the non-poor. They can be monetary (for example, a certain level of consumption) or nonmonetary (for instance, a certain level of literacy). The use of multiple lines can help in distinguishing among different levels of poverty. There are two main ways of setting poverty lines—relative and absolute.

a) ***Relative poverty lines***

These are defined in relation to the overall distribution of income or consumption in a country; for example, the poverty line could be set at 50 percent of the country's mean income or consumption. The crudest definition of relative poverty line is that income level which cuts off the poorest percent of the population in the national income distribution. There are two objections to this approach. First, it pre judges the extent of poverty – it is p percent by definition. Second, it necessitates that "the poor are always with us".

b) ***Absolute poverty lines***

These are anchored in some absolute standard of what households should be able to count on in order to meet their basic needs. For monetary measures, these absolute poverty lines are often based on estimates of the cost of basic food needs, that is, the cost of a nutritional basket considered minimal for the health of a typical family, to which a provision is added for nonfood needs. Considering that large parts of the populations of developing countries survive with the bare minimum or less, reliance on an absolute rather than a relative poverty line often proves to be more relevant in developing countries like Ethiopia (Goedhart,1977).).

Alternative poverty lines are also sometimes used. They can be set on the basis of subjective or self-reported measures of poverty. Moreover, absolute and relative poverty lines can be combined. This technique allows for taking into account inequality and the relative position of households while recognizing the importance of an absolute minimum below which livelihood is not possible.

For an application, see Pradhan and Ravallion (2000). Information contained in the consumption or income data and information from qualitative data if the qualitative data show that people consider a specific good to be a basic need, the elasticity of ownership of that good to income can be used (Madden, 2000).

The choice of a poverty line is ultimately arbitrary. In order to ensure a wide understanding and wide acceptance of a poverty line, it is important that the poverty line chosen resonates with social norms, with the common understanding of what represents a minimum. For example, in some countries it might make sense to use the minimum wage or the value of some existing benefit that is widely known and recognized as representing a minimum. Using qualitative data could also prove beneficial in deciding what goods would go in the basket of basic needs for use in constructing an absolute poverty line.

2.1.1.5 Choosing and estimating poverty measures

The poverty measure itself is a statistical function that translates the comparison of the indicator of household well-being and the chosen poverty line into one aggregate number for the population as a whole or a population subgroup. Many alternative measures exist, but the three measures described are most commonly used.

I. Incidence of poverty (headcount index)

This is the share of the population whose income or consumption is below the poverty line, that is, the share of the population that cannot afford to buy a basic basket of goods. An analyst using several poverty lines, say, one for poverty and one for extreme poverty, can estimate the incidence of both poverty and extreme poverty. Similarly, for nonmonetary indicators, the incidence of poverty measures the share of the population that does not reach the defined threshold (for instance, the percentage of the population with less than three years of education).

II. Depth of poverty (poverty gap)

This provides information regarding how far off households are from the poverty line. This measure captures the mean aggregate income or consumption shortfall relative to the poverty line across the whole population. It is obtained by adding up all the shortfalls of the poor (assuming that the non-

poor have a shortfall of zero) and dividing the total by the population. In other words, it estimates the total resources needed to bring all the poor to the level of the poverty line (divided by the number of individuals in the population). This measure can also be used for nonmonetary indicators, provided that the measure of the distance is meaningful. The poverty gap in education could be the number of years of education needed or required to reach a defined threshold. In some cases, though, the measure does not make sense or is not quantifiable (for example, when indicators are binary, such as literacy, in which case only the concept of the headcount can be used).

The poverty gap can be used as a measure of the minimum amount of resources necessary to eradicate poverty, that is, the amount that one would have to transfer to the poor under perfect targeting (that is, each poor person getting exactly the amount he/she needs to be lifted out of poverty) to bring them all out of poverty.

III. Poverty severity (squared poverty gap)

This takes into account not only the distance separating the poor from the poverty line (the poverty gap), but also the inequality among the poor. That is, a higher weight is placed on those households further away from the poverty line. As for the poverty gap measure, limitations apply for some of the nonmonetary indicators.

All of these measures can be calculated on a household basis, that is, by assessing the share of households that are below the poverty line in the case of the headcount index. However, it might be better to estimate the measures on a population basis - in terms of individuals - in order to take into account the number of individuals within each household.

The measures of depth and severity of poverty are important complements of the incidence of poverty. It might be the case that some groups have a high poverty incidence but low poverty gap (when numerous members are just

below the poverty line), while other groups have a low poverty incidence but a high poverty gap for those who are poor (when relatively few members are below the poverty line but with extremely low levels of consumption or income).

Depth and severity might be particularly important for the evaluation of programs and policies. A program might be very effective at reducing the number of poor (the incidence of poverty) but might do so only by lifting those who were closest to the poverty line out of poverty (low impact on the poverty gap). Other interventions might better address the situation of the very poor but have a low impact on the overall incidence (if it brings the very poor closer to the poverty line but not above it).

2.1.2 Concepts of Vulnerability to Poverty

According to the World Bank definition, vulnerability to poverty is the probability, today, of being in poverty or to fall into deeper poverty in the future. Vulnerability is very different from the standard analysis of poverty because it recalls a forward-looking perspective rather than an ex-post assessment, allowing the design of protection policies that can prevent households and individuals from experiencing welfare losses.

The concept of vulnerability to poverty stems its roots from a seminal article by Jalan and Ravaillon (1998) on transient and chronic poverty. Here the authors noticed how in rural China variability in consumption accounts for a large part of the observed poverty: half of the mean squared poverty gap and over a third of the mean poverty gap is transient and directly attributable to year-to-year consumption fluctuations.

While theoretically vulnerability to poverty is almost well-defined as the risk of experiencing poverty, three different definitions can be recognized empirically: vulnerability as expected poverty (VEP), vulnerability as low expected utility

(VEU) and vulnerability as uninsured exposure to risk (VER). These definitions are all equally used in the literature, since they describe the poverty risk according to three different perspectives.

The very first VEP version translates vulnerability into a probability measure of facing poverty in the future. More precisely, when welfare is defined in terms of consumption or income, then vulnerability of the h^{th} household (or individual), at time t, is V_{ht}, the probability that consumption (income) tomorrow, C_{ht+1} (Y_{ht+1}), falls below the poverty line, Z.

Ligon and Schechter (2003) proposed a different measure, based on utility, to take properly into account risk sensitivity. They pointed out that a policy-maker, who allocates resources to minimize the expected value of one of the Foster et al., (1984) (FGT) indexes, would tend to assign too much risk to poorer households. Therefore they defined vulnerability as the difference between the utility derived from some level of certainty-equivalent, at and above which the household h would not be considered vulnerable.

This approach, while appealing in terms of risk considerations, has some drawbacks since it is necessary to specify a utility functional form for Uh and a value for the risk aversion parameter. VEU has been used less extensively compared to VEP because it measures vulnerability in terms of utility units, with a less straightforward interpretation of the results.

The third approach, VER, even if based on inter temporal variability of consumption as VEP and VEU, is very different in terms of perspective. Vulnerability as uninsured exposure to risk is backward-looking, while the former methods are forward-looking. VER is in fact an ex-post assessment of the extent to which a negative income shock caused a welfare loss in terms of consumption. This third approach is based on consumption smoothing and risk sharing literature, where the degree of vulnerability is defined by the extent to

which the growth rate of household consumption covaries with the household income growth rate (Gerry and Li 2010, Skouffias and Quisumbing, 2003).
VER aims to understand if households are able to spread the effects of income shocks through formal or informal insurance strategies, with the following interpretation in terms of vulnerability: if consumption and income are correlated, then the households use not so effective risk management instruments, increasing their vulnerability to negative income shocks.

2.1.2.1 Measuring vulnerability to poverty: a conceptual overview

Vulnerability defined, within the framework of poverty eradication, as the ex-ante risk that a household will, if currently non-poor, fall below the poverty line, or if currently poor, will remain in poverty. Certainly this is not the only definition possible. In fact, in much of the recent work on the vulnerability of different segments within a population (Glewwe and Hall, 1998; Cunningham and Maloney, 2000), vulnerability is defined in terms of exposure to adverse shocks to welfare, rather than in terms of exposure to poverty.

Our definition for vulnerability would include among the vulnerable, households who are currently poor and have a high probability of remaining poor even if they do not experience any large adverse welfare shocks. On the other hand, our definition would exclude those households among the non-poor who face a high probability of a large adverse shock but are currently well-off enough so that even were they to experience the shock, they would still remain non-poor. Formally, the vulnerability level of a household h at time t is defined as the probability that the household will find itself consumption poor at time t +1:

$$V_{ht} = \Pr\left(C_{ht+1} < Z\right) \qquad \textbf{(1)}$$

Where C_{ht+1} is the household's per-capita consumption level at time t+1 and Z is the appropriate consumption poverty line. Note that the level of vulnerability

at time t is defined in terms of the household's consumption prospects at time t+1. The difference is noteworthy because it reflects an important distinction between the notion of vulnerability and the concept of poverty. Vulnerability is a forward looking or ex-ante measure of a household's well-being, whereas poverty is an ex-post measure of a household's well-being (or lack thereof). This implies that while the poverty status of a household is concurrently observable i.e. with the right data we can make statements about whether or not a household is currently poor. We can estimate or make inferences about whether a household is currently vulnerable to future poverty, but we can never directly observe a household's current vulnerability level.

An assessment of vulnerability is, therefore, innately a more difficult task than assessing who is poor and who is not. To assess a household's vulnerability to poverty we need to make inferences about its future consumption prospects. And in order to do that, we need a framework for thinking explicitly about both the inter-temporal aspects and cross-sectional determinants of consumption patterns at the household level. Over the last two decades, a large amount of literature has developed which addresses precisely these issues (Deaton, (1992) and Browning & Lusardi (1995). This literature suggests that a household's consumption in any period will, in general, depend on a number of factors. Among them its wealth, current income, expectations of future income (i.e., lifetime prospects), and the uncertainty it faces regarding its future income and its ability to smooth consumption in the face of various income shocks. Each of these will in turn depend on a variety of household characteristics, those that are observable and possibly some that are not, as well as a number of features of the aggregate environment (macroeconomic and socio-political) in which the household finds itself. At a general conceptual level, this suggests the following reduced form of expression for consumption:

$C_{ht} = C(X_h, \beta_t, \alpha_h, \varepsilon_{ht})$ **(2)**

where X_h represents a bundle of observable household characteristics, β_t is a vector of parameters describing the state of the economy at time t, and α_h and ε_{ht} represent, respectively, an unobserved time-invariant household-level effect, and any idiosyncratic factors (shocks) that contribute to differential welfare outcomes for households that are otherwise observationally equivalent. Substituting (2.2) into (2.1), we can rewrite the expression for the vulnerability level of a household as:

$$V_{ht} = \Pr(C_{ht+1} < Z) = \Pr[C(X_h, \beta_{t+1}, \alpha_h, \varepsilon_{ht+1}) < Z / (X_h, \beta_t, \alpha_h, \varepsilon_{ht})] \quad \textbf{(3)}$$

The expression above makes clear that a household's vulnerability level derives from the stochastic properties of the inter-temporal consumption stream it faces, and these in turn depend on a number of household characteristics and characteristics of the environment in which it operates. And at a conceptual level, the expression is very general in a number of respects.

First, it allows for the possibility of complicated interactions between the multiple cross-sectional determinants of a household's vulnerability level. For instance, X_h could include variables such as the educational attainment of the head of the household, presence of a government poverty scheme in the community in which the household resides, as well as interactions between the two to capture potential inequities in the level of access to public programs.

Second, because a household's vulnerability is defined in terms of its future consumption prospects conditional on its current characteristics, both observed and unobserved, the possibility of poverty traps and other non-linear poverty dynamics is implicitly built in. And third, the possible contribution of aggregate shocks and unanticipated structural changes in the macro-economy to vulnerability at the household level is also incorporated through inclusion of the time-varying set of parameters, β_t.

2.2 Empirical Literature

Chaudhuri *et al.,* (2002) found vulnerability to poverty using cross-sectional data from Indonesia. Three main conclusions emerge from their analysis. First, the fraction of the population that faces a non-negligible risk of poverty is considerably greater than the fraction that is observed to be poor. They estimated that 45% of the population was vulnerable, while 22% of the Indonesian population was observed to be poor in December 1998. Second, the distribution of vulnerability across different segments of the population can be differed markedly from the distribution of poverty. Third they found striking differences in the sources of vulnerability for different segments of the population. For rural households and for less educated households, the main source of vulnerability appears to be low mean consumption prospects; for urban households and for more highly educated households, on the other hand, vulnerability to poverty stems primarily from consumption volatility.

Another study conducted on measuring vulnerability by Ligon and Schechter, 2003, adopting a utilitarian framework was able to correctly capture the effects of risk on household welfare. Using data from Bulgaria they estimated the vulnerability measure and its components and also looked at the correlates of each of the components of vulnerability. Their estimates suggest that elimination of poverty would increase welfare by 14% in their Bulgarian sample, while eliminating aggregate risk would increase welfare by nearly 3%. Idiosyncratic risk stemming from observable sources (income shocks, unemployment incidence, and pensions), while significantly, unemployment is important in terms of magnitude. According to this study, Education is the most useful way to reduce vulnerability; households with college educated heads were significantly less poor, and significantly less vulnerable to both aggregate and idiosyncratic sources of risk.

Based on a panel of 4,281households that were surveyed both in 1993 and 1998, Dercon (2001) found that the headcount poverty rate was 56 percent in

1993 and fell to 34 percent in 1998. Almost half of those who were identified as poor in 1993 were not poor in 1998; and more than a tenth of those who were not poor in 1993 were found to be poor in 1998, despite the rapid economic growth of about 8 percent annually that occurred between these two periods. On the other hand results from a survey by Baulch and Hoddinott (2000), based on six sets of panel data showed that the fraction of people who were "always poor"- that is, poor in both periods, and so persistently poor - is generally quite modest; on the other hand, a large fraction of the population in most of the countries covered were poor in one or other of the periods, but not in both ("stochastically poor").

Christiaensen and Boisvert (2000) used panel data on a small sample from Northern Mali to construct a prediction model of food intake in the hunger season. They predicted the probability that the household would have food intake below 2345 Kcal per capita. They considered vulnerability as a probability above 50 percent, low or no vulnerability as anything from 50 percent to zero percent.

Estimates from Bangladesh using panel data revealed that the household variability of food consumption is negatively associated with the level of household consumption, but neither the variability of food nor total consumption is significantly associated with the probability of being poor (Skouffias, 2003). Moreover, Levison and Hermann, (2011) estimated household seasonal vulnerability to poverty in the Hadejia-Nguru Wetlands in North Eastern Nigeria. They both observed poverty and vulnerability to poverty in the study area varies seasonally; capital assets (physical, social, human) reduce the level of vulnerability mainly through their influence on expected consumption; increase in household income, contribution of fishing and livestock rearing increase seasonal variation in vulnerability while increase in household income, contribution of farming and off-farm activities reduce the seasonal variation in vulnerability; and households with more diversified income sources experienced less seasonal variation in vulnerability.

Another study conducted using an Indian household survey panel data for 2000 and 2003 suggested that poverty is the most significant source of vulnerability among rural households. These findings implied that being poor itself is the main contributor to vulnerability. Moreover, we found that household participation in micro finances reduces the vulnerability of households, largely through its impact on poverty reduction, and to a much smaller extent, its non-pecuniary effect on risk. The little impact of self-help microfinance groups on the risk component of vulnerability suggested that non-pecuniary impact, if there are any, may take a longer time than what their data captures (Ranjula et al, 2008).

A Food Security and Vulnerability study in Addis Ababa (2009) concluded that: food availability was negatively affected as a result of poor supply of food commodities, malfunctioning of markets, high transport costs, hoarding of grains by traders, and increased exports of food items that contributed to the shortage of commodities in markets. The study also showed that food accessibility was seriously impacted due to several factors that include: Poor level of asset base for more than half of the surveyed households.

High poverty conditions of the majority of the population; more than 70% of households according to this study were found below the national absolute poverty line. High level of expenditure allotted on food by the majority of households (more than 60% of their income spent on food) and about one-third of the surveyed population lived below-acceptable level of consumption. The justification was increased inflation of prices of food commodities and other services that led households to have deteriorated purchasing power. The study also revealed a significant proportion of households were also increasingly exposed to several risk factors that include high prices of food and non-food commodities and services, worsening food insecurity, preventable/communicable diseases, family disintegration, and disruption of social support/networks (Addis Ababa City Administration, 2009).

Decomposition of poverty into chronic and transient components using the components approach (FGT) by Seyoum *et al.,* (2012) revealed that transient

poverty was dominant in the study area compared to that of chronic poor. This result was considered as an indicator that programs targeting poverty should primarily focus on risk factors that swing households in and out of poverty such as drought, conflict, price fluctuations and the like and transfers to higher poverty levels.

Another study, using the three round Tigray rural household panel data, examined the determinants of the household's welfare using fixed effects regression and found that larger farm size and female headed households significantly improved the welfare of the households, whereas number of children, juniors and adults in the household found to negatively affect the household's welfare. This analysis showed that the likelihood of becoming both chronic and transient poverty is positively affected by factors such as the age of the household head and number of children in the household. Factors such as dependency ratio, farm size owned and participation in the off-farm activities reduce significantly the likelihood of becoming both chronic as well as transient poor (Awel, and Yusuf, 2007).

This study also estimated the vulnerability to poverty of households using 2003 cross sectional data drawn from the panel and found that on average there is 0.56 probability of entering into poverty a period ahead. The vulnerability of a household is positively significantly correlated with household head age squared and household size. Factors like household age, household head education, total livestock unit, owned farm size, the number of seniors in the household and member of the household's educational attainment found negatively correlated with the household's vulnerability to poverty (Ibid).

Vulnerability to poverty in Malawi analyzed the impact of drought on household's vulnerability using a two-period panel data set of 259 rural households and following the framework of vulnerability as expected poverty, by Christiaensen and Subbarao (2004), showed that recurrent drought makes households more vulnerable to the extent that households that were affected

by drought in both periods were twice as vulnerable as those who experienced drought in only one period (Makoka, 2008).

A study to measure vulnerability to poverty between 1992\93 and 1999\2000 using a panel data set of 1309 households in Uganda estimated the impact of household characteristics on vulnerability based on the expected mean and variance of household consumption the likelihood of future poverty was estimated. Education, spatial chs and access to community infrastructure were found to have important impacts on vulnerability. Specifically, the reduction in vulnerability to poverty increases with higher education attainment of the specific household head and hhs in northern Uganda are 60% more vulnerable compared to central Uganda and found that causes of vulnerability in Uganda are similar to causes of poverty (Kasirye, 2007).

3. Methodology

3.1 Estimating poverty measures

The poverty measure itself is a statistical function that translates the comparison of the indicator of household well-being and the chosen poverty line into one aggregate number for the population as a whole or a population subgroup. In this study we use Foster-Greer-Thorbecke (FGT) indices which are the most commonly used measures.

I. Incidence of poverty (headcount index)

Poverty incidence refers to the percentage of people living below a minimum threshold. This is given by:#

$$P_o = \frac{q}{n}$$

Where:q is the number of households below poverty line, Z and
n is the total number of sampled hpuseholds

II. Depth of poverty (poverty gap)

This provides information regarding how far off households are from the poverty line and is given as:

$$P_1 = \frac{1}{n}\sum_1^q(\frac{Z-C_i}{Z})$$

Where: Z is absolute poverty line, C_i per adult consumption expenditure of household H_i

q is the number of households below poverty line, Z and

n is the total number of sampled hpuseholds

III. Poverty severity (squared poverty gap)

Poverty severity is a measure of relative deprivation among the poor and computed as:

$$P_2 = \frac{1}{n}\sum_1^q(\frac{Z-C_i}{Z})^2$$

Where: Z,, C_i, q and nare as defined above.

3.2 Estimating Vulnerability Measures

3.2.1 Basic Approach Adopted in Vulnerability Estimation

Whatever the precise measure of vulnerability we choose to work with, specification of the data generating process for consumption is first and foremost. This is because that no matter how rich data we have, vulnerability to poverty of a household is never observable. From this, it naturally follows that the observed consumption expenditures at a point in time (i.e., from a single cross-section survey) should be viewed as the outcome (snapshot) of a dynamic process that is occurring in real time. And this means that vulnerability assessments have to be rooted in explicit models of inter-temporal household behavior.

Once a specification has been chosen, the next step is to estimate the parameters of the process using the household data. In general it will be possible to estimate the key parameters in a fairly flexible way without making too many stringent distributional assumptions. However, in going from estimates of the consumption process to estimates of vulnerability, the problem of estimating the distribution of consumption will need to be faced. In this study we work with a pre-specified parametric distribution in contrast to the non-parametric technique. Hence, the basic approach we use to arrive at the vulnerability to poverty of households can be summarized as:

Step 1: Specify the data generating process for consumption.
Step 2: Use survey data on household consumption expenditures and characteristics to estimate the relevant parameters of the consumption process.
Step 3: Make the necessary distributional assumptions needed to draw inferences about future consumption prospects i.e. to go from estimates of the consumption process to estimates of vulnerability.
Step 4: Use the vulnerability estimates, decompositions of the vulnerability estimates, and a variety of counterfactuals constructed using the estimates of the consumption process, to address various policy relevant questions.

Generally, we use both descriptive and inferential statistical analysis techniques in this study. Descriptive statistics is used to characterize the variables of interest and to analyze the poverty and vulnerability status of households but inferential statistics is adopted to arrive at the expected consumption and expected variance; then in turn to find vulnerability to poverty and to examine the correlates of vulnerability to poverty. STATA version 12 was used for both types of analysis.

3.3 Modeling and Variable Specification

3.3.1 Model Specification

The probability that a household will find itself poor depends on its expected (i.e. mean) consumption looking forward, and also on the volatility (i.e., variance, from an inter-temporal perspective) of its consumption stream, and possibly on higher moments of the consumption. We need to estimate, in this study, both expected consumption and the variance of its consumption to estimate household's vulnerability to poverty. Ideally, this would be done using longitudinal data (where the same households are tracked over a number of periods) of sufficient length. With such data, one could directly estimate the inter-temporal variance of consumption at the household level without the need for auxiliary assumptions. However, longitudinal data, especially in our study area are rare. And even where longitudinal data are available, the cross-sectional coverage of these data tends to be very limited or in aggregate, reducing their usefulness for policy analyses that require representative samples.

Cross-sectional household surveys are much more widely used in cases where longitudinal surveys are not available. These cross-sectional surveys provide the raw data for most of the poverty assessments that are now routinely done for numerous developing economies. Based on the available information in our study area we, therefore, prefer a method for estimating vulnerability to poverty that can be implemented using cross-sectional data.

We made a number of fairly stringent assumptions regarding the stochastic process of generating consumption to estimate vulnerability from a single cross-section. Essentially assumptions limiting the degree of unobservable heterogeneity in the future consumption prospects of households that are, observationally ethical along a number of dimensions. Chaudhuri (2000) provides a detailed description of the assumptions that are needed to interpret the estimates we obtain in terms of vulnerability to poverty. We begin here by

assuming that the stochastic process generating the consumption of a household h is given by:

$$\ln C_h = X_h\beta + \varepsilon_h \quad \textbf{(4)}$$

where C_h is per capita consumption expenditure, X_h represents a bundle of observable household characteristics, such as household size, location, educational attainment of the household head, etc., β is a vector of parameters, and ε_h is a mean-zero disturbance term that captures idiosyncratic factors (shocks) that contribute to different per capita consumption levels for households that are otherwise observationally equivalent. Implicit in expression (3.1) is the assumption that the idiosyncratic shocks to consumption are identically and independently distributed over time for each household. This implies that we are ruling out unobservable sources of persistence (arising for example, from serially correlated shocks or unobserved household-specific effects) over time in the consumption level of an individual household. We also assume that the structure of the economy (captured by the vector β) is relatively stable over time, ruling out the possibility of aggregate shocks (i.e., unanticipated structural changes in the economy). That is, in assuming a fixed β over time, we are assuming that the uncertainty about future consumption stems solely from the uncertainty about the idiosyncratic shock, ε_h, that the household will experience in the future.

We are ignoring uncertainty about future consumption that arises from uncertainty about the future structure of the economy. However, as we note below, we do not assume that they are identically distributed across households. Both these assumptions are forced upon us because we are attempting to estimate vulnerability from a single cross-section. Without longitudinal data we cannot identify the parameters driving persistence in individual consumption levels. And without a long enough time-series of repeated cross-sections, we cannot identify the stochastic process generating β.

We do however allow the variance of eh (and hence of lnch) to depend upon observable household characteristics in some parametric way. This is simply to allow for heteroskedasticity in consumption data generating process. There are a number of ways in which this can be done. The estimates we report are generated assuming the following extremely simple functional form:

$$\sigma^2_{e,h} = X_h\theta \qquad \textbf{(5)}$$

We estimate β and θ using a three-step feasible generalized least squares (FGLS) procedure suggested by Amemiya (1977). Using the estimates $\hat{\beta}$ and $\hat{\theta}$ that we obtain form FGLS, we are able to directly estimate expected log consumption

$$E\,[\ln C_h / X_h] = X_h\hat{\beta} \qquad \textbf{(6)}$$

and the variance of log consumption:

$$\text{Var}\,[\ln C_h / X_h] = \sigma^2_{e,h} = X_h\hat{\theta} \qquad \textbf{(7)}$$

For each household h assuming that consumption is log-normally distributed (i.e., that ln C_h is normally distributed), we are then able to use these estimates to form an estimate of the probability that a household with the characteristics, X_h, will be poor, i.e, of the household's vulnerability level. Letting Φ (.) denote the cumulative density of the standard normal, this estimated probability will be given by:

$$\hat{v} = \widehat{Pr}\,(\ln C_h < \ln Z / X_h) = \Phi\left(\frac{\ln Z - X_h\hat{\beta}}{\sqrt{X_h\hat{\theta}}}\right) \qquad \textbf{(8)}$$

The method we have outlined is the standard one used in most vulnerability to poverty assessments that rely on regression methods, but with one important difference compared to poverty assessments[1].

Moreover, we use the simple OLS regression to see the impact of the explanatory variables listed above in equation 3.1 on the vulnerability to poverty.

3.3.2 Variable Specification

Based on theoretical expositions and previous empirical studies, the following explanatory variables are hypothesized to influence the welfare of households as follows. Annual real consumption expenditure per adult equivalent is dependent variable in the FGLS and vulnerability to poverty is dependent variable in the OLS regression.

The measure of consumption used in this paper is the sum total of food consumption and nonfood consumption. The food consumption includes food that the household purchased, gained and produced (used for own consumption) for 41 food items. The nonfood consumption is based on the sum total of expenditures on 32 non-food items. The respective prices for the food and non-food items are collected from respondents to make the welfare calculation to take in to account the price difference among localities.

Independent Variable	**Dependent variable: Consumption per Adult Equivalent (Annual)**
Woreda	Could not specified
HH sex (Male = 1)	(+)
HH age (HH age sqr.)	+ (-)
Adult Equivalent Scale	+ (more work force) or – (high dependency ration)
Dependency Ratio	
Household Education	(+)
Household Occupation	(+)
HH members with higher education	(+)
HH members with no occupation	(-)
HH members with paid work	(+)
	NB: +ve impact on consumption implies –Ve impact on vulnerability and vice versa

3.4 Data

Like most researches in the empirical world, our study relied on taking sample since the population we are dealing with is large in terms of cost and data management. Moreover, as our study deals with population that is distributed across a wide range of geographic region, we find it expensive to take sample from across the whole geographic region. Hence, in order to reduce the costs, a two-stage sampling procedure is used to draw the sample from the population of the Woliata and Dawuro zones as whole. We first selected five cluster Woredas from the 21 Woredas of two zones in S.N.N.P using simple random sampling and we found Araka, Boditi, Humbo, Sodo and Tercha Woredas as first stage units. Then we used simple random sampling to select households from selected cluster Woredas based on proportional allocation.

Regarding the type and source of data, this research is based on primary cross sectional data surveyed from five Woredas of Wolaita and Dawro zones in 2011. A multipurpose precoded questionnaire was designed and administered to 165 households to collect data on household consumption expenditure, household demographics, household income, and household assets and other household and community shocks. Besides, secondary data was collected from Central Statistical Agency (CSA) for adjustment purposes (like adjustment in poverty line, adjustment in inflated commodity prices reported by respondents, etc.).

4. Results and Discussions

4.1 Descriptive Statistics

Description of the data on variables of interest (Table 1) shows a big difference in terms of household composition across Woredas as reflected by mean values; though there is huge average disparities of the distribution of these variables around these means (look at SD). Humbo has the highest number of adult equivalent scale, highest dependency ratio and highest number of house hold members with no occupation. This is also evident from its second lower

annual consumption per adult equivalent. On the other hand, Tercha has the lowest number of adult equivalent scale; lowest dependency ratio and lowest number of household members with no occupation possibly which help the Woreda to have the highest welfare among the surveyed areas as measured by annual consumption per adult equivalent. Based on the number of household members with paid work, Sodo town has the highest mean number followed by Boditi. Moreover, Sodo town is found to have the highest number of members with higher education. Despite of these highest levels of education and occupation, the town has the lowest welfare. This may be a result of its highest dependency ratio.

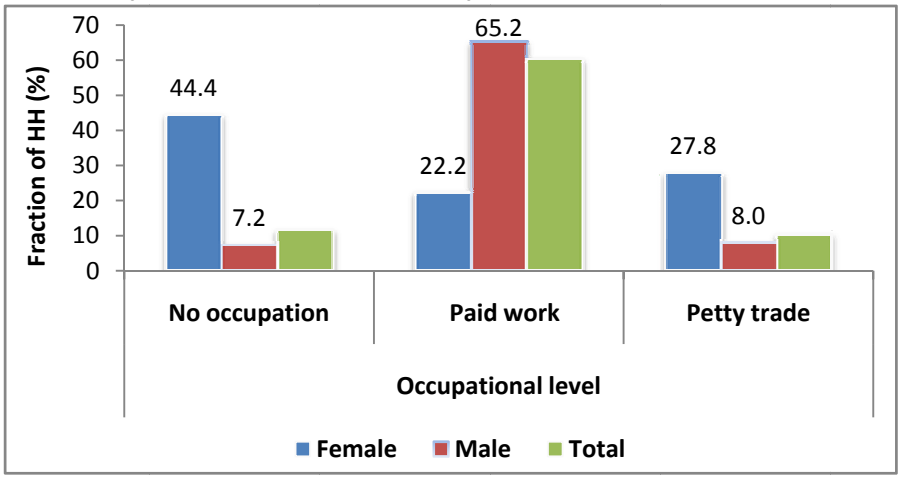
Table 1: Summary Statistics

		Woreda					
Variable		**Araka**	**Boditi**	**Humbo**	**Sodo**	**Tercha**	**Total**
House head Age	Mean	34.8	37.4	38.3	41.8	39.0	39.2
	SD	9.0	9.2	3.1	11.9	11.7	11.0
HH size	Mean	4.6	5.4	7.0	5.9	3.1	5.1
	SD	1.7	3.0	2.8	2.0	1.6	2.3
House hold adult equivalent scale	Mean	3.4	3.8	4.7	4.2	2.5	3.7
	SD	1.2	1.8	1.5	1.4	1.1	1.5
Dependency Ratio	Mean	0.9	1.0	1.2	1.1	0.4	0.9
	SD	0.7	1.0	1.2	0.9	0.5	0.9
HH size with Primary education	Mean	2.2	2.2	3.5	2.4	1.5	2.2
	SD	1.8	2.2	2.2	1.5	1.3	1.7
HH size with secondary education	Mean	1.0	1.5	2.2	1.3	1.1	1.3
	SD	1.0	1.5	0.8	1.5	1.0	1.3
HH size with Higher education	Mean	0.5	0.5	0.7	0.9	0.3	0.7
	SD	0.8	1.1	1.2	1.4	0.7	1.2
HH size with no occupation	Mean	3.0	3.3	5.7	3.8	1.8	3.3
	SD	1.7	2.9	2.4	1.7	1.4	2.0
HH size with Paid work	Mean	0.8	0.9	0.5	1.4	0.6	1.1
	SD	0.8	0.9	0.5	1.1	0.8	1.0
Consumption per Adult Equivalent (Annual)	Mean	2155.6	2428.1	1656.0	1234.7	3611.9	2000.0
	SD	1994.1	3698.8	1433.1	1285.5	4632.2	2783.5
Sample Size		31	24	6	76	28	165

Source: Authors' Calculation

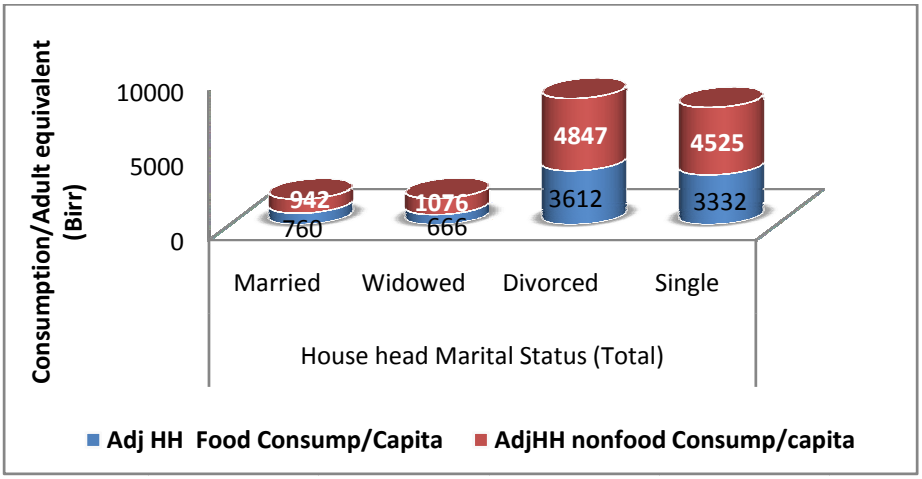
Observation of some of these variables across different socio-economic groups also shows considerable differences. Chart 1 show that 46.7 percent of the female headed households and only 6.9 percent of the male headed households have no occupation. While 23.8 percent of the female headed households and 65.3 percent of the male headed households are engaged in paid works. Female headed households are found more participatory in petty trade (23.8 percent) than male headed households (9 percent).

Chart 1: Population Distribution of Occupational Level



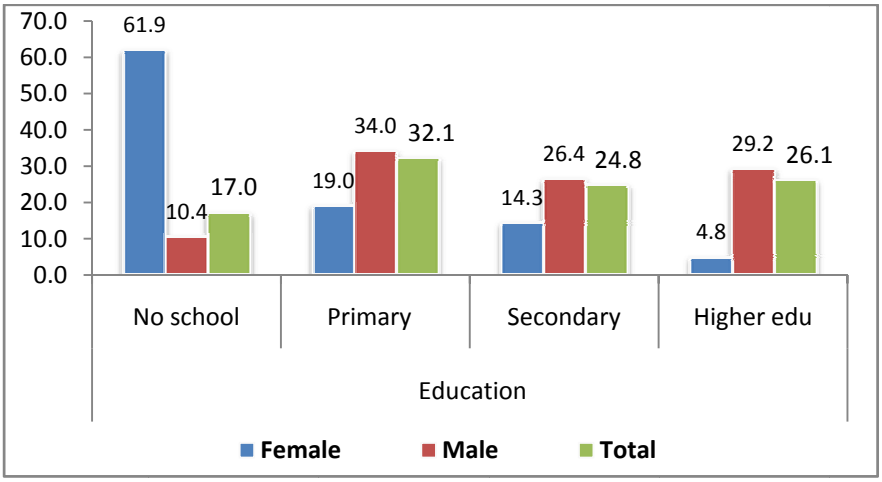
In relation to marital status of house heads (Chart 2), household with single and divorced house heads consume much higher than households with married and widowed house heads (on average households with single and divorced house heads consume 4.8 times consumption of households with married and widowed house heads). This result is consistent with the results of previous empirical studies that married and/or widowed house heads have higher number of children compared to single and divorced which lowers their welfare (Abreham Seyoum Teshaye et al, 2012).

Chart 2: Consumption by House Head Marital Status



A number of empirical findings show that education of house heads is positively related to the household's welfare. In our survey about 55.8 percent of the male heads have secondary and above education while 61.9 percent of the female heads have no education at all (Chart 3) and this implies male heads are found to have better educational background than female heads.

Chart 3: Population Distribution by Education



4.2 Extent of Poverty

Previous poverty studies mainly focused on the use of the standard classification of poor and non-poor. To set this classification our study adopted poverty line (84.59 Birr per month per adult) set by Gebremedhin and Whelan (2007) based on the cost of basic needs approach for Hawassa using 2000 survey. We adjusted for the price changes between 2000 and 2007 by inflating the poverty line using the 2007 regional general inflation rate (26%) for SNNP. Then we readjusted this inflated poverty line to 2011 price using the regional general inflation rate (213%) for 2011 for SNNP. This double adjustment is due to the change in base year from 1999 to 2007 in calculating the inflation rate by the Central Statistical Agency of Ethiopia. Accordingly, the poverty line for our study is 4037.02 Birr per adult per year.

After setting the poverty line, an attempt is made to analyze the various measures of poverty. The Foster-Greer-Thorbecke (FGT) indices are the most widely used poverty indices comprising of three measures: the incidence of poverty, also called the headcount index; the aggregate poverty gap (poverty depth); and the squared poverty gap (poverty severity). Poverty incidence refers to the percentage of people living below a minimum threshold as measured by local living standards. The poverty gap captures the mean aggregate consumption shortfall relative to the poverty line across the whole population. In other words, it estimates the total resources needed to bring all the poor to the level of the poverty line. Poverty severity is a measure of relative deprivation among the poor, i.e., it takes into account not only the distance separating the poor from the minimum threshold, but also the inequality among the poor. It places a higher weight on those households further away from the poverty line. Using the poverty line and the data on real annual consumption expenditure per adult equivalent, the three FGT poverty indices have been computed.

4.2.1 Aggregate and Geographic Poverty Profile

The analysis of the poverty at aggregate and Woreda levels in Table 2 indicates higher incidence of poverty, poverty gap and severity in all the survey areas. It is found that 56 percent of the sampled households are deemed poor. The poverty gap for the overall study area is 44 percent which reflects that if the surveyed areas mobilized 44 percent of the poverty line (4037.02 Birr per year) for very adult equivalent individuals and distribute it to the poor in the amount needed, each poor household will move to the poverty line. Table 2 also showed as the severity of the poverty is 37 percent showing a higher relative deficiency among the poor. Table 2 also shows differences in the FGT indices across the Woredas. The proportion of poor (62 percent and 61 percent respectively) in Sodo and Boditi is higher than the proportion of non-poor. While the proportion of poor (44 percent and 40 percent respectively) in Araka and Humbo are lower than the proportion of non-poor. Moreover, Table 2 shows that the number of poor and non-poor is balanced in Tercha. Sodo has the highest contribution (47 percent) to the overall poverty of the study area and while Humbo has the lowest contribution (2 percent) to the overall poverty.

Table 2: Aggregate and Geographic Poverty Profile

Measures of Poverty	Araka	Boditi	Humbo	Sodo	Tercha	Overall
Number of Non poor	15	9	3	28	14	69
Number of Poor	12	14	2	45	14	87
Head Count Index	0.44	0.61	0.40	0.62	0.50	0.56
Poverty Gap	0.31	0.50	0.33	0.51	0.37	0.44
Poverty Severity	0.28	0.42	0.27	0.43	0.30	0.37
Population Share	0.17	0.15	0.03	0.47	0.18	1.00
Share of overall poor	0.14	0.16	0.02	0.52	0.16	1.00

Source: Authors' Calculation

Results in Table 2 are consistent with the demographic composition of the households. If we see the impact of household size on the wellbeing of the households, theoretical expositions and previous empirical studies show that its impact is mixed. Its effect will be positive if larger household size means

more working force (hence less dependency ratio) and negative if it implies higher dependency ratio. Based on this consideration, though all households have an average of 5.1 higher household size (Table 1), all have an average of 0.9 higher dependency ratio (Table 1) which may put them in the category of those deemed poor.

4.2.2 Demographic Poverty Profile

A summary of the poverty measures across different demographic groups given in Table 3 shows that poverty incidence of female headed households (72 percent) is much higher than the poverty incidence in the male headed households (54 percent). As a result, to mitigate poverty (keeping other factors constant) female headed households need higher proportion of the poverty line (57 percent) for every individual adult equivalent compared to male headed households (43 percent). Moreover, the severity of poverty among female headed households is higher than that of male headed households. When we consider marital status of house hold heads, households with married house hold heads have higher incidence of poverty, poverty gap and severity compared to the households with unmarried heads and the married groups contribute 89 percent to the overall poverty.

Taking theoretical and empirical considerations, old age is negatively associated with welfare of households as aged household heads face a decline in labor supply and decision making capability. However, results in Table 3 shows us households with aged heads (60 years and higher) have lower incidence of poverty (27 percent) compared to the younger house heads (59 percent). Moreover, these households with aged heads have lower poverty gap and poverty severity. This result may be due to the higher number of productive household members (lower dependency ratio of 0.76) that those household groups possess compared to the number of productive members (higher dependency ratio of 0.94) that households with younger heads have.

Table 3: Demographic Poverty profile

Measures of Poverty	House head Sex		House head Age		House head Marital Status		HH Dependency Ratio	
	Female	Male	>=60 Years	<60 Years	Married	Unmarried	< 0.25	>= 0.25
Household size	5.6	5.1	6	5.1	5.3	4.2	3.3	5.6
Dependency Ratio	0.9	0.9	0.76	0.94	1	1.2	0.02	1.2
No of Non poor	5	64	11	58	59	10	22	47
Number of Poor	13	74	4	83	77	10	14	73
Head Count Index	0.72	0.54	0.27	0.59	0.57	0.50	0.39	0.61
Poverty Gap	0.57	0.43	0.23	0.47	0.46	0.35	0.24	0.50
Poverty Severity	0.46	0.36	0.20	0.39	0.38	0.34	0.21	0.42
Population Share	0.12	0.88	0.10	0.90	0.87	0.13	0.23	0.77
Share of overall poor	0.15	0.85	0.05	0.95	0.89	0.11	0.16	0.84

Source: Authors' Calculation

Looking at a glance at the dependency ratio of households, results in Table 3 are consistent with theoretical and previous empirical considerations that households with a higher dependency ratio have higher risk of falling in to poverty. Households with a dependency ratio 0.25 and above have poverty incidence of 61 percent which contributes 84 percent to the overall poverty. This group has also higher gap and severity of poverty.

Now let's turn to the distribution of poverty across different educational and occupational levels. Given that there are differences among sex and age compositions of households one would expect that educational and occupational levels will affect the poverty measures as females have less access to education and access to education has grown in recent times. Table 4 ascertains that households with heads having higher educational levels have the lowest poverty incidence (37 percent) which contributes 16 percent to the overall poverty in the study area. Those households with secondary education

completed heads have the second lowest poverty incidence (58 percent) but accounts for the 25 percent of the overall poverty higher than the contribution of households with heads with no education (20 percent).

Moreover, Table 4 shows that households with primary school completed heads have the same incidence of poverty compared to households with heads that have no formal education. However, households with heads with no formal education have higher deficit (52 percent) but less sever (43 percent) compared to the households with primary education completed heads. It is also important to note that households of the primary school completed heads contribute 39 percent to the overall poverty.

Table 4: House head Education and Occupational level

Measures of Poverty	Educational level of House head				Occupation of House head			
	No school	Primary School	Secondary School	Higher Education	No occupation	Unpaid work	Paid work	Petty trade
Household size	5.5	4.8	4.7	5.7	4.6	5.5	5.2	5.1
Dependency Ratio	0.8	0.9	1.1	0.9	0.4	0.9	1.0	1.0
No of Non poor	10	19	16	24	11	9	44	5
Number of Poor	17	34	22	14	7	19	50	11
Head Count Index	0.63	0.64	0.58	0.37	0.39	0.68	0.53	0.69
Poverty Gap	0.52	0.50	0.46	0.29	0.24	0.57	0.43	0.55
Poverty Severity	0.43	0.44	0.37	0.23	0.25	0.51	0.35	0.44
Population Share	0.17	0.34	0.24	0.24	0.12	0.18	0.60	0.10
Share of overall poor	0.20	0.39	0.25	0.16	0.08	0.22	0.57	0.13

Source: Authors' Calculation

It is also interesting to see changes in the poverty measures across different occupational levels of house hold heads. A surprising result observed regarding this composition is that households with heads who are no more engaged in any job have the lowest incidence of poverty, poverty gap and poverty severity (Table 4) contributing only 8 percent to the overall poverty. This may be due to the fact that those households have on average an almost equal household size (4.6) but lower dependency ratio (0.4) compared to remaining groups. It is clear from Table 4 that households with heads engaged in unpaid works (like cultivating own land) and in petty trade have almost the same fraction of their members below poverty line (68 and 69 percent respectively). However, the severity of the poverty is higher in households headed by heads who are engaged in unpaid work. Moreover, households with heads engaged in paid work have the second lowest proportion of poor (53 percent) contributing 57 percent to the overall poverty. These groups of households have higher dependency ratio compared to the households with unengaged heads.

4.3 Econometric Results

Before discussing the results of the estimation of the models specified in section 3.4.1 it is in order to have some explanation of the set of explanatory variables used in the estimation. The selection of the explanatory model was guided by the conceptual framework in section 1.3 and other previous empirical works in Ethiopia and developing countries. A key consideration was given in selecting arguably exogenous variables. The explanatory variables include demographic characteristics of the household, the employment sector of the household and shocks that disturb income of households.

The demographic characteristics of the household include age of the household head (its squared value) in order to capture any possibilities of lifecycle effects, household size, dependency ratio, adult equivalent scale, the number of members with no education, those with primary education, secondary education, higher education, the number of members with no occupation, and

number of members with paid work; and number of dummies for household sex, location of households, drought, absence of oxen, crop damage, land shortage and excess rain fall. However, some of these explanatory variables are dropped due to multicollinearity problems and if they are found to be with unexpected sign and insignificant.

4.3.1 The Vulnerability Model

Using our survey cross sectional data for the year 2011 derived from Humbo, Araka, Sodo, Boditi and Tercha and the model specified in section 3.4.1, we estimated the models and the results are presented as follows.

The FGLS results (Table 5) indicate that expected log consumption per adult equivalent is positively affected by adult equivalent whereas dependency ratio, number of household members with primary education and number of members with paid work have a significant negative effect on expected log consumption per adult equivalent. Moreover, there is a significance difference between wellbeing of male headed households and female headed households in which male headed households take the advantage over female headed households.

Education of household head has also a significant positive effect. As household head education increases, the wellbeing of its family increases significantly. From the FGLS results it is also apparent that geographical differences have a significant effect on the wellbeing of households in the study area. Household age, number of household members with secondary education and excess rainfall have also a negative effect on expected log consumption per adult equivalent though insignificant. But number of household members with secondary education has an insignificant positive effect on household wellbeing.

A surprising result that we should note here is that though crop damage and land shortage have expected significant negative effect, drought and absence of oxen have positive significant effect on expected log consumption per adult equivalent. This may show that during drought food aid from government and other sources have a significant effect as we do not smooth for such consumption. Moreover, it is known in the study areas that absence of oxen is one of the main selection criteria for food aid.

Similarly, though not very well fitted as the FGLS model for the log consumption per adult equivalent, the FGLS for the variance of log consumption per adult equivalent is jointly explained by some household characteristics (Table 5). Household age and number of workers with paid work have positive significant effect on the variability of the household welfare whereas the number of household members with higher education has a significant negative effect. However, dependency ratio and adult equivalent are found to have insignificant effects on the variance of log consumption per adult equivalent.

It is also clear form Table 5 that dummies household sex, crop damage, land shortage, drought and absence of oxen have significant effects on the variability of the household's welfare. Moreover, differences in marital status of household have also show significance differences in the variability of the log consumption per adult equivalent.

Provided the above results and using assumption specified in section 3.4.1 that consumption is log-normally distributed, we computed the Vulnerability to poverty for each household and found that the mean vulnerability to poverty is 47 percent. This result tells us, on average, there is a probability of 0.47 of falling in to poverty in next period, which is expected head count poverty for the next period.

Table 5: FGLS Regression Results

Explanatory Variables	Dependent Variable - log consumption Expenditure per adult equivalent	
	E [ln (C / X)] Coefficient (SD)	**Var [ln(C / X)] Coefficient (SD)**
Woreda	0.1606161 (0.08)*	-0.01385 (0.02276)
House head Sex	3.096069 (0.5577)*	-0.17833 (0.08823)*
House head Age	-0.0236491 (0.0141)	0.00675 (0.00276)*
House head Age square	Dropped (Multicollinearity)	Dropped (Multicollinearity)
Adult equivalent Scale	0.4703982 (0.1683)*	-0.06072 (0.03281)
Dependency Ratio	-0.2965106 (0.1465)*	-0.01041 (0.05513)
House head Marital Status	0.2493314 (0.2145)	0.13314 (0.06435)*
House head Education	0.3312109 (0.1578)*	Dropped (Insignificant Unexpected sign)
No of HH members with Primary Education	-0.2164046 (0.1016)*	0.02476 (0.03524)
No of HH members with Secondary Education	-0.1220665 (0.1855)	-0.00756 (0.03038)
No of HH members with Higher Education	0.2914044 (0.2081)	-0.07347 (0.03466)*
No members HH with paid work	-0.785366 (0.1679)*	0.11692 (0.03233)*
Food Shortage Reason - Drought	3.024162 (0.7426)*	-0.44377 (0.11002)*
Food shortage reason - Absence of oxen	3.743265 (0.6093)*	-0.28454 (0.10508)*
Food shortage reason - Crop Damage	-2.753184 (0.6262)*	0.54303 (0.12841)*
Food shortage reason - Land Shortage	-3.71528 (0.6468)*	0.45442 (0.09199)*
Food shortage reason - Excess Rainfall	-0.2592026 (0.6174)	-0.07826 (0.12282)
Constant	4.142342 (0.5587)*	0.37176 (0.43266)
Number of observations	**156**	**165**
F(K-1, N-K)=	**177.47**	**20.12**
Prob. > F=	**0**	**0**
R-squared=	**0.9255**	**0.6695**
Level of significance=	**0.05**	**0.05**

Source: Authors' Regression

* Significant at 0.05 confidence level

In the same way that regressions can be used to assess the determinants of expected log consumption per adult equivalent and its variance, it is possible to use regressions to identify the factors affecting the estimated vulnerability. Simple OLS regression of demographic characteristics of the household, the employment sector of the household and shocks that disturb income of households on vulnerability we found the following important results.

Table 6: OLS Regression Results

Explanatory Variables	Dependent Variable Mean Vulnerability to Poverty Coefficient (SD)
Woreda	-0.0558261 (0.0138)*
House head Sex	-0.6473515 (0.0662)*
House head Age	0.0131996 (0.0105)
House head Age square	-0.0000426 (0.0001)
Adult equivalent Scale	-0.1594353 (0.0333)*
Dependency Ratio	0.0801245 (0.0317)*
House head Marital Status	0.0429605 (0.0244)
House head Education	-0.0584177 (0.0266)*
House head Occupation	-0.0302294 (0.0261)
No of HH members with Primary Education	0.0409519 (0.0189)*
No of HH members with Secondary Education	0.0398928 (0.0249)
No of HH members with Higher Education	-0.0624205 (0.0331)
No members HH with no occupation	0.0238284 (0.0203)
No members HH with paid work	0.2656843 (0.0252)*
Food Shortage Reason-Drought	-0.4119416 (0.0964)*
Food shortage reason - Absence of oxen	-0.617465 (0.0983)*
Food shortage reason -Crop Damage	0.6957637 (0.073)*
Food shortage reason-Land Shortage	0.585724 (0.0692)*
Food shortage reason-Excess Rainfall	-0.0415209 (0.0837)
Constant	0.9261409 (0.2344)*
Number of Observations	**156**
F(K-1, N-K)=	**21.94**
Prob > F=	**0**
R-squared=	**0.754**

Source: Authors' Regression * Significant at 0.05 confidence level

Female headed households are more vulnerable than male headed households in a way that household sex (Male = 1, Female =0) is significantly negatively correlated to vulnerability (Table 6). It is also consistent that geographical differences induce significant differences in vulnerability of households. Dependency ratio, number of household members with primary education and number of members with paid work have significant positive effect on vulnerability but adult equivalent and house head education correlate wth vulnerability negatively.

The surprising result that followed from surprising determination of expected log consumption per adult equivalent is that drought and absence of oxen have a significant negative effect on vulnerability. However, crop damage and land shortage increases the vulnerability of households in the study area.

4.4 Interpreting and using Vulnerability Estimates

As a wide range of literature on vulnerability is available, comparing the entire vulnerability distribution is not feasible. Hence, we use a well-chosen capture measures to summarize the key properties of the vulnerability distribution. Mean vulnerability which is approximately equal to the observed poverty rate if there are no aggregate shocks is one summary measure adopted in our work. A second summary measure that we use for vulnerability results in this study is the fraction of the population that has a vulnerability level above some threshold, and can therefore be called vulnerable.

The choice of a vulnerability threshold is ultimately quite arbitrary. Following Chaudhuri, Jalan, and Suryahadi (2002) we sorted households into three categories: Those who are highly vulnerable, for whom the expected vulnerability is 0.5 or above, those who are relatively vulnerable, for whom their expected vulnerability level is between 0.22 and 0.5; 0.22 inclusive and those who are not vulnerable, for whom their expected vulnerability is less than 0.22. We just adopt this classification because the incidence of poverty in

the study area is higher than 0.50 and the incidence of poverty for SNNP for the year 2011 was 0.296 (MoFED, March 2012).

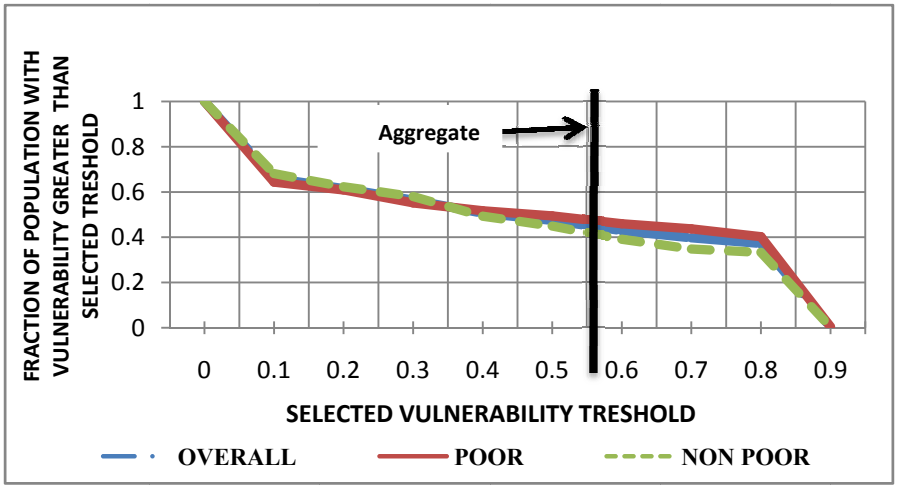
Another important summary measure we adopted following Pritchettet et al., 2000 to describe vulnerability is the ratio of the fraction of the population that is vulnerable (given a threshold) to the fraction of poor called the vulnerability to poverty ratio. This ratio provides a useful measure of how dispersed vulnerability is in the population. In general, for any given vulnerability threshold, a higher vulnerability to poverty ratio indicates a more dispersed distribution of vulnerability, whereas a lower ratio suggests that vulnerability is concentrated among a few.

4.4.1 Aggregate vulnerability profile

The easiest and very important analysis in the assessment of vulnerability is to see a pattern of overall level of vulnerability by sketching the aggregate distribution of the vulnerability, measured by a fraction of incidence of vulnerability against selected vulnerability threshold. This is depicted in Chart 4, using vulnerability threshold ranging from 0 to 1 (measured along the horizontal axis) for the population as a whole as well as observed poverty status.

By construction, as the threshold increases, the incidence of vulnerability (the fraction of the population with vulnerability higher than the threshold) declines. Thus, at a threshold of zero, everyone is vulnerable while no one is vulnerable at the threshold of one. For the vulnerability thresholds between 0.1 up to 0.3, the incidence of vulnerability for non-poor is higher than for poor. However, not surprisingly, for any threshold above 0.3, the incidence of vulnerability is higher for the poor than for the population as a whole, which in turn is higher than the incidence of vulnerability amongst the non-poor. More significantly, Chart 4 suggests that for a wide range of thresholds, poverty and vulnerability are significantly different from each other. This implies not all the poor are vulnerable while a significant proportion of the non-poor are vulnerable.

Chart 4: Aggregate Incidence of Vulnerability by Selected Vulnerability Tresholds.



Information showed in Table 7 intensifies our notation for the incidence of vulnerability depicted in Chart 4. At the aggregate level, while 56 percent of the population is observed to be poor, we estimate that 62 percent of the population is vulnerable to poverty. Hence, there are households who are not currently poor whose vulnerability (ex-ante poverty) is high (above 0.22 percent). In fact, out of the currently non poor households that constitute 44 percent of the population, 62 percent are vulnerable and this implies that about 28 percent of the population though not currently poor is vulnerable to poverty. Therefore, it is clear from our result to deduce that the incidence of poverty underestimates the fraction of people that are going to be poor in the coming years.

On the other hand, it is clear form Table 7 that there are some households who are classified as poor whose vulnerability level is low enough for them to be categorized as non-vulnerable. Among the overall poor, 61 percent are vulnerable implying that 39 percent of the observed poor are non vulnerable. This simply reflects none the known deterministic nature of the relationship between poverty and vulnerability that is mentioned in the above paragraphs. Moreover, this is also apparent in our results which show that 57 percent of the

non-vulnerable households and 55 percent of the vulnerable households are poor (Table 7).

Amongst the households classified as vulnerable (vulnerability level higher than 22 percent), 77 percent are highly vulnerable. This constitutes 47.4 percent of the population of our study area. And among the highly vulnerable about 58 percent (27.6 percent of the overall population) is currently poor which implies that nearly 20% of the population is highly vulnerable but currently non-poor.

Table 7: Aggregate Vulnerability Profile

Vulnerability Measures	Overall	Among Non Poor	Among Poor	Among Non Vulnerable	Among Vulnerable	Among Relatively Vulnerable	Among High Vulnerable
Mean Consumption/Capita	2,057.22	3,608.51	826.88	2,188.88	1,974.93	1,851.11	2,011.74
Mean Vulnerability	0.47	0.45	0.49	0.02	0.76	0.33	0.88
Number of HH in Group	156	69	87	60	96	22	74
Population Share	1.00	0.44	0.56	0.38	0.62	0.14	0.47
Number of Poor	87	0	87	34	53	10	43
Number of Vulnerable	96	43	53	0	96	22	74
No of Relatively Vulnerable	22	12	10	0	22	22	0
No of Highly Vulnerable	74	31	43	0	74	0	74
Fraction of Poor	0.56	0.00	1.00	0.57	0.55	0.45	0.58
Fraction of Vulnerable	0.62	0.62	0.61	0.00	1.00	1.00	1.00
Fraction of Relatively Vulnerable	0.14	0.17	0.11	0.00	0.23	1.00	0.00
Fraction of Highly Vulnerable	0.47	0.45	0.49	0.00	0.77	0.00	1.00
Vulnerability to Poverty Ratio	1.10		0.61	0.00	1.81	2.20	1.72

Source: Authors' Calculation

To end up the discussion on the aggregate level of vulnerability, let us see the mean vulnerability across poverty and vulnerability status of households. The mean vulnerability for the non-poor (45 percent) and poor (49 percent) is about balanced. And households classified as non-vulnerable have mean probability of only 2 percent to be poor in the near future. Moreover, though mean vulnerability of the households classified as vulnerable is 76 percent, it is more certain (88 percent certain) that highly vulnerable households are going to be poor in the near future.

The central point from our discussion on aggregate vulnerability considering policy issues is that though poverty and vulnerability are two related concepts, there remain important distinctions between the two and neither is a subset of the other. Particularly in our study, a fraction of the population that faces considerable risk of poverty is higher than the fraction of the observed poor. The second important policy implication that emerges from the discussion is that characteristics of those who are observed to be poor at any given point in time may differ from the characteristics of those who are estimated to be vulnerable to poverty, whether or not they are currently poor. Hence, Interventions and programs that aim to reduce the level of vulnerability among the population may therefore need to be targeted differently from those aimed at poverty alleviation.

4.4.2 Comparing Vulnerability Profiles across Different Population Segments

In Tables 8 and 9 vulnerability profiles for different segments of population of the study area are presented. The vulnerability profile by Woreda and by certain selected demographic characteristics showing some insights, on average, about the geographical location of vulnerable along with their socio-economic characteristics is reported.

It begins our detailing by considering the spatial distribution of vulnerability. Vulnerability is high enough in all Woredas of the study area with high

variability across different Woredas. The tremendous variation in the poverty rates across Woredas of the study area has been documented in section 4.2 above. The fraction of the population that is observed to be poor ranges from a low of 40 percent in Hunbo to a high of 62 percent in Sodo. Inter-woreda differences in the estimated incidence of vulnerability are even more pronounced than the Woreda wide disparities in poverty rates (Table 8). The fraction of the population estimated to be vulnerable ranges from a low of 40 percent in Hunbo to a high of 70 percent Araka.

Table 8: Spatial Distribution of Vulnerability

Vulnerability Measures	Araka	Boditi	Humbo	Sodo	Tercha
Mean Consumption/Capita	2,287.51	2,521.32	1,849.81	1,243.68	3,611.94
Mean Vulnerability	0.50	0.56	0.33	0.52	0.30
Number in Group	27	23	5	73	28
Population Share	0.17	0.15	0.03	0.47	0.18
Number of Poor	12	14	2	45	14
Number of Vulnerable	19	15	2	47	13
Number of Relatively Vulnerable	5	1	0	10	6
Number of Highly Vulnerable	14	14	2	37	7
Fraction of Poor	0.44	0.61	0.40	0.62	0.50
Fraction of Vulnerable	0.70	0.65	0.40	0.64	0.46
Fraction of Relatively Vulnerable	0.19	0.04	0.00	0.14	0.21
Fraction of Highly Vulnerable	0.52	0.61	0.40	0.51	0.25
Share of overall poor	0.14	0.16	0.02	0.52	0.16
Share of overall Vulnerable	0.18	0.17	0.02	0.51	0.11
Share of Highly Vulnerable	0.17	0.15	0.03	0.48	0.16
Vulnerability to Poverty Ratio	1.58	1.07	1.00	1.04	0.93

Source: Authors' Calculation

Moreover, the estimated mean vulnerability also shows considerable difference among different regions. Humbo and Tercha on average lie on the relatively vulnerable category (Vulnerability between than 0.22 and 0.5) whereas the remaining Woredas are among the highly vulnerable (Vulnerability higher than 0.5). It is also easy to recognize from Table 8 that though Araka has

the highest incidence of vulnerability, Boditi is number one considering the fraction of highly vulnerable within its population

Two important points revealed from comparison of vulnerability and poverty across geographic composition that indicate differences in distribution of the vulnerability are: First, in each Woredas the estimated incidence of vulnerability is at least as high (Humbo) and in most cases higher, than the observed incidence of poverty (Table 8). Moreover, there is considerable variation in the vulnerability to poverty ratio. Based on Table 8 vulnerability to poverty ratio for Araka is 1.58 showing vulnerability to poverty is dispersed among the population. In contrast, the vulnerability to poverty is much concentrated in the rest of the Woredas with vulnerability to poverty ratio of around 1.

The second important point from the comparison is that, two geographic segments with roughly similar observed poverty rates may have very different incidences of vulnerability. This can be revealed from Humbo and Araka Woredas. In both Woredas incidence of poverty is almost balanced (Table 8). However, the estimated fraction of vulnerability in Araka is 70 percent, pretty high compared to the incidence of vulnerability in Humbo (40 percent).

Turning the discussion to the comparison of vulnerability across demographic composition of the population, there is a difference in the poverty and vulnerability rates for different groups. Female headed households are found to be poorer and more vulnerable than male households (Table 9). Moreover, all of the vulnerable female headed households are estimated to be highly vulnerable but vulnerability to poverty is much concentrated in male headed households. When we consider the age of the households, surprisingly, households with aged heads (60 years or higher) are less poor and less vulnerable than those households headed by younger people (less than 60 years) (Table 9). In addition to this Table 9 reveals that vulnerability to poverty is much dispersed in the households headed by aged heads as indicated by high vulnerability to poverty ratio (2.25).

Table 9: Vulnerability across Different Demographic Composition

Vulnerability Measures	House Head Sex		House Head Age		House Head Marital Status		HH Dependency Ratio	
	Female	Male	>= 60 Years	< 60 Years	Married	Unmarried	< 0.25	>=0.25
Mean Consumption per Capita	2,319	2,023	1,422	2,124	1,717	5,293	4,213	1,410
Mean Vulnerably	0.92	0.42	0.48	0.47	0.46	0.70	0.79	0.74
Number in Group	18	138	15	141	136	16	36	120
Population Share	0.12	0.88	0.10	0.90	0.87	0.13	0.23	0.77
Number of Poor	13	74	4	83	77	10	14	73
Number of Vulnerable	17	79	9	87	80	16	22	74
Number of Relatively Vulnerable	0	22	2	20	17	5	5	17
Number of Highly Vulnerable	17	79	9	87	63	11	22	74
Fraction of Poor	0.72	0.54	0.27	0.59	0.57	0.50	0.39	0.61
Fraction of Vulnerable	0.94	0.57	0.60	0.62	0.59	0.80	0.61	0.62
Fraction of Relatively Vulnerable	0.00	0.16	0.13	0.14	0.13	0.25	0.14	0.14
Fraction of Highly Vulnerable	0.94	0.41	0.47	0.48	0.46	0.55	0.47	0.48
Share of overall poor	0.15	0.85	0.05	0.95	0.89	0.11	0.16	0.84
Share of overall Vulnerable	0.22	0.78	0.10	0.90	0.84	0.55	0.50	0.47
Share of Highly Vulnerable	0.13	0.86	0.10	0.90	0.87	0.13	0.24	0.76
Vulnerability to Poverty Ratio	1.31	1.07	2.25	1.05	1.04	1.60	1.57	1.01

Source: Authors' Calculation

Another important point implied by Table 9 is households headed by married heads are poorer but less vulnerable than households headed by unmarried heads. Households with high dependency ratios are likely to be poorer and more vulnerable than households with low dependency ratios and vulnerability is concentrated in the households with high dependency ratios.

For households with in the lowest educational attainment category, which make up 17 percent of the overall population, the incidence of poverty is about same compared to the second lowest educational attainment category but with higher vulnerability incidence (74 percent) compared to the other educational attainment categories. However, vulnerability and poverty declines as educational attainment increases for the rest of educational attainment categories (Table 9). It is not also surprising to note from Table 9 that vulnerability is dispersed in the households with heads that complete higher education.

If we divide the sample according to the employment status of the household head (Table 10) we realize that though households with heads having no occupation have lower incidence of poverty, they are estimated to have higher vulnerability incidence next to households with salaried heads. An important point to add here is that, households with paid work that constitute 60 percent of the population, on average, lie in the high vulnerable category (mean vulnerability of 0.51) with 52 percent of the group being highly vulnerable but with dispersed vulnerability.

Table 10: Vulnerability Profiles for Different Educational and Occupational Levels

	Educational level of House head				Occupational level of House head			
	No school	Primary School	Secondary School	Higher Education	No occupation	Unpaid work	Paid work	Petty trad
Mean Consumption/Capita	1,322.59	1,835.55	2,613.64	2,331.93	3,873.31	1,068.65	1,967.17	2,273.12
Mean Vulnerability	0.66	0.53	0.42	0.31	0.54	0.33	0.51	0.43
Number in Group	27	53	38	38	18	28	94	16
Population Share	0.17	0.34	0.24	0.24	0.12	0.18	0.60	0.10
Number of Poor	17	34	22	14	7	19	50	11
Number of Vulnerable	20	36	22	18	11	12	64	9
Number of High Volatility Vulnerable	0.00	4.00	5.00	2.00	3.00	0.00	7.00	1
Number of Low Mean Vulnerable	20	32	17	16	8	12	57	8
Fraction of Poor	0.63	0.64	0.58	0.37	0.39	0.68	0.53	0.69
Fraction of Vulnerable	0.74	0.68	0.58	0.47	0.61	0.43	0.68	0.56
Fraction of High Volatility Vulnerable	0.00	0.08	0.13	0.05	0.17	0.00	0.07	0.06
Fraction of Low Mean Vulnerable	0.74	0.60	0.45	0.42	0.44	0.43	0.61	0.50
Share of overall poor	0.20	0.39	0.25	0.16	0.08	0.22	0.57	0.13
Share of overall Vulnerable	0.24	0.38	0.22	0.16	0.13	0.13	0.65	0.09
Share of High Volatility Vulnerable	0.00	0.36	0.24	0.22	0.11	0.00	0.60	0.13
Share of Low Mean Vulnerable	0.20	0.35	0.22	0.20	0.14	0.18	0.59	0.10
Low Mean Vulnerable to Poverty Ratio	1.18	0.94	0.77	1.14	1.14	0.63	1.14	0.73

Source: Authors' Calculation

4.4.3 Geographic Targeting Using Vulnerability Estimates

In cases where regional disparities in poverty are common, geography is often the basis for poverty targeting. For example in Ethiopia, the outcomes of the regional poverty analysis are often used in designing appropriate poverty interventions (pro-poor programs) such as intensification of agriculture, infrastructural development, food security programs, the pro-poor urban development activities (such as development of micro and small scale enterprise development and use of cobblestone in urban road construction, housing construction, etc), the on-going efforts undertaken by the government to create a favorable environment for private sector investment and job creations, and the distribution of subsidized food to the urban poor (MoFED, March 2012). The World Bank, the huge development partner of Ethiopia, also argues that the main block grant from the central government to local government units (LGUs) and the Internal Revenue Allocation (IRA) should explicitly be based on poverty criterion (World Bank, 2000).

With the increasing number of fiscal decentralization initiatives like in Ethiopia, under which funds and expenditure authority are being devolved down to local governments, a better understanding of the geographic aspects of poverty has become even more crucial. If the severity of poverty in a region is to be included in the criteria for determining the allocation of central funds, information on the geographic distribution of poverty is obviously essential.

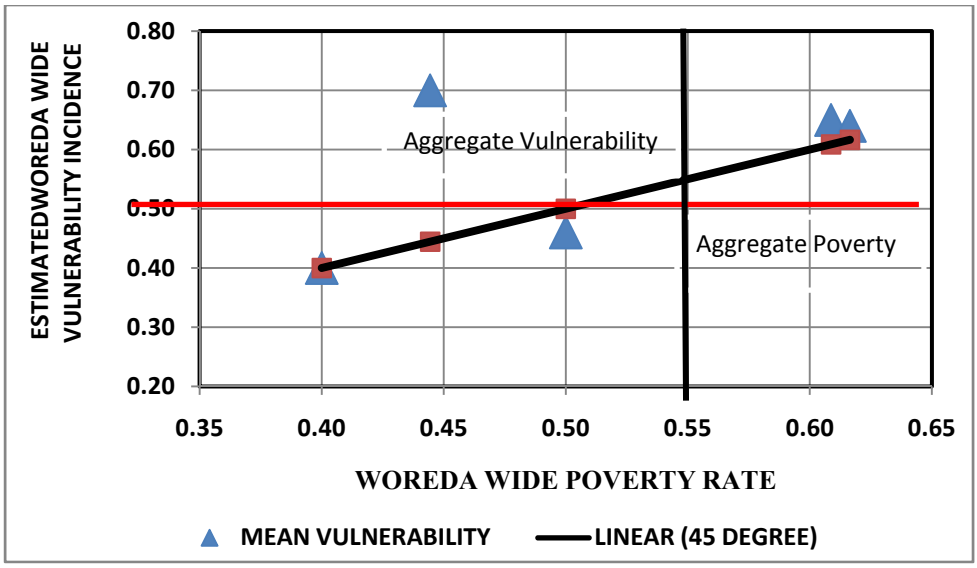
The method we proposed here (an assessment of the geographic distribution of vulnerability to poverty) supports the effective allocation of available resources to poverty concerned programs. But doing so raises the question of whether funds for poverty alleviation efforts should be allocated on the basis of the incidence of poverty or the incidence of vulnerability to poverty. If the rankings of geographic units in terms of vulnerability and poverty are largely overlap, the question could obviously be sidestepped. However, Chart 5 below, which plots the estimated incidence of vulnerability against the observed incidence of

poverty for each Woreda, shows differences in poverty and vulnerability incidences across Woredas.

For most Woredas, the estimated incidence of vulnerability is higher than the observed incidence of poverty. This can be seen from the fact that three of the Woredas lie above the 45-degree line (Chart 5). The remarkable note here is that geographic targeting based on incidence of poverty ranking drives to different actions compared to geographic targeting based on incidence of vulnerability. If we consider geographic targeting based on incidence of poverty, Woredas to the left of aggregate poverty line (Araka, Humbo and Tercha) will not be included in the program. But if we consider geographic targeting based on vulnerability, Woredas above the aggregate vulnerability line and to the left of aggregate poverty line (Araka) along with Woredas to the right of the aggregate poverty and above the aggregate vulnerability line (Sodo and Boditi) will be included in the program.

The key to resolving this apparent dilemma lies in distinguishing ex-ante poverty prevention interventions from ex-post poverty alleviation interventions. The incidence of poverty should determine the allocation of funds for ex-post poverty alleviation programs. In case of Ethiopia this may constitute programs like food for work, distribution of subsidized food items, use of cobblestone road construction and housing construction for urban job creation, housing construction (condominium) for low income households, etc. However, the allocation of funds for preventive interventions (ex-ante interventions aimed at poverty prevention) should be guided by the incidence of vulnerability to poverty. Ex-ante poverty prevention interventions may include infrastructural development, vocational training schemes, agricultural extension programs, investment funds to major irrigation projects,d etc.

Chart 5: Poverty Rate Vs Vulnerability Incidence for Woredas



4.4.4 Exploring the Proximate Sources of Vulnerability

A wide range of literature on vulnerability to poverty pinpoints that households with similar levels of vulnerability may be vulnerable for very different reasons. Vulnerability to poverty may stem primarily from low long term consumption prospects or from volatile consumption prospects. Vulnerability due to high consumption volatility may call for ex-ante interventions that reduce the risks faced by households like insurance for crop production for peasant households that live in arid areas. On the other hand, vulnerability due to low endowments may need transfer programs like distribution of subsidized food items to the urban poor. Hence, from a policy perspective, it will be important to distinguish between these possible sources of vulnerability to poverty.

Chart 6 shows differences, though not much, in the sources of vulnerability to poverty for the same vulnerability levels. We have plotted our estimates of the mean and standard deviation of consumption for households with selected levels of vulnerability thereby constructing, empirically, a number of iso-

vulnerability curves (combinations of mean consumption and standard deviation of consumption that imply the same level of vulnerability).[1]

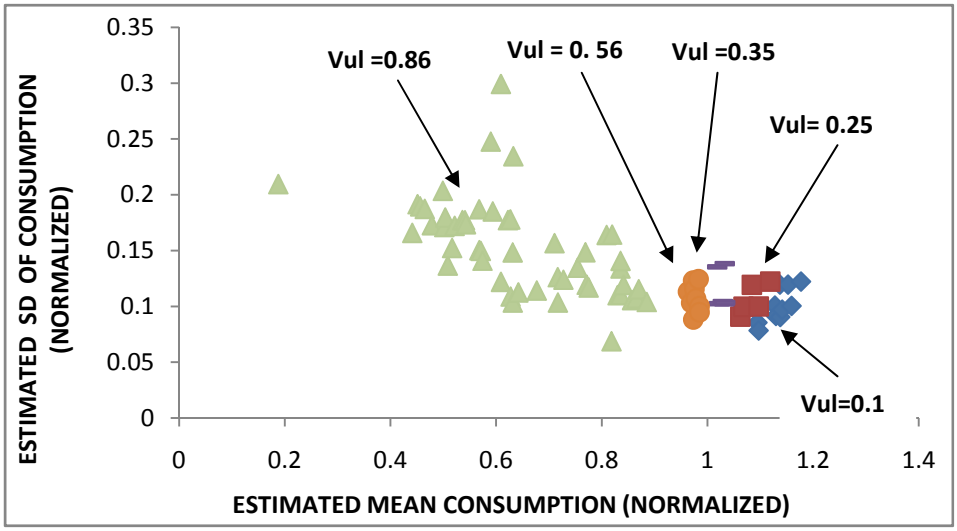
Consider the cluster of points associated with a vulnerability level of 0.25, which is slightly above the threshold level of vulnerability (0.22) above which we consider households to be vulnerable. All the households represented in this cluster have estimated levels of vulnerability in the range of 0.2405 and 0.262. Yet the normalized mean consumption levels estimated for these households (the ratio of estimated mean consumption to the poverty line) ranges from a low of about 1.06 (with correspondingly lower levels of normalized volatility) to a high of about 1.2. Within this group, therefore, some households are vulnerable because they have low levels of mean consumption whereas others are vulnerable because their consumptions are more volatile (positively slopped iso-vulnerability curve).

However, mean and standard deviation of consumption need not be monotonically related across households. For instance, amongst households with an estimated vulnerability level of 0.35, a household with the highest estimated standard deviation of consumption has a lower estimated mean level of consumption than several of the households with lower estimated levels of vulnerability (steeper positively slopped iso-vulnerability curve). This implies that, estimated variance of consumption to be always higher for households with higher estimated mean consumptions. Hence, the effect of consumption volatility on vulnerability to poverty declines for higher estimated levels of vulnerability with lower mean consumption.

To facilitate the discussion of the sources of vulnerability we adopt a three-way classification of households. The first group is non-vulnerable group with an estimated vulnerability level below the threshold level of 0.22 and has estimated levels of mean consumption well above the poverty line. The second group, whom we label the high volatility (HV) vulnerable, is that with an estimated vulnerability level above the threshold, but estimated mean

consumption above the poverty line. These households are vulnerable because their consumptions are volatile. Were we to eliminate the variability in their consumptions, these households, because their mean consumptions lie above the poverty line, would no longer be vulnerable to poverty. The third group is low-mean (LM) vulnerable group which consists of those households with mean levels of consumption below the poverty line and households having vulnerability levels of above 0.5.

Chart 6: Estimated Standard deviation (SD) Vs Mean Consumption for selected Vulnerability levels



Keeping this classification in mind, we estimate that 54 percent of the population is vulnerable due to their low endowments while 7 percent is vulnerable because of high consumption volatility (Table 11). Thus, of the 62 percent of the population that is estimated to be vulnerable, only 11.5 percent are so due to the high volatility of their consumption. Low mean income is also the main source of vulnerability for those currently poor. Of the 61 percent of the poor whom we estimate to be vulnerable, almost all are vulnerable

because they have low endowments (Table 11). To put it in another way, no currently poor household will be out of poverty even if they stabilize their consumption streams in the near future. However, we could not sidestep the effect of consumption volatility on the future poverty of the currently non-poor households. Out of the 62 percent of the currently non poor vulnerable households, 23.3 percent are high volatile income vulnerable which means about 23.3 percent of the non-poor households will not be poor in the near future if they stabilize their consumption in the near future. An important point that should be noted is also that low mean vulnerability is somewhat concentrated among vulnerable households (with LM vulnerability to poverty ratio of 1.6)

Table 11: Sources of Vulnerability (Aggregate)

	Overall	Among Non-Poor	Among Poor	Among Non-Vulnerable	Among Vulnerable	Among High Volatility Vulnerable	Among Low Mean Vulnerable
Mean Consumption/Capita	2,057.22	3,608.51	826.88	2,188.88	1,974.93	7,961.97	1,200.13
Mean Vulnerability	0.47	0.45	0.49	0.02	0.76	0.79149335	0.75125712
Number in Group	156	69	87	60	96	11	85
Population Share	1.00	0.44	0.56	0.38	0.62	0.07	0.54
Number of Poor	87	0	87	34	53	1	52
No of Vulnerable	96	43	53	0	96	11	85
No of High Volatility Vulnerable	11	10	1	0	11	11	0
No of Low Mean Vulnerable	85	33	52	0	85	0	85
Fraction of Poor	0.56	0.00	1.00	0.57	0.55	0.09	0.61
Fraction of Vulnerable	0.62	0.62	0.61	0.00	1.00	1.00	1.00
Fraction of High Volatility Vulnerable	0.07	0.14	0.01	0.00	0.11	1.00	0.00
Fraction of Low Mean Vulnerable	0.54	0.48	0.60	0.00	0.89	0.00	1.00
Low Mean Vulnerable to Poverty Ratio	0.98		0.60	0.00	1.60	0.00	1.63

Source: Authors' Calculation

Looking at the differences in the sources of vulnerability across Woredas (Table 12), Sodo town compared to the other Woredas has higher fraction of low mean vulnerable households in which amongst the vulnerable households living in Sodo almost all are low income vulnerable. Even though Humbo has the lowest proportion of vulnerable households, almost all of its vulnerable households are low income vulnerable like Sodo town. However, 21 percent of the vulnerable households living in Araka and 26.7 percent of the vulnerable households living in Boditi will not be poor in the near future if they smooth their consumption. Moreover, low mean vulnerability is concentrated in Araka compared to other Woredas (LM vulnerability to poverty ratio of 1.25)

Table 12: Sources of Vulnerability (Spatial Differences)

	Araka	Boditi	Humbo	Sodo	Tercha
Mean Consumption/Capita	2,287.51	2,521.32	1,849.81	1,243.68	3,611.94
Mean Vulnerability	0.50	0.56	0.33	0.52	0.30
Number in Group	27	23	5	73	28
Population Share	0.17	0.15	0.03	0.47	0.18
Number of Poor	12	14	2	45	14
Number of Vulnerable	19	15	2	47	13
Number of High Volatility Vulnerable	4	4	0	1	2
Number of Low Mean Vulnerable	15	11	2	46	11
Fraction of Poor	0.44	0.61	0.40	0.62	0.50
Fraction of Vulnerable	0.70	0.65	0.40	0.64	0.46
Fraction of High Volatility Vulnerable	0.15	0.17	0.00	0.01	0.07
Fraction of Low Mean Vulnerable	0.56	0.48	0.40	0.63	0.39
Share of overall poor	0.14	0.16	0.02	0.52	0.16
Share of overall Vulnerable	0.18	0.17	0.02	0.51	0.11
Share of High Volatility Vulnerable	0.17	0.16	0.00	0.59	0.13
Share of Low Mean Vulnerable	0.16	0.16	0.04	0.49	0.14
Low Mean Vulnerable to Poverty Ratio	1.25	0.79	1.00	1.02	0.79

Source: Authors' Calculation

From Table 13 it is also clear to recognize differences in the sources of vulnerability in different demographic segments of the population. Though households with unmarried heads have higher incidence of vulnerability (80 percent) compared to households headed by married heads (59 percent), most vulnerable married headed households are low mean vulnerable and 20 percent of the vulnerable unmarried headed households are volatile income vulnerable. Depending on the dependency ratio of the households, the proportion of low dependency households that could be prevented from being poor in the near future by smoothing their consumption (19 percent) is higher than that of the higher dependency households (3 percent). However, male and female headed households have same proportion of their vulnerable households that could be prevented from being poor in the future if their consumption is stabilized (around 11 percent of the vulnerable). Moreover, low mean vulnerability to poverty if a much more concentrated amongst the households headed by old aged (60 years and higher) heads compared to the households headed by younger people (less than 60 years)

A similar clear pattern emerges in differences in the sources of vulnerability across educational attainment and occupation categories (Table 14). As seen from the educational attainment prospective of heads, educational attainment, though not much, bring differences in the sources of vulnerability. Of the primary school completed vulnerable household and higher education completed vulnerable household, 11.1 percent is each are found to be high volatile consumption vulnerable. But the number of low income vulnerable for secondary education completed headed households is comparatively lower (with 22.7 percent high volatile consumption vulnerable) than the remaining educational attainment categories. Moreover, households with heads that are not engaged in any work have a higher number of vulnerable that may be prevented from being poor in the near future by smoothing consumption compared to the other occupational levels.

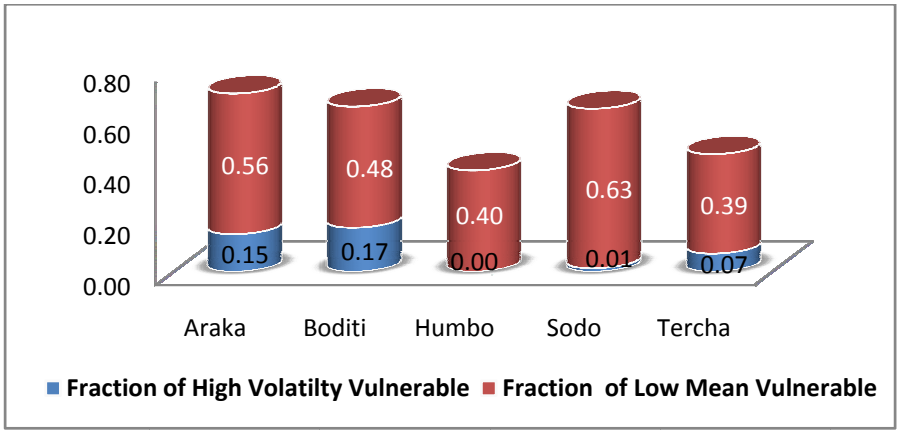
Table 13: Sources of Vulnerability (Demographic Differences)

	House Head Sex		House Head Age		House Head Marital Status		HH Dependency	
	Female	Male	>= 60 Yrs	< 60 Yrs	Married	Unmarried	< 0.25	>=0.25
Mean Consumption/ Capita	2319.4203	2,023.02	1,422.55	2,124.73	1,717.53	5,293.81	4,213.95	1,410.20
Mean Vulnerability	0.92	0.42	0.48	0.47	0.46	0.70	0.79	0.74
Number in Group	18	138	15	141	136	16	36	120
Population Share	0.12	0.88	0.10	0.90	0.87	0.13	0.23	0.77
Number of Poor	13	74	4	83	77	10	14	73
Number of Vulnerable	17	79	9	87	80	16	22	74
Number of High Volatility Vulnerable	2	9	0	11	7	4	7	4
Number of Low Mean Vulnerable	15	70	9	76	73	12	15	70
Fraction of Poor	0.72	0.54	0.27	0.59	0.57	0.50	0.39	0.61
Fraction of Vulnerable	0.94	0.57	0.60	0.62	0.59	0.80	0.61	0.62
Fraction of High Volatility Vulnerable	0.11	0.07	0.00	0.08	0.05	0.20	0.19	0.03
Fraction of Low Mean Vulnerable	0.83	0.51	0.60	0.54	0.54	0.60	0.42	0.58
Share of overall poor	0.15	0.85	0.05	0.95	0.89	0.11	0.16	0.84
Share of overall Vulnerable	0.22	0.78	0.10	0.90	0.84	0.55	0.50	0.47
Share of High Volatility Vulnerable	0.14	0.84	0.00	0.90	0.92	0.01	0.01	0.02
Share of Low Mean Vulnerable	0.15	0.83	0.10	0.90	0.88	0.12	0.25	0.77
Low Mean Vulnerable to Poverty Ratio	1.15	0.95	2.25	0.92	0.95	1.20	1.07	0.96

Source: Authors' Calculation

To wind up the discussion in sources of vulnerability, the majority of the vulnerable (88.5 percent of the overall vulnerable) of the study area is low income vulnerable (Chart 7). This suggests that calls for ex-ante interventions that reduce the risks faced by households is not a preferable policy measure. Transfer programs like distribution of subsidized food items to the urban poor should rather be made intensively.

Chart 7: Geographic Incidence of HV and LM Vulnerability



5. Conclusions and Recommendations

5.1 Conclusions

1. Poverty is quite high in Wolaita and Dawuro zones. It is found that 56 percent of the sampled households are deemed poor. Moreover, there is a high poverty gap of households from the poverty line (with a poverty gap of 44 percent) and higher relative of deficiency among the poor (with poverty severity of 37 percent).
2. Extent of Poverty differs across different geographic and demographic segments of the population. Poverty, as measured by FGT indices, is worst in Sodo and Boditi compared to other sampled Woredas. Sex, marital status and age of household heads also affect the level of household poverty. Male headed households are less poor than female headed

households and households with unmarried heads are less poor than those with married heads. A little bit surprising is that, households with aged heads are less poor than households with young heads. Moreover, poverty declines as education of household heads increases but households with no occupation are less poor.

3. The study estimated the vulnerability to poverty of households using 2011 cross sectional data drawn from five Woredas of Wolaita and Dawuro zones and found that on average there is 0.47 probability of entering into poverty a period ahead. The vulnerability of a household is positively significantly correlated with dependency ratio, number of household members with primary education and number of members with paid work. Factors like household sex (Male =1, Female =0), adult equivalent and house head education found negatively correlated with the household's vulnerability to poverty. It is also consistent with geographical differences which induce significant differences in vulnerability of households.
4. In Wolaita and Dawuro zones, the fraction of the population that faces a non-negligible risk of poverty (62 percent) is considerably greater than the fraction that is observed to be poor (56 percent). This study also notes that a significant proportion of the non-poor (62 percent of the non-poor) is vulnerable to poverty.
5. The findings of the study suggest that for a wide range of vulnerability thresholds, poverty and vulnerability are significantly different from each other and this implies that not all the poor are vulnerable. Hence, the study argued that while thinking about anti-poverty policy interventions in these zones, we should look at not only just who is poor today, but also who is likely to be poor in the future.
6. In thinking about forward-looking anti-poverty policy interventions in these zones, the key point lies in distinguishing ex-ante poverty prevention interventions from ex-post poverty alleviation interventions. The incidence of poverty should determine the allocation of funds for ex-post poverty alleviation programs. In case of Ethiopia this may constitute programs like food for work, distribution of subsidized food items, use of cobblestone

road construction and housing construction for urban job creation, housing construction (condominium) for low income households, etc. However, the allocation of funds for preventive interventions (ex-ante interventions aimed at poverty prevention) should be guided by the incidence of vulnerability to poverty. Ex-ante poverty prevention interventions may include infrastructural development, vocational training schemes, agricultural extension programs, investment funds to major irrigation projects and, etc.

7. The majority of the vulnerable (88.5 percent of the overall vulnerable) of the study area is low income vulnerable. Moreover, there is no striking difference in sources of vulnerability to poverty across different population segments in which low endowments are the main source of vulnerability to poverty in all segments. This suggests that while we are looking for forward looking anti-poverty interventions, we should focus on those that boost endowments of households in the prior period.

5.2 Recommendations

1. As poverty and vulnerability to poverty are the big risk faced by households living in Wolaita and Dawuro zones, the regional government in general and the zonal administrations in particular should work hard to implement the well-known poverty targeted programs launched by the Federal Government of Ethiopia.
2. As vulnerability is quite high in both zones, zonal administrations should not ignore ex-ante poverty prevention interventions. However, since the majority of the vulnerability to poverty sources stem from low mean consumption both zonal administrations should emphasize on transfer programs.
3. The Wolaita zonal administration should give due attention to Sodo and Boditi towns in implementing poverty alleviation programs. Moreover, when zonal administrations undertake transfer programs, female headed households, households with married heads, households with less

educated heads and households headed by young people (at most 60 years older below) should be given priority. The priority should also be in the order of leadership sex marital status, education and age.

4. Humbo and Tercha Woredas can be given less priority when both zonal administrations are dealing with ex-ante poverty prevention interventions. Moreover, when zonal administrations undertake ex-ante poverty prevention interventions, female headed households, households with unmarried heads, households with less educated heads, households with paid works and households headed by young people (at most 60 years old) as below, should be given priority.

The priority should also be in the order of headship sex, marital status, education and age.

References

Skoufias and Quisumbing (2003). "Consumption Insurance and Vulnerability to Poverty: A synthesis of the evidence from Bangladesh, Ethiopia, Mali, Mexico and Russia".

Ligon and Schechter (2003): "Measuring Vulnerability: The Director's Cut. Chiwaula, Levison; Waibel, Hermann (2011). A case study from the Hadejia-Nguru *Wetlands in Nigeria",* Proceedings of the German Development Economics Conference, Berlin 2011, No. 19

Bali *and* Floro (2008). "Effect of Microfinance on Vulnerability, Poverty and Risk in Low Income Households."

Addis Ababa City Administration. (2009). *"Food Security and Vulnerability in Addis Ababa"* Addis Ababa Ethiopia.

Awel and Yusuf (2007)."Vulnerability and Poverty Dynamics in Rural Ethiopia", Department of Economics, University of Oslo, May 2007.

Makoka (2008)."*The Impact of Drought on Household Vulnerability: The Case of Rural Malawi",* University of Bon, July 2008.

Aline Coudouel, Jesko S. Hentschel, and Quentin T. Wodon (2006)."Poverty Measurement and Analysis."

Seyoum Tsehaye & Bauer (2012)."*Poverty Dynamics and Vulnerability: Empirical Evidence from Smallholders in Northern Highlands of Ethiopia."*Justus Liebig University Institute of Project and Regional Planning.

Kasirye (2007)."*Vulnerability and Poverty Dynamicsin Uganda (1992-1999)",* Research series no. 51.

Chaudhuri and jalan (2002)."*Assessing household vulnerability to poverty from cross-sectional data: a methodology and estimates from Indonesia",* Colombia university, New York, USA.

Yamané, T. (1973). *"Statistics: An introductory analysis",* New York: Harper and Row.

MoFED (2012). *"Ethiopia's Progress towards Eradicating Poverty: An Interim Report on Poverty Analysis Study (2010/11)",* Addis Ababa, Ethiopia.

MACROECONOMICS DETERMINANTS OF INFLATION AND ITS EFFECT ON ECONOMIC GROWTH IN ETHIOPIA

Abate Yesigat[1]

Abstract

Ethiopia has experienced increasing inflation since 2003 onwards and the existence of high inflation under the face of high economic growth has puzzled many about its source and effect on economic growth. Hence, the main focus of the study is to examine the determinants of inflation and its effect on economic growth in Ethiopia using a cointegrated VAR model over the period 1974/75 to 2009/10. The result of cointegration test, using Johansen Maximum likelihood approach, indicates the existence of long run relationship among the variables entered in both inflation and growth models.

The estimated result of the mixed inflation model ,which includes both demand and supply side variables revealed that the main determinants of inflation in the long run are expected inflation, exchange rate and foreign price whereas money supply, real GDP, foreign price, interest rate and expected inflation are the short run determinants of inflation in Ethiopia. Moreover, the results from the growth model shows that inflation has insignificant effect on economic growth in the long run, while it affects negatively and significantly in the short run. To control inflation, therefore, the monetary authority needs to use tight monetary policy and the government may also reduce imported inflation by encouraging import substituting industries. Besides, increasing agricultural productivity which rises food supply has a down ward pressure on inflation in Ethiopia.

Keywords: Inflation, Economic growth, VAR model, Ethiopia

[1] Department of Economics, Hawassa University: e-mail:abateyesigat@yahoo.com

1. Introduction

There is a high-level consensus among many economists, central bankers and policy makers that one of the fundamental objectives of macroeconomic policies in both the developed and developing economies is to sustain high economic growth together with low inflation (chimobi, 2010). Likewise, one of the most fundamental objectives of macroeconomic policies in Ethiopia is to sustain high economic growth together with low, single-digit inflation (MoFED, 2010).

Historically, the Ethiopian economy was known for its low inflation. Prior to 2003/04, the country has not suffered from high inflation. The major hikes in the general price level occurred during the times of war and drought only. Many people relate this price stability achievement to strict fiscal and monetary policy of the imperial regime, the direct price control policy of the socialist government, and the prudent macroeconomic stabilization policy of the current government until 2003/04 (Alemayehu & Kibrom, 2008). Since 2004, however, the economy has deviated from its historical trends of stable price and inflation rose from 3.3 percent in 2004/05 to as high as 44.39 percent in 2008/09 (NBE, 2010). Similarly, over the long period of time the Ethiopian economy was known by its slow growth rate and highly dominated by the agricultural sector, which contributes more than 50 percent of the GDP. However, for the last few years, Ethiopian economy has shown continuous and high growth rate. For instance, between 2004/05 and 2009/10 real GDP grew by more than 11 % on average (MoFED, 2010).

The existence of high inflation under double digit economic growth seems contradictory situation and puzzling for the policy makers and for the societies at large. Moreover, the increasing price has also become detrimental to the low-income groups and retirees who live with a fixed income. This situation has got wide range of debate regarding the source and impact of inflation on economic growth among different stockholders. They also argued that the

upsurge in inflation may adversely affect economic growth that the country has experienced recently (Emerta, 2011). Moreover, throughout the five-year growth and transformation plan, the government intends to keep inflation below 10 percent (MoFED, 2010) so as to maintain macroeconomic stability and boost saving and investment. Thus, to control inflation and to know its effect on economic growth, understanding and identifying the main sources of inflation and its effect on economic growth is a prerequisite and needs a rigorous empirical analysis.

Theoretical the determinant of inflation differs among different schools of thought. For example, the Structuralist school emphasizes supply side factors as determinants of inflation. In contrast, the monetarist approach emphasizes, "inflation is always and everywhere a monetary phenomenon" in the sense that an increase in money stock eventually leads to a rise in prices in the same proportion (Friedman, 1956).

Like the contradicting theoretical views about the sources and impact of inflation on economic growth, there is also lack of consensus in the previous empirical findings as to the main determinants of inflation and its effect on economic growth. For instance, some have identified that excess aggregate demand generated by expansionary monetary policy to finance government expenditure are the key driving factors of inflation in the long-run (World Bank (2007), IMF (2008), and Alemayehu & Kibrom (2008)), while EDRI (2007) and FAO (2008) argue that other domestic and external factors, and Loening et al. (2009) found that external sector are accounted for the increasing inflation. Besides, the inconsistence research outputs previous studies (such as Alemayehu and Kibrom, 2008; Taddesse, 2010; Loening, 2009) not only focus on food price inflation but also do not cover the period of high inflation.

On the other hand, both theory and empirical evidence indicate that there is no straightforward and one-sided relationship between inflation and economic growth. Put differently, different studies both in developed and developing

countries shows different results such as; no-relationship (Datta and Kumar, 2011), negative relationship (Barro, 1995; Ahmed and Mortaza, 2005) and positive relationship (Mallik and Chowdhury ,2001).

Despite this plethora of studies both for developing and developed countries, the literature on inflation and economic growth in Ethiopia is scanty. Thus, examining the effect of inflation on economic growth and assessing its determinants in the case of Ethiopia is very important. Thus, the motivation is to fill the indicated gap and to analyze the macro level determinants and effects of inflation on economic growth in Ethiopia. Specifically the study aimed:

- To identify the short-run and long-run macroeconomic determinants of inflation in Ethiopia.
- To identify the extent and significance of the pass-through of changes in foreign prices and the exchange rate to domestic prices in Ethiopia.
- To empirically examine the short-run and long-run impact of inflation on economic growth of Ethiopia.
- To indicate the possible policy implications based on the finding.

2. Methodology

2.1 Theoretical framework and model specification

2.1.1 Determinants of inflation

In this part, a model that examines the determinants of inflation and the relative role of exchange rates is developed. It is constructed on the basis of different previous models of inflation, particularly those employed to the problem in the developing countries. Different studies place varying weights on different sources of inflation.

In case of developing countries, the Major sources of inflationary phenomenon may include public finance, demand factors (monetarist and Keynesian theories), cost push factors and price inertia (expectation based price

stickiness). In case of the first one, if the government expenditure requirement exceeds its income generation capacity and if this gap is financed via the central bank resources, it may lead to inflationary phenomenon. If the government finances its budget deficit through borrowing from central bank, the growth of monetary base over the demand for these balances by economic agents can cause the public finance requirement to be considered as the main determinant of inflationary process and in a such environment inflation would be a fiscal phenomenon reflecting expenditure pressure on public sector, rather than a monetary case.

The second main cause for inflation in developing countries in particular is the demand determined factors. Monetarists have the opinion that the quantity of money and the general price level have a proportionate relationship between each other and the direction of this relationship flows from the changes in monetary balances to the changes in price level, that is, inflation. The increase in money supply does not have any effect upon real variable but, raises the price level directly showing the demand pressure in the economy (Dornbusch, 1994).

The third potential reason for inflationary process in developing country is given by Post- Keynesian school of thought (Structuralist economists). This school of thought argues that the main cause of inflation is the cost-push factors (supply side factors) and these include output level, exchange rate, foreign price, wage and interest rate (Fischer, 1986). As a last reason of inflation, we can take account of expectation-based price rises (price inertia). But this factor would be a secondary reason securing the perpetuity of past inflation to future. This means that the past inflation experience is the main causes of inflation.

Moreover, quantity theory of money and the purchasing power parity theory of exchange rate clearly establish the relationship between price and exchange rate and states that price level is a function of exchange rate. That means,

these two theories are used to formulate the theoretical frame work for our inflation model in the present study. The quantity theory of money has since the 16th century been used to explain the relationship between money supply and inflation. It states that there is a direct relationship between the quantity of money in an economy and the level of prices of goods and services sold. The quantity theory of money can be stated as:

$$MV=YP \quad \textbf{(1)}$$

Where; M, V, Y and P are money supply, velocity of money, output and general price level for home country respectively. The theory assumes that V and Y are constant in the short term and the change in price level is proportional to the change in money supply. The above equation can be expressed as:

$$P=MV/Y \quad \textbf{(2)}$$

However, according to the Purchasing Power Parity (PPP) theory of exchange rate determination, the long-run equilibrium exchange rate of two currencies is the rate that equalizes the purchasing powers of the currencies. When the domestic prices of a country increase, the exchange rate of the country's currency must fall in order to return to PPP. The absolute PPP theory states that the equilibrium exchange rate between two currencies is equal to the ratio of the price in the two countries.

$$E=P/P^* \quad \textbf{(3)}$$

Where E, P and P* denote exchange rate, domestic and foreign price respectively. Therefore, from equation (2) and (3) we can derive the following theoretical frame work for our inflation model which states that domestic price level (P) is a function of domestic money supply (monetarist theory), domestic output level, exchange rate and foreign price (Structuralist theory).

$$P = MV/Y = E(P^*) \quad \textbf{(4)}$$

Equation (4) implies that domestic price level is a function of supply and demand side factors and states that the greater the devaluation of a nation's currency, the greater is its inflationary effects on the economy of the devaluating country (Dornbusch and Fisher, 1996). Therefore, following the works of (Tidiane, 2011, Hang and Thanh, 2010, Olusanya, 2008, Alemayehu and Kibrhom, 2008) the study will employ the following econometric model to examine the short-run and the long-run determinants of inflation in Ethiopia that comprise both the structural (cost-push) and the monetarists (demand-side) approach along with policy variables and adaptive expectations which helps to identify the main determinants of inflation can specified as follow.

$$CPI = \beta_0 + \beta_1 NEER_t + \beta_2 FCPI_t + \beta_3 M2_t + \beta_4 RGDP_t + \beta_5 EXINF_t + \beta_6 BD_t + \beta_7 IRr_t + \mu_t \quad \textbf{(5)}$$

Where CPI is domestic consumer price index, NEER is nominal effective exchange rate, FCPI is the foreign consumer price index, RGDP real gross domestic product, EXINF is expected inflation, IR is interest rate, μ -is the error term and all variables are in long form except interest rate and expected inflation.

2.1.2 Effects of inflation on economic growth

The phenomenon of inflation and its effect on real economic variables has been discussed ever since the appearance of classical economic theory and been developed later on as the development of modern economic theories. In this section, there will be a review of different economic theories, and the focus in this case is on the explanations of inflation and its effect on economic growth.

Classical growth theory: the Classical growth model was laid by Adam Smith who posited a supply side driven model of growth. He viewed saving as a creator of investment and hence growth. Therefore, he saw income distribution

as being one of the most important determinants of how fast (or slow) a nation would grow. He also posited that profits decline – not because of decreasing marginal productivity, but rather because the competition of capitalists for workers will bid wages up. The link between the change in price levels (inflation) and its effects on profit levels and output were not specifically articulated in classical growth theories. However, the relationship between the two variables is implicitly suggested to be negative, as the reduction in firms' profit levels through higher wage costs. Put simply, according to classical explanation inflation affects economic growth negatively (Gokal and Hanif, 2004).

Keynesian growth theory: In the framework of Keynesianism, the aggregate demand (AD) and aggregate supply (AS) curves are adopted to show the relationship between output and inflation. According to Keynesian, in the short run, the AS curve is upward sloping rather than vertical. If the *AS* curve is vertical, changes on the demand side of the economy affect only prices. However, if it is upward sloping, changes in *AD* affect both price and output. This holds with the fact that many factors, such as expectations, prices of other factors of production, fiscal and monetary policy, drive the inflation rate and the level of output in the short-run. When the general prices increase Producers of a certain product feel that only the prices of their products have increased while the other producers are operating at the same price level. However, in reality overall prices have risen. Thus, the producer continues to produce more and output continues to rise. It reveals that according to Keynesian there exists a positive effect of price increase on output at least in the short-run (Snow don, 2005).

Monetarist growth theory: Monetarists linked inflation and economic growth by simply using the quantity theory of money, by equating the total amount of spending to the total amount of money in the economy. This can be shown as below by taking Velocity of money constant in the short run:

$$\frac{\Delta Y}{Y} = \frac{\Delta M}{M} - \frac{\Delta P}{P} \quad \textbf{(6)}$$

Where: $\frac{\Delta Y}{Y}$ -the growth rate of output, $\frac{\Delta M}{M}$ -the growth rate of money supply and $\frac{\Delta P}{P}$ inflation. The above equation indicates unambiguously negative relationship between inflation and economic growth (Dornbusch and Fischer, 2001).

Neo-classical and endogenous growth theories: Mundell (1963) and Tobin (1965) have explained the effect of inflation on economic growth based on neo-classical growth theory. They depict a positive relationship between inflation and economic growth by assuming that real money balance and investment are substitute. Thus when inflation is high, it will decrease the return on real money balances but the return on investment will increase and people substitute real money balance by investing on other assets. This increases capital accumulation and the economic growth and it will show positive relationship between inflation and economic growth.

Contrary to the conclusion of the Mundell-Tobin effect, Stockman (1981) develops a long-run equilibrium growth model with assumption of "cash-in-advance constraint. In the model of Stockman (1981), the two variables relationship is complement, accounting for a negative relationship between the steady-state level of output and the inflation rate. Stockman models this cash investment as a cash-in-advance restriction on both consumption and capital purchases. Since inflation erodes the purchasing power of money balances, people reduce their purchases of both cash goods and capital when the inflation rate rises. Correspondingly, the steady-state level of output falls in response to an increase in the inflation rate. Also return to labor falls when the inflation rate rises. As such, people substitute away from consumption to leisure, because the return on labor falls and this in turn reduce economic growth.

Thus, this study has used the combination of the above theory so as to develop the theoretical frame work which helps to examine the effect of inflation on economic growth. According to the endogenous growth model, which is the extended form of the neo-classical growth model, production function is given as:

$$Y = F(K, L, H)..$$ **(7)**

Where, Y, K, L & H are levels of output, physical capital, labour force and human capital respectively and these variables are known as supply-driven inputs (Dornbusch and Fischer,2001,Romer,1996). Monetarists' link inflation with economic growth using the quantity theory of money as can be seen from equation (1) above. Economic growth in addition to supply driven factors depends on demand side variables. Thus, a theoretical framework which helps to examine the effect of inflation on economic growth can be specified as follow by including both supply and demand variables.

$$RGDP_t = \beta_0 + \beta_1 PK_t + \beta_2 LF_t + \beta_3 HCD_t + \beta_4 CPI + \beta_5 M2_t + \beta_6 OPP_t \ \beta_7 REER_t + \beta_8 DD_{t+} \mu_t. \quad \textbf{(3)}$$

Where $RGDP_t$ refers to real gross domestic product, PK_t to physical capital, LF_t to labor force, HCD_t to human capital development, CPI to consumer price index, $M2$ to broad money supply, OPP_t to openness, REER to real effective exchange rate, DD, is dummy to drought μ_t to denotes the stochastic error term and subscript *t* refers to time. All variables are in log form.

2.2 Data type and source

The study use annual time series secondary data covering the period from 1974/75 to 2009/10 and collected from different sources. The potential caveats that hinder the success of this study may include lack of adequate data, data

aggregation, time and financial constraints and the like. The absence of quarterly data on some macroeconomic variables like real GDP and government spending in Ethiopia has forced the present study to rely on annual. The major data sources for the problem under investigation are shown in Table 1 below**.**

Table 1: Sources of data and measurement

Variable description	Unit	Source
Consumer Price Index (CPI)	Index number	NBE
Foreign consumer price index(FCPI)	Index number	UNCTAD
Nominal effective exchange rate(NEER)	Index number	NBE
Real effective exchange rate(REER)	Index number	NBE
Real Gross Domestic Product(RGDP)	In million birr	MoFED
M2-broad money supply	In million birr	NBE
Budget deficit as percentage of GDP	Percentage	MoFED
Physical capital (PK) –proxied by capital formation (investment).	In million birr	MoFED
Human capital development (HCD)-proxied by expenditure on education as % of GDP	Percentage	EEA-CD room
Labour force-employed + unemployed working force	In million	EEA-CD room
Openness-export + import as % of GDP	Percentage	MoFED

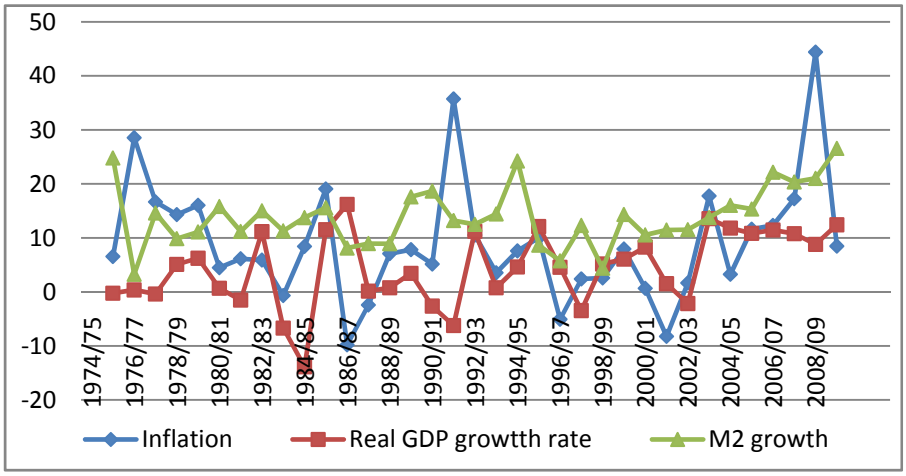
2.3 Trend Analysis

The preceding chapter, chapter two, dealt with survey of theories and empirics regarding the potential determinants of inflation and its effect on economic growth in the context of developing countries. But, this chapter presents the present study in visual presentation or descriptive form and tries to examine the possible relationship between inflation and its potential determinants via cross plot and trend analysis.

2.3.1 Inflation and economic growth

The trend of inflation shows the change in the inflation over the study period. Looking at the trends of inflation would enable us to understand the change of inflation during the study period over the years. Further it observes what goes wrong or right at a particular year. The trend analysis in Figure 1 below indicates that the country has been experiencing the higher price rise since 2003/2004. In 2001/02, the inflation rate was negative -8.2 percent. In 2003/04, the inflation rate increased to 17.7 percent. But the recovery of the agricultural production and the general economic growth has reduced the inflation rate to 3.2 percent in 2004/05. After 2004/05, the inflation rate could not show any sign of declining till 2008/09. In 2008/09, the inflation reached its highest 44.3 percent.

Figure 1: Trends of inflation, real GDP and broad money (M2) growth rate



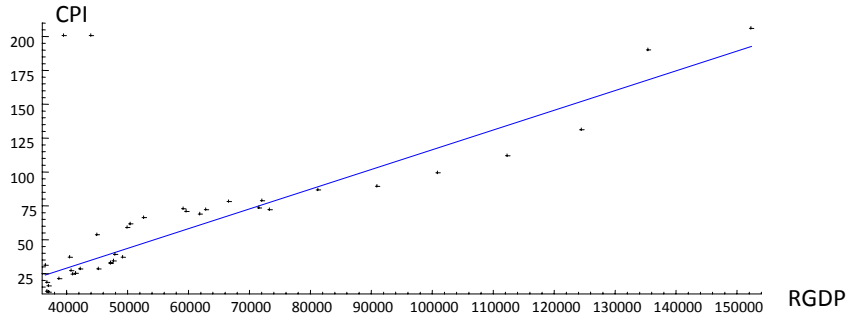
Source: Own computation based on MoFED and NBE data, 2010.

However, comparing Ethiopia's inflation against the growth rate of real GDP, one may expect a negative relationship between the two as the Ethiopian economy is agrarian and increase output means high food supply and this in turn reduces prices of food items, which account 57% of consumer price index.

However, the trend analysis in Figure 1 indicates inconclusive pictures about their relation for the period 1974/75 to 2009/10.It depicts almost an inverse relationship in the earlier period. Besides, as can be seen from Figure 1 and annex 1, high inflation was occurred at the time of low economic growth when the economy was affected by drought and war (for instance, drought in 1985/86 and war in 1991/92). However, in the later period, between 1993/94 and 2009/10, the trends of inflation and economic growth have reversed and showed positive relation. That is, both high inflation and high economic growth appear together.

Furthermore, the cross plots of inflation against real GDP revealed that an increase in output of the economy leads to an increase in inflation. As can be seen from Figure 2 below, as real GDP of the country increases (when we move from the origin to the right) consumer price index increases. This positive relationship between RGDP and inflation can be explained by the increase in aggregate demand for goods than their supply because of the increase in income due to the expansionary monetary and fiscal policy especially since 2003. As can be seen from annex 1, money supply and budget deficit has showed an increasing trend since 2003 onwards which is an indicator of expansionary monetary and fiscal policy.

Figure 2: Cross plot of inflation on RGDP

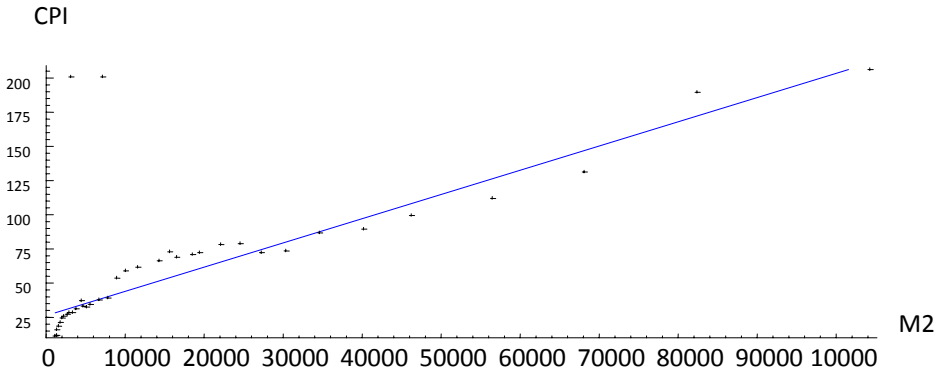


2.3.2 Inflation and money supply (M2)

A monetarist states that monetary policy has a positive and direct impact on inflation. Looking the trend of broad money supply (M2[2]) with inflation in Figure 1 above supports the theoretical and empirical literature and reveals positive relationship between the two. Between 1974/75 and 2009/10 money supply has on average grown by 13.9%, while real GDP has grown on average by 4.4.% in the same period(see Annex 1). It indicated that the growth rate of money supply was greater than that of real GDP growth, citreous paribus, implying that money supply has been growing at a higher rate and leads to increase in general price level. Besides, as shown in Figure 1 above almost in all the study period, except the period at which inflation reached at its peak the growth rate of money supply was above the rate of inflation. Moreover, after 2000 growth rate of money supply could not show any sign of declining and it seems that money supply growth derives inflation up.

In addition to the trend analysis the cross plot below in Figure 3 more clearly explains the positive relationship between inflation and money supply. This supports the current situation in Ethiopia, which the government and stock holders insisted that money supply is one of the sources of current inflationary pressure.

Figure 3: Cross plot of inflation on money supply



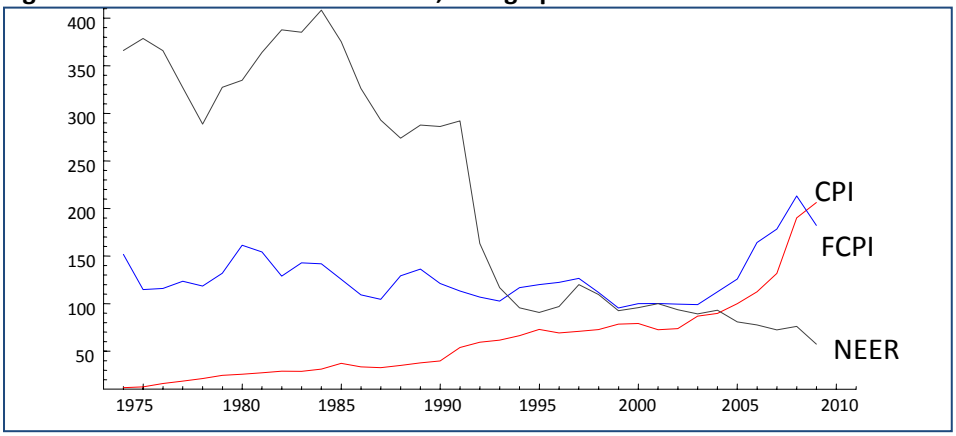
[2] The sum of demand deposits, currency outside banks, and saving and time deposit

2.3.3 Inflation and foreign consumer price index

Changes in the foreign prices affect domestic prices through a pass-through to import prices and by affecting the price of exportable items in the home country. When the price of exported goods increases the relative prices of non-traded good also increases through spillover effect. As can be seen from Annex 1 in the military regime (before 1991) there was unpredictable relation between domestic and foreign price. It is mainly due to the presence of price control, absence of free market, maximum profit margin for imported goods in the economy during the period which minimizes the effect of foreign price on domestic inflation.

However, Ethiopia exerted its efforts since 1992 to join the world economy by introducing various trade liberalizations and other related reforms. This measures and the high development desire in the country increased the demand for imported goods. Through this import, international price rise transmitted to the domestic economy. As the figure below shows that, there has been a rise in foreign and domestic consumer price index starting from 2001 onwards and started to fall in 2008 at the time of world financial crisis. In sum, this graphical visualization of inflation with foreign price reveals their positive co movement and it seems that the increase in world commodity price derives domestic prices up.

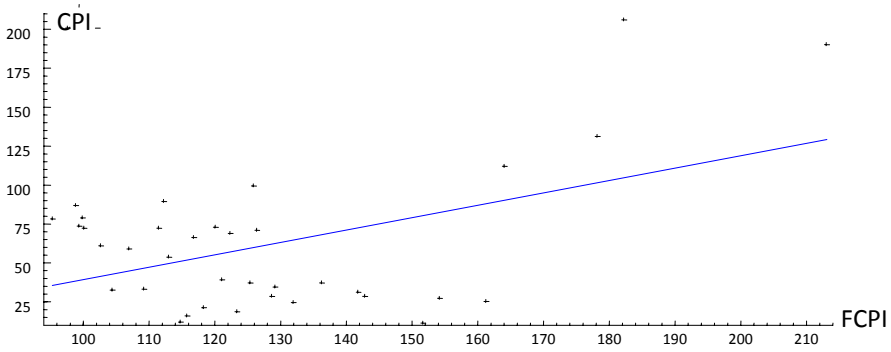
Figure 4: Trends of domestic inflation, foreign price and NEER.



Source: Data from NBE (2010/11)

The cross plot below also shows that the increase in foreign price leads to a rise in the domestic price level. When we move to the right from the origin (as foreign price increases) the domestic consumer price index also rises. Thus, this graphical analysis supports the hypothesis that the increase in international prices of goods leads to higher domestic prices. Put simple, Changes in foreign prices pass through into domestic prices via imports. This relation supports the idea of Ethiopian government that pass through inflation is one of the factors for the increase in prices in the economy. This is out off the direct control of the government and affects the management of the domestic price level.

Figure 5: Cross plot of inflation on foreign consumer price index.



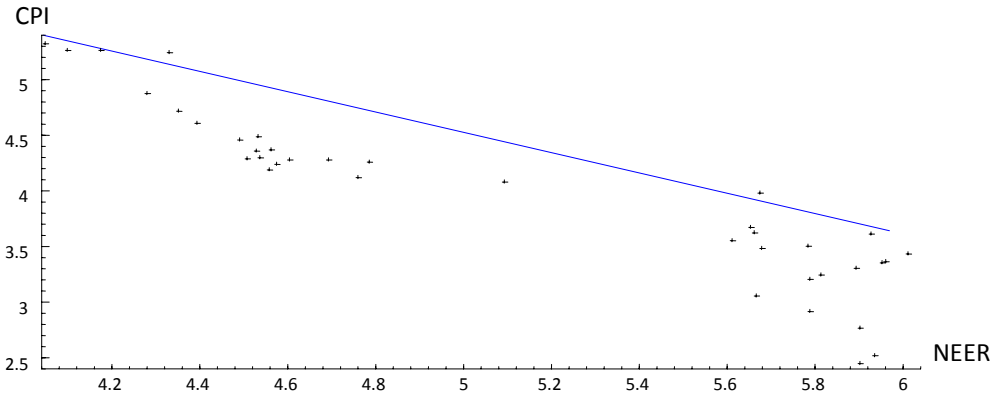
3.4 Consumer price index and nominal effective exchange rate

The other variable which affects inflation based on our theoretical and empirical review is nominal effective exchange rate, which is defined as the units of foreign currency per a unit of domestic currency taking accounts of trading partner countries trade weight, expected to affect domestic inflation positively through increasing the cost of imports and the price of exported commodities. According to the definition decrease in nominal effective exchange rate means devaluation/depreciation, which increases inflation and in our case both the cross plot of Figure 6 and the trend analysis of Figure 4 supports the theoretical

relation and confirms a straightforward positive relationship between devolution of nominal effective exchange rate and inflation.

It is clear from Figure 6 above that devaluation results in higher price level. As we move to the origin or as the domestic currency devalues domestic price level increase. It is due to the fact that Ethiopia is an import dependent country by raising the price of imported commodities and capital goods, exchange rate devaluation will lead to a rise in the domestic price level. Thus, this descriptive analysis is in line with the prediction of the theories that devaluation of nominal exchange rate related with the price level positively.

Figure 6: Cross plot of inflation on nominal effective exchange rate.

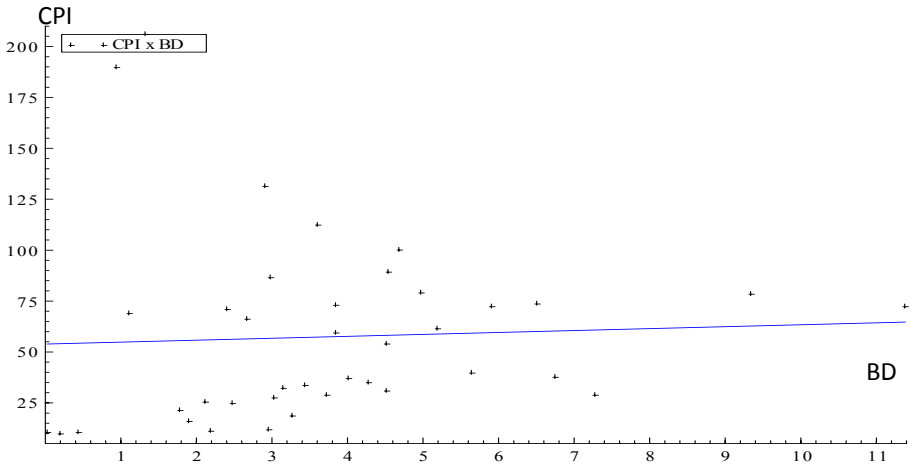


2.3.5 Inflation and budget deficit

Large and persistent budget deficits are considered to be the root cause of monetary expansion, inflation and macroeconomic instability in most of the time. However, as the empirical literature review section indicts that the effect of budget deficit on inflation is mixed and depends on the sources of financing the deficit. As the data indicates in the year between 1974/75-2009/10 government's revenue including grants in Ethiopia falls short of its expenditure. The average budget deficit as a percentage of GDP for 1975/76 to 1982/83

was 3.1% while inflation was 12.3%. The average budget deficit for the period between 1983/94 to 1990/91 increased to 3.73% and inflation declined to 8.56%. The increase in budget deficit in this Period was due to high military spending, on the other hand despite the increase in budget deficit inflation was declined during the same period, and the low level of inflation was the result of conservative fiscal and monetary policies coupled with price controls of the period. The trend seems to be negative and opposite of their theoretical relationship. Nevertheless, their average growth for the period 2000/10 to 2009/01 has increased as compared to the previous year average (that is budget deficit as % of GDP was 4.4% and inflation was 11%). Therefore, from this descriptive analysis it is difficult to conclude that deficit financing leads to inflation, without further empirical investigation.

Figure 7: Cross plot of inflation on budget deficit



The cross plot below also indicates absence of correlation between the two variables and the data appear to be of random distribution with horizontal regression line. This seems that the increase in budget deficit has no inflationary effect. However, this relation is contrary to the view of the society and other stock holders that budget deficit is one of the sources of current

inflationary pressure. We will see whether the empirical analysis supports these tentative conclusions or not in the econometric analysis part.

2.4 Estimation Procedure and Results

2.4.1 Unit root test

In time series analysis, the first step is examining the stationarity of the data used in the regression analysis. There are several ways of testing for the presence of unit root. The most common and popular one in econometric work is the Dickey-Fuller (DF) test due to Dickey and Fuller (1979, 1981) either because of its simplicity or its more general nature (Maddala, 1992; Gujarati, 2003). Therefore, to perform the stationarity test for the variable included in the model, the conventional Dickey-Fuller (DF) and Augmented Dickey – Fuller (ADF) tests are used. The test results reveal that all variables included in both inflation and growth models are found to be non stationary. However, the test applied to the same variables after first difference become stationary at the conventional 5% level of significance (see Annex 1A). It means that, all the series are integrated of order (1). Therefore, the series can be tested for the existence of a long-run relationship (co integration).

2.4.2 Cointegration test

After unit root tests, the next step is to test for the existence of long term Cointegration relationship among the variables. This is checked using the Johansen's multivariate test. Thus, using Johansen's approach of cointegration with one lag for both growth and inflation model, which is determined by Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Information Criterion (HQIC) with the lowest in AIQ, SIC and HQIC in absolute value is the most efficient one (see Annex 1B and 1C) indicates that there is one cointegration relationship between variables based on both trace and maximum eigenvalue tests.

Put differently, as can be seen from (annex 1D), for instance, for inflation model the trace test indicates that the null hypothesis that there is no cointegration $(r = 0)$ against the alternative $(r = 1)$ is rejected, Because, the trace Statistic- $\lambda trace$ (330.1) is greater than the 95 percent critical value (156). But, the null hypothesis of one co-integration vector is not rejected since the trace Statistic- $\lambda trace$ (121) less than the 95 percent critical value (124.2). Similarly, maximum eigenvalue test indicates that the null hypothesis that there are no cointegration vector(r=0) against the alternative hypothesis of one cointegration vector (r= 0+ 1) is rejected since the test statistic (209.2) is greater than the 95 percent critical value (51.4). By applying the same procedure for growth models to determine the number of cointegration we found one cointegration relationship between the variables (see Annex 1E).

3. Discussion of Estimation Results

3.1 Long run estimation results of inflation model

The presence of one cointegration vector is supported by the Johansen cointegration test statistics, thus we can formulate the long run equation from the β coefficient of the cointegration regression result. For this purpose, the first row of β and the first column of α matrix from the cointegration analysis are important. As indicated in Annex 2A, the first row of β represents the long run coefficients of the variables; whereas the first column of α coefficient (seen annex 2B) represents the speed of adjustment of the long run coefficients towards their long run equilibrium relationship. After testing the significance of the explanatory variables and performing the weak exogeneity test(see annex 2C and 2D respectively), the long run equation of the model is formulated by taking the opposite signs (normalizing) of the first row of beta coefficients (Annex 2A). Thus, the long run normalized inflation equation with the corresponding signs and significance is presented as follows:

$$LCPI = -1.933LNEER - 2.66LRGDP + 0.266LM2 + 2.30LFCPI + 0.263LBD + 0.776EXInf - 1.19Lir$$
(0.0468)*[3] (0.0541) (0.7522) (0.0187) * (0.1112) (0.0000)** (0.2887)

As can be seen from the long run equation, the sign of all the variables incorporated in the model are as expected. That is, inflation is positively related to money supply, foreign consumer price index, budget deficit, expected inflation and exchange rate devaluation/depreciation.[4] On the other hand, inflation is negatively related with real GDP and interest rate. However, the most important significant determinants of inflationary process in the long run are nominal effective exchange rate, expected inflation and foreign consumer price index.

As the theory predicts, devaluation of the domestic currency is inflationary and our result also supports that devaluation of the domestic currency results in inflation. For a one percent devaluation (decrease in the nominal effective exchange rate), inflation increases approximately by 1.933 percent. It means that devaluation of the domestic currency with respect to trading partner's currency contributes to inflationary pressures by increasing import prices. It also implies that in Ethiopia the import component of goods prices inflation is a significant determinant of domestic inflation. This result is also consistent with the findings of Kinda (2011), Akinboade et al. (2004, Isakova (2007), Laryea and Sumaila (2001) for other developing countries.

The effect of foreign price on domestic price level is in line with the theories and a one percent increase in foreign prices increases domestic inflation by 2.30 percent. This means that higher prices of commodities, such as food, raw material, capital goods and fuel in the trading partners and in the world in general increases import prices, which in turn spill over into domestic inflation. Beside this as the elasticity indicates domestic price inflation is more elastic to

[3] The figure in the parentheses indicates probability that the null hypothesis of no significance is rejected. That is the variable is significant in affecting the concern variable.

[4] Based on the computation of National Bank of Ethiopia a rise in NEER means appreciation and the fall in NEER is devaluation.

foreign price inflation than exchange rate devaluation in the long run, other things being the same. Domestic price inflation fetches more of imported inflation through exchange rate and foreign prices, which is in line with imported inflation of cost push theories through import of food items, raw materials and capital goods. The finding is in line with the findings of Loening et.al (2009) for the case of Ethiopia, Kinda (2011) for the case of Chad.

Another significant determinant of inflation in the long run is expected inflation. The significance of expected inflation indicates the importance of inflation inertia in the inflationary process in Ethiopia. That means prices are rising because people expect them to rise and they expect them to rise because they have seen the rising price level time to time in the economy. The increase in expected inflation in one percent increases the actual inflation by around 0.776 percent. This finding is consistent with the literature in other developing countries, particularly with Isakova (2007), Moneyed and Mohammed (2009), Dlamini et.al (2006), Y. boujelbene and T. boujelbene (2009), and Khan et al. (2007). Moreover, the long run result indicates that supply side factors are the main determinants of inflation in the long run than demand side determinants. That is exchange rate and foreign price have cost raising effect and increase domestic inflation through increasing the cost of production.

3.2 The Short-run dynamic (error correction) model of inflation

After determining the existence of long run relationship among the variables, the next step is to set up the short run dynamic or the error correction model. It is obtained by estimating the first difference of the dependent variable on its own lag, on the first difference of all explanatory variables and their lags and also including one year lagged error term which is obtained from the long-run model estimation. The reason for including one year lag of the error term is to indicate how the time path matter to correct any error or deviation from the long run equilibrium.

The change in the variables entered into the model to represent variation in the short run, while the coefficients obtained from the error correction term will represent the speed of adjustment towards the long run equilibrium relationship. As shown in the long run the existence of one co-integrating vector is supported by the Johansen cointegration test. This indicates that there is no problem of simultaneity. Therefore, Ordinary Least Square (OLS) will be efficient and can be used in this case to estimate the short run dynamics. Thus, the parsimonious error correction model can be estimated using OLS technique, starting from a general over parameterized model. This means that the short run dynamic model is subjected to a systematic reduction and testing process until a robust parsimonious model is obtained. Following the above specification, the following short run model is obtained.

Table 2: Results for the dynamic short run inflation equation (DLCPI)

Variable	Coefficient	Std.Error	t-value	t-prob
DLCPI_2	0.383487	0.1661	2.31	0.029
Constant	-0.117060	0.04902	-2.39	0.024
DLRGDP_1	-0.946592	0.2181	-4.34	0.000
DLM2	0.869588	0.2621	3.32	0.003
DLM2_1	0.741052	0.2406	3.08	0.005
DLFCPI	0.267028	0.1031	2.59	0.015
DLLir_2	-0.205519	0.08667	-2.37	0.025
ECM_1	-0.378868	0.1601	-2.37	0.025
R^2 0.581798 F (7, 28) = 5.565 [0.000] ** DW 1.7				
Diagnostic test summary				
AR 1-2 test: F (2, 26) = 0.76675 [0.4747]				
ARCH 1-1 test: F (1, 26) = 0.51191 [0.4807]				
Normality test: Chi^2(2) = 5.1779 [0.0751]				
Hetero test: F (14, 13) = 0.32352 [0.9775]				
RESET test: F (1, 27) = 1.7498 [0.1970]				

Similar to the long run regression results, before interpreting the short run dynamic regression result, the adequacy of the model is checked by using

different diagnostic tests. As indicated above the test summary reveals that there is no problem of error term autocorrelation. That is the test does not reject the null hypothesis of no error term autocorrelation (AR1-2). The test for autoregressive conditional heteroscedasticity (ARCH) failure to reject the null of no ARCH indicates the existence of constant variance. The test for normality cannot reject the null hypothesis of normality and indicates that the error term is normally distributed. Finally, the RESET (regression specification test) does not reject the null hypothesis of no functional misspecification in the estimated equations and it reveals that there is no problem of model misspecification. Moreover, as shown in the above table all explanatory variables together explain about 60.1 percent of the variation in the model. The F statistics rejects the null hypothesis that all the coefficients in the model are jointly insignificant. Durban Watson (DW) test also suggests that there is no autocorrelation problem, as its value is reasonably close to two.

The estimated result of the short-run model shows that the main derivers of inflation in the short-run are money supply, real GDP, expected inflation, interest rate and foreign price. As shown in the above table, the lagged values of LCPI is positively and significantly influenced the behavior of current inflation. Specifically, the coefficient of expected inflation is positive and significant at the 1% significant level which is consistence with its long run result. That is inflation expectation is the main derivers of inflation in Ethiopia both in the long and short run. Similarly, the effect of foreign price is also significant in both the long and short run model. This significant effect of foreign price both in short and long run revealed that imported or pass through inflation is one of the main derivers of domestic inflation both in the long and short run.

As can be seen from the result above, inflation is negatively related to real GDP and for a one percent increase in the lag of real income inflation decreases by 0.98 percent. Because, the Ethiopia economy is agrarian more GDP means more agricultural output and this in turn reduces inflation, especially price inflation of food items which comprises 57% of CPI.

The result of interest rate is as expected. The result has shown that a 1 percent increase in the two period lagged interest rate would lead to decrease in CPI by 0.2 percent. It implies that the increase in interest rate increases the cost of borrowing which in turn decreases money supply which in its turn also reduces aggregate demand and then inflation. On the other hand, increase in interest rate can reduce money supply by encouraging saving and this in turn reduces inflation. Moreover, the present and the lagged value of money supply affect inflation positively in the short run. The coefficient of one period lagged change in money supply is positive and significant at one percent level of significance. More clearly, a last year increases in money supply by one percent will lead to a 0.74% increases in the current period domestic price level. Moreover, a one percent increase in current money supply will results in 0.74 percent increase in the price level.

The one year lagged error correction mechanism (ECM-1) included in the model to indicate how the time path matter to correct any error or deviation from long run equilibrium relation occurring in the previous period is correctly signed (negative) and significant at 5 percent level of significance. It points out that about 37.8 percent of the disequilibrium from the long run path will be corrected in one year. The magnitude of the coefficient also indicates that there is somewhat medium level of correction for divergence of general price level from equilibrium. The speed of adjustment further indicates that it takes almost three years for any deviation or disequilibrium to be fully adjusted. In sum, the significant determinants of inflation in the short run, therefore, include; money supply, real GDP, inflation expectation, foreign price and interest rate.

3.3 The effect of inflation on economic growth (Long run estimation results)

Before formulating the long run model the significance test on the long run parameters are undertaken. Accordingly, a zero-restriction is imposed on each β coefficients and the result of the test along with their respective probability

values are reported on annex (3c). As shown in annex (3B) the speed of adjustment of the long run coefficients towards their long run equilibrium has the expected sign. Moreover, as can be seen from annex (3A) the variables are with the hypothesized sign. Hence, the long run growth equation with their respective significance test is presented as follows:

RGDP= -0.27CPI + 0.05HCD + 0.37PK+0.04Opp -0.044DD + 0.29REER 0.29LF + 0.20M2
[0.1414] [0.6951] [0.0073] ** [0.6899] [0.0000] ** [0.0009] ** [0.0242]* [0.0819]

Where * and **denotes rejection of the null hypothesis at 1% and 5% level of significance respectively. A value in parenthesis indicates the test of significance.

The result implies that labor force and physical capital development play the main role in increasing economic growth in Ethiopia together with good weather condition (rainfall). For instance, a one percent increases in physical capital and labor force development leads to 0.37 and 0.29 percent increase in economic growth respectively. On the other hand, the positive and significant coefficient of real effective exchange rate revels that devaluation affects economic growth negatively through increasing the cost of production of imported items.

Openness proxy by the volume of trade as percentage of RGDP has insignificant impact towards economic growth. This seemingly contradictory result can be justified by the basic idea that in less developed countries import takes the lion share of the trade volume. These importable items are mainly of consumable goods which have no significant relationship with investment and ultimately economic growth and this offsets the positive effect of openness through transfer of knowledge and import of capital goods for production in the long run.

Moreover, the result of our concern variable inflation indicates the insignificant effect on economic growth, which supports that the Mundell-Tobin effect of

inflation on output growth through increasing capital accumulation offset by Stockman effect which says that inflation reduces economic growth by increasing cost of investment. This result is in line with the findings of Faria and Carneiro (2001).

3.4 The Short-run dynamic (error correction) model of growth

The short run dynamics of the growth model is estimated using the general to specific modeling approach of OLS techniques like that of the inflation model as explained above. As shown in Annex (3E) the various diagnostic tests showed that the model is correctly specified. As indicated above the test summary reveals that there is no problem of error term autocorrelation. That is the test does not reject the null hypothesis of no error term autocorrelation (AR1-2). The test for autoregressive conditional heteroscedasticity (ARCH) failure to reject the null of no ARCH indicates the existence of constant variance. The test for normality cannot reject the null hypothesis of normality and indicates that the error term is normally distributed. Finally, the RESET (regression specification test) does not reject the null hypothesis of no functional misspecification in the estimated equations and it reveals that there is no problem of model misspecification

As in our long run model, the coefficient of the short run model shows the short run elasticity of the variable with respect to the output growth. The coefficient of the first lag of the change in the consumer price index (DLCPI_1) is negative and statistically significant implying that inflation negatively affects output growth in Ethiopia. That is higher rate of inflation reduces output growth and supports the Stockman's effect. Differently, either it outweighs the Mundell-Tobin effect, or it contributes to increased macroeconomic uncertainty which, in turn, negatively affects economic activity and consequently economic growth. This finding is in line with findings of Barro (1995), Khan and Senhadji (2000), Gokal and Hanif (2004), Ahmed and Mortaza (2005), Seleteng (2004), Sergii (2009), Bettencourt (2010), Salian and

Gopakkumar (2009), and Mubarik (2005). Moreover, the one period lag of RGDP has a positive and significant effect on the current change in real GDP growth at 1 percent level of significance. Specifically, a 1% change in real GDP last year will lead to a 0.8% change in real GDP growth in the current period. A 1% change in labor force and physical capital will lead to 0.12% and 0.06% increases in output growth in the short run respectively. Moreover, real exchange rate and openness have also positive and significant effects on output growth in the short run at 1 percent level of significance.

On the other hand, domestic money supply and drought affect output growth in Ethiopia negatively and significantly in the short run. The negative effect of money on economic growth in the short run is by increasing inflation, which results in uncertainty in the economy. Moreover, the coefficient of error correction term (ECM-1), which indicates the rate at which output growth adjust to shocks in the system, has a negative sign as expected and statistically significant at 1% level of significance.

4. Conclusions and Policy Implications

4.1 Conclusions

One of the main objectives of macroeconomic policy of the Ethiopia economy is to attain sustainable economic growth together with stable price level. However, in recent times the country has been experiencing an increasing price level and the situation has got wide range of concern regarding its source and impact on economic growth. Hence, the central focus of this study is to identify the main macro level sources of inflation and its effect on economic growth, specifically by using the framework of VAR and vector error correction mechanism using annual data covering the period from 1974/75 to 2009/10. All the variables are tested for unit roots using Augmented Ducky Fuller test and the test result revealed the variables are stationary at their first difference. The result of cointegration test, using Johansen Maximum likelihood approach,

indicates the existence of long run relationship among the variables entered in both inflation and growth models.

The first investigation is concerned with the determinants of inflation using the framework of mixed inflation model to test the importance of demand and supply side theories of inflation in explaining the current inflationary behavior in Ethiopia. Accordingly, in the long run, general price level is found to be influenced by foreign price, nominal effective exchange rate and expected inflation with different elasticity. The significant impact of expected inflation in the long run assures the importance of inflation inertia in the inflationary process and the higher the inflation expectation in the economy the higher the price level. The foreign price, play significant role in the long run inflationary process and this reflects the direct effect of international price increase on the domestic price level through increasing the price of both domestic production and the price of imported commodities. Similarly, nominal exchange rate devaluation found to be significantly affects the general price level. Thus, our result reflects that the external factors and expected inflation play an important role in triggering an inflationary process in Ethiopia in the long run. On the other hand, money supply, real output, foreign price, expected inflation and interest rate are found to be the most important forces behind the short run price movements. The short run result reflects that inflation in Ethiopia is determined by both demand pull and cost push factors along with inflation expectation.

The study also examined the effects of inflation on economic growth using VAR model by including other control variables. The result of the study has shown that the effect of inflation is insignificant in the long run which reflects that the Mundell-Tobin effect of inflation on economic growth is offset by the Stockman effect in the long run

4.2 Policy implications

The regression result indicates that imported inflation through foreign price and exchange rate devaluation has been significantly contributing for domestic inflation. This result attributed to the high dependence of the Ethiopian economy on imports. Thus, to reduce the effect of foreign price increase and exchange rate devaluation on domestic price level, there is a need to reduce the high dependence of the economy on imports by encouraging and expanding industries that produces import substituting products. Similarly, inflation expectation is found to be one of the main long run determinants of inflationary process, thus, to reduce the effect of expected inflation on the inflationary process the government shall do more to increase the supply of those products which the society expect their price to rise,(such as sugar, wheat and balm oil).

The monetary authority shall take into consideration the inflationary effect of money supply so as to ensure stable price level in the economy. To this end, the monetary authority shall carefully control the money supply through selective money market operations, by controlling the flow of credit to non-productive area and also by better control of public expenditure through improving public financial management, better investment planning as well as integrating the inflationary effect of public expenditure when designing public spending program. In addition, in the short run the demand-pull inflationary pressure of increased real income (RGDP) more than offset by the increase in output and real income growth is found to be one of the important negative determinants of inflation. Since more than half of consumer price index is composed of food, increasing agricultural productivity by encouraging more investment in agricultural sector through the use of modern techniques, such as irrigation and improved seeds have a down ward pressure on domestic price level (inflation) by increasing food supply.

References

Ahmed, S. and Mortaza, G. (2005). Inflation and Economic Growth in Bangladesh: 1981 - 2005, Policy Analysis Unit (PAU) Working Paper 0604.

Ahortor, C. (2009). Inflation,Capital Accomulation and Economic growth in Imported-dependent Developing Economies. *A paper Prepared for the 14th Annual confernce on EconomicModelling for Africa*, (pp. 1-31). Abuja, Nigeria.

Akinboade, O., F. Siebrits and E. Niedermeier (2004), "The Determinants of Inflation in South Africa: An Econometric Analysis," AERC Research Paper 143.

Alemayehu, G. and Kibrom, T. (2008): The Galloping Inflation in Ethiopia: A Cautionary Tale for Aspiring 'Developmental States' in Africa, Addis Ababa University, Ethiopia.

Barro, R. J. (1995) "Inflation and Economic Growth," National Bureau of Economic Research, Working Paper, No. 5326

Bettencourt, B. (2010) "Inflation and Economic Growth in Latin America: Some Panel Time- Series Evidence," Department of Economics, University of Pretoria, Lynnwood Road.

Boujelbene,T and Boujene,Y (2010), "Long-run Detrminants and short-run Dynamins of Inflation in Tunisia," *Applied Economics Letters*,Vol.1255-1263

Chaimobi, O. (2010). Inflation and Economic Grwoth in Nigeria, *Jornal of Sustainable Development ,* Vol. 3, No. 2(2010).

Datta, K. and Kumar, C. (2011) Relationship between Inflation and Economic Growth Malaysia, *International conference on Economics and Financial Research*, Vol.4/415- 419

Dornbusch, R. and Fischer, S. (2001). *Macroeconomics,* 6th ed. McGraw hill. New Delhi.

Ethiopian Economic Association (2009): Statistical Data Base, CD ROM. Addis Ababa, Ethiopia.

Enders, W. (1995), Applied Economics Time Series, John wile and Sons Ltd, New York

Faria, J, R. and Carneiro, F, G. (2010). Does High Inflation affect Growth in the Long and short- run*? , Journal of Applied Economics*,Vol.4/1,PP.89-105.

Fischer, S. (1993). The Role of Macroeconomic Factors in Growth*, National Bureau of Economics Research Working Paper, No. 4565*

Gashaw, T. (2010), "monetary policy shocks transmission to consumer price index: challenge to monetary policy in Ethiopia," paper presented at the Ethiopia economic Association 9th international annual conference, Addis Ababa.

Greene, W. H. (2000). Econometric Analysis, 4th ed. Prentice Hall International, Inc., USA

Gokal and Hanif, G. (2004), Relationship between Inflation and Economic Growth: Economic Department Reserve Bank of Fuji, Suva.

Gujarati, D. (2003). *Basic Econometrics*, 4th ed. The McGraw-Hill, Inc., New York.

Hang, N. and Thanh, N. (2010), "Macroeconomic Determinants of Vietnam's Inflation 2000-2010: Evidence and Analysis," *Vietnam Centre for Economic and Policy Research*, Vietnam, National University Hanoi.

Harris, R. (1995). *Using Cointegration Analysis in Econometric Modeling*, Prentice Hall, London

IMF. (2011). *World Economic outlook:* World Economic and Financial Survey, Washington, DC: IMF.

Iqbal, N. and Nawaz, S. (2010), "Investment, Inflation and Economic Growth Nexus, Pakistan Institute of Development Economics.

Isakova, A. (2007), "Modeling and Forecasting Inflation in Developing Countries: The Case of Economies in Central Asia," Charles University Discussion Paper Series, Discussion Paper, No. 2007-174.

Kenny, G. and McGettigan, D. (1997), "Inflation in Ireland: Theory and Evidence," *Journal of the Statistical and Social Inquiry of Ireland*, Vol. 27, pp.157-207.

Khan, M. S. and Senhadji, S. A. (2001) "Threshold Effects in the Relationship between Inflation and Growth", IMF Staff Papers, Vol. 48(1), pp. 1-21

Khan and Gill, A. (2011), Determinants of Inflation: A case of Pakistan (1970-2007), Department of Economics Bahawalpur, Vol.1/45-51

Kibritçioğlu, A. (2002): "Causes of Inflation in Turkey: A Literature Survey with Special Reference to Theories of Inflation". Forthcoming in: Inflation and Disinflation in Turkey, pp. 43-76.

Kihangire, D. and Mugyenyi, A. (2005). IS Inflation Always and Everywhere a Non-monetary Phenomenon:Evidence from Uganda.

Laryea, S. and Sumaila, U. (2001), "Determinants of Inflation in Tanzania," Chr. *Michelsen Institute Working Paper, No*. 2001/12.

Loening, L. J., Durevall, D., Birru, Y. A. (2009), "Inflation Dynamics and Food Prices in an Agricultural Economy: The Case of Ethiopia," Working Paper 347. Gothenburg: University of Gothenburg.

Maddala, G. S. (1992), *Introduction to Econometrics*, 2nd [Ed], Florida University, Macmillan, New York.

Mallik, G. and Chowdhury, A. (2001) "Inflation and Economic Growth: Evidence from South Asian Countries," *Asian Pacific Development Journal,* Vol. 8, No.1. (2001).

Mankiw, N. G. (2002), *Macroeconomics*, 5th edition, Worth Publishers

MoFED (2010), Growth and Transformation Plan, Vol. I and II, Addis Ababa, Ethiopia

Moseyed, P. and Mohammed, R. (2009), "Source of Inflation in Iran: *International Journal of applied Economics and quantitative studies*, Vol. 6-1, PP, 62-76

National Bank of Ethiopia, 2006/07 annual report, Addis Ababa, Ethiopia.

Romer, D., (1996), *Advanced Macroeconomics*, 1st edition, McGeaw-Hill

Salian, P. and Gopakkumar, K. (2009), Inflation and Economic Growth in India –An Empirical Analysis, Indian Economic Service, New Delhi

Sergii, P. (2009) "Inflation and Economic Growth: The Non-Linear Relationship. Evidence from CIS Countries," MA Thesis in Economics, Kyiv School of Economics

Snowdon. (2005), *Modern macroeconomics: Its Origin, Development and Current State.* Edward Elgar Publishing Limited, United kingdom.

Taddesse, E. (2010), "the Dynamics of food price inflation in Ethiopia," proceedings of the seventh international conference on the Ethiopian Economy, Vol. I. Addis Ababa.

Thullah (2006), "the Impact of Deficit Financing on Inflation in Sierra Leone,"

Tidiane, K. (2011), Modeling inflation in Chad, *IMF working pape*r, African Department, No.11/57.

Totonchil, J. (2011), Macroeconomics Theories of Inflation: *International Conference on Economics and Financial Research IACSIT Press, Singapore,* Vol.4, PP.459-462.

Appendices

Annex 1A: unit root tests for the variables used in the models

	Lag length 0		Lag length 1		Lag length 2	
	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
LCPI	0.2601	-1.404	0.1489	-2.212	0.1213	-2.248
LRGDP	2.174	-0.2364	1.925	-0.2779	3.610	1.151
LNEER	-0.09997	-1.849	-0.3343	-2.539	-0.1884	-2.385
LFCPI	-1.212	-1.202	-2.253	-2.152	-1.844	3-1.616
LM2	2.177	0.6942	1.583	0.08099	1.384	-0.7223
LBD	-2.4802	-3.950*	-2.0441	-2.7515	-1.9591	-2.6493
LPK	0.8263	-1.760	1.141	-1.418	0.6159	-2.090
LHCD	-1.644	-1.926	-2.092	-2.414	-2.430	-2.822
LOPP	-1.388	-2.002	-1.117	-1.715	-1.664	-2.389
LLF	3.243	-1.006	3.710	-0.1340	3.421	-0.6610
Unit root tests of the variables at first difference						
DLCPI	-4.554**	-4.571**	-3.498*	-3.415*	-2.195	-1.995
DLRGDP	-4.645**	-5.316**	-4.722**	-6.259**	-2.119	-3.182*
DLNEER	3.861**	-3.857**	-3.457*	-3.481*	-3.505*	-3.567*
DLFCPI	-4.318**	-4.333**	-4.071**	-4.135**	-3.229*	-3.301*
DLM2	-3.167*	-3.655**	-1.864	-2.345	-1.198	-1.655
LBD	-7.522**	-7.577**	-4.637**	-4.770**	-3.691**	-3.866*
DLPK	-6.253**	-6.502**	-3.104*	-3.258*	-3.644*	-3.994**
DLOPP	-6.557**	-6.447**	-3.070*	-2.992*	-3.722**	-3.647*
DLLF	-4.905**	-5.681**	-1.640	-2.298	-1.541	-2.181
DLHCD	-4.842**	-4.772**	-3.483*	-3.432*	-3.129*	-3.085*

Where; ** and * represents rejection of the null hypothesis(which says the data has a unit root) at 1% and 5% significant level respectively and critical value of 1% is -3.623 and -4.2436 with constant only and with constant and trend, respectively; and 5% critical value is- 2.948 and -3.544 with constant only and with constant and trend, respectively.

Annex 1B: VAR lag length selection for inflation model

Lag	FPE	AIC	SC	HQ
1	1.82e-11*	-7.721166*	-6.121379*	-7.168920*

* indicates lag order selected by the criterion

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Annex 1C: VAR lag length selection for growth model

Lag	FPE	AIC	SC	HQ
0	4.27e-12	-6.314328	-6.003258	-6.206946
1	2.76e-17*	-18.32239*	-15.83383*	-17.46334*

Annex 1D: Johansen test results for number of cointegrating vectors for inflation model

Hypotheses Ho:rank=p	Max Eigen Statistic ($\lambda \max$)	Critical Values (95%)	Trace Statistic- $\lambda trace$	Critical Values (95%)
p == 0	209.2**	51.4	330.1**	156.0
p <= 1	33.37	45.3	121	124.2
p <= 2	27.82	39.4	87.59	94.2
p <= 3	22.67	33.5	59.77	68.5
p <= 4	17.93	27.1	37.1	47.2
p <= 5	11.31	21.0	19.17	29.7
p <= 6	6.225	14.1	7.864	15.4
p <= 7	1.639	3.8	1.639	3.8

*** Rejection of the null at 1% level of significance*

Annex 1E: Johansen test results for number of cointegrating vectors for growth model

Hypotheses Ho:rank=p	Max Eigen Statistic ($\lambda \max$)	Critical Values (95%)	Trace Statistic- $\lambda trace$	Critical Values (95%)
p == 0	70.99**	57.1	220.2**	192.9
p <= 1	39.57	51.4	149.2	156.0
p <= 2	38.69	45.3	109.6	124.2
p <= 3	22.7	39.4	70.91	94.2
p <= 4	17.29	33.5	48.22	68.5
p <= 5	15.68	27.1	30.92	47.2
p <= 6	7.892	21.0	15.25	29.7
p <= 7	6.093	14.1	7.353	15.4
p <= 8	1.26	3.8	1.26	3.8

Annex 2A: Standardized\beta eigenvectors or β coefficients for determinants of inflation.

LCPI	LNEER	LRGDP	LM2	LFCPI	LBD	EXINF	Lir
1.0000	1.932	2.6601	-0.26613	-2.3032	-0.26260	-0.77638	1.1961
2.0712	1.000	2.7139	-1.4779	-2.6347	0.21281	0.0087879	1.0899
0.94001	-0.2885	1.0000	-0.54478	-1.4116	-0.57984	0.0013552	-0.99425
-0.49260	0.6831	-1.4268	1.0000	-0.39879	-0.12908	0.0036917	0.40403
2.1496	-5.9479	-4.4245	-1.9643	1.0000	0.1831	0.0084	-7.7382
-12.478	2.1739	4.9911	7.0987	-1.9396	1.0000	0.0412	4.7800
-165.76	185.51	191.84	107.04	-149.19	8.2718	1.0000	1.5733
-2.0031	-0.3931	-1.1457	0.9557	-0.2081	0.1318	0.01948	1.0000

Annex 2B: Standardized \alpha coefficients for inflation model.

LCPI	-0.00248	-0.0920	-0.0128	-0.0259	0.00305	0.0119	0.0003	0.0083
LNEER	0.0077	-0.0911	0.0164	-0.2706	-0.0051	-0.0034	-0.0002	0.0208
LRGDP	-0.0032	0.0085	0.0187	0.0499	0.0151	0.0071	-0.0002	-0.0032
LM2	-0.0008	0.0119	0.0218	-0.0853	-0.0031	0.0036	8.6299e-	-0.0157
LFCPI	0.0030	0.0398	0.1323	-0.0788	0.00516	0.0049	0.0003	0.0294
LBD	-0.0088	-1.0363	0.4183	1.161	-0.1830	-0.0933	-0.0013	0.0040
EXINF	1.0127	-10.614	-2.0592	-3.510	0.3934	1.3641	0.0344	1.031
Lir	-0.0070	0.0074	0.0011	0.1209	0.0747	-0.0024	0.0005	-0.0100

Annex 2C: Significance test on the long-run β coefficients for inflation model

Variables	LNEER	LRGDP	LM2	LFCPI	LBD	EXINF	Lir
LR-test χ2 (1)	3.951	3.7109	0.09966	5.5279	2.5374	168.72	1.1257
P-Value	[0.0468] *	[0.0541]	[0.7522]	[0.0187] *	[0.1112]	[0.0000] **	[0.2887]

*Where, ** and * represents rejection of the null hypothesis (that is the variable is insignificant) at 1% and 5% significance level respectively.*

Annex 2D: Test of weak exogeneity on α coefficient for inflation model

Variables	LCPI	LNEER	LRGDP	LM2	LFCPI	LBD	EXINF	Lir
LR-test χ2 (1)	7.5021	1.8757	0.22958	0.73378	18.709	0.099847	1.2142	1.8035
P-Value	[0.0062] **	[0.1708]	[0.6318]	[0.3917]	[0.0000] **	[0.7520]	[0.2705]	[0.1793]

*** Rejection of the null hypothesis that the variable is weakly exogenous at 1% level of significance.*

Annex 3: Long run regression results of growth equations and its test summary.

A) Standardized \beta' eigenvectors

LY	LCPI	LHCD	LPK	LOpen	DD	LREER	LLF	LM2
1.0000	0.27734	-0.051885	-0.36957	-0.043338	0.43665	-0.29367	-0.29312	-0.20316
0.46354	1.0000	0.64731	0.38378	-0.58783	0.084847	-0.29887	0.65388	-0.45575
-1.8347	-1.4541	1.0000	-1.8066	1.3135	-0.084389	0.45283	1.4533	1.5926
2.1051	-2.2648	2.0202	1.0000	-1.0096	0.36187	0.44460	0.48848	0.52995
-2.1923	-1.1895	-0.49281	0.38347	1.0000	0.059797	0.64572	-0.51366	0.39877
-1.7653	-0.85530	-1.3971	0.34055	2.4739	1.0000	2.6974	1.3985	0.091524
0.23436	-0.024806	0.17606	0.40526	-0.24690	-0.23287	1.0000	-0.15749	0.15130
2.8351	1.8452	-6.3451	-1.0708	-0.20424	0.13226	0.43351	1.0000	-0.84863
-1.0486	-1.0942	-0.15053	0.48406	-0.54545	-0.099174	0.066527	-0.20732	1.0000

B) Standardized \alpha coefficients

LY	-0.1237	0.06747	-0.01056	-0.008013	0.01307	0.03074	-0.01960	-0.007	0.00581
LCPI	0.07308	-0.2761	0.09905	0.05344	-0.05199	0.01763	0.004476	-0.001216	0.0049
LHCD	-0.1223	-0.09043	-0.04995	-0.001565	-0.0041	0.02032	0.02268	0.028897	0.03887
LK	0.3084	0.08172	0.1469	-0.1015	-0.2097	0.03696	0.004968	-0.006249	-0.0557
LOpen	0.3988	0.5108	0.008937	-0.004520	-0.2725	0.02525	0.01619	0.002802	0.01182
DD	-1.487	-0.9374	-0.1412	-0.03353	-0.3860	-0.1654	0.1424	0.01409	-0.006842
LREER	0.01291	-0.56118	-0.0015762	0.056219	-0.011430	-0.01270	-0.1293	0.014698	0.002317
LLF	0.74693	-0.33069	-0.29911	0.0004997	-0.045678	0.03063	0.07581	-0.041881	-0.00212
LM2	-0.0496	0.000828	-0.04224	0.03208	-0.027110	0.01200	0.008680	0.0042189	-0.02455

C. Test of significance / Zero restriction on β-coefficient

Variables	LCPI	LHCD	LPK	LOPP	DD	LREER	LLF	LM2
LR-test χ2	2.1627	0.15357	7.195	0.15924	30.511	11.087	5.0788	3.0269
P-Value	[0.1414]	[0.6951]	[0.0073] **	[0.6899]	[0.0000] **	0.0009**	[0.0242]*	[0.0819]

D. Test of weak exogeneity (test for zero restriction on α coefficients)

Variables	LRGDP	LCPI	LHCD	LPK	LOPP	DD	LREER	LLF	LM2
LR-test χ2	7.7018	0.3331	0.55447	1.8035	0.89453	5.516	0.004157	3.2941	0.004157
P-Value	[0.0055]**	0.5638	0.4565	0.1793	[0.3443]	[0.0188] *	[0.9486]	[0.0695]	[0.9486]

E: Results for the dynamic short run growth equation (DRGDP)

Variables	Coefficient	Std.Error	t-value	t-prob
Constant	0.0793800	0.01899	4.18	0.000
DLRGDP_1	0.811700	0.1619	5.01	0.000
DLRGDP_2	-0.501922	0.1133	-4.43	0.000
DLCPI_1	-0.228652	0.1047	-2.18	0.039
DLPK	0.0620385	0.02975	2.09	0.048
DLHCD	0.157234	0.05676	2.77	0.011
DLOpp_1	0.153537	0.03914	3.92	0.001
DLM2	-0.270179	0.1272	-2.12	0.044
DLREER_1	0.209882	0.04904	4.28	0.000
DLLF	0.121916	0.03370	3.62	0.001
DD	-0.140868	0.01971	-7.15	0.000
ECM_1	-0.752981	0.1994	-3.78	0.001
R^2 0.859009 F (11, 24) = 13.29 [0.000] ** DW 2.2				

Diagnostic Test summary

AR 1-2 test: F (2, 22) = 1.1307 [0.3409]

ARCH 1-1 test: F (1, 22) = 0.44769 [0.5104]

Normality test: Chi^2(2) = 2.7922 [0.2476]

Hetero test: F (21, 2) = 0.12154 [0.9977]

RESET test: F (1, 23) = 0.81685 [0.3755]

VALUATION OF TOTAL BENEFITS OF IMPROVED MUNICIPAL SOLID WASTE SERVICE IN AN URBAN CONTEXT: A CHOICE EXPERIMENT

Solomon Tarfasa[1]

Abstract

This paper estimates households' willingness to pay (WTP) for improvements in the solid waste management (SWM) service in Hawassa, Ethiopia, employing choice modeling method. Random parameter logit (RPL) model is employed in analyzing the data on randomly selected sample of 201 households. The SWM service attributes of focus in this study are (i) collection frequency of solid waste per week per household (ii) finding out whether there is sorting of recyclable waste before it is disposed and (iii) identifying whether children less than 18 years old or adults should be employed in providing the service. The results indicate that sampled households exhibit significant WTP to ensure improvements in the service in terms of all the attributes proposed. The estimated monthly mean WTP of households for the improvement in solid waste service such that the recyclable solid waste sorted increasing the existing collection frequency and employing only adults in providing the service altogether was roughly Birr 17.54. If all of the 12,500 households getting the service in the city would be willing to pay this amount, then the total WTP would be over Birr 219298 per month. Provided that households in the study area demand improved solid waste service and willing to pay for it, policy makers may consider the proposed aspect of the service to be improved.

Keywords: Municipal Solid Waste; Choice Experiment; Attributes; Nonmarket Valuation; Random Paramete logit; Ethiopia.

[1] Department of Economics, Hawassa University, Ethiopia.
Email: gutamajale@gmail.com

1. Introduction

Public access to reliable solid waste service is an essential component of improved human health, safe environment and sustainable development (Atlaf and Deshazo, 1996; Ahmed and Ali, 2004).Increasing levels of municipal solid waste (MSW) have long posed serious threats to local environmental quality and human health. During the last decade the volume and complexity of solid waste generated, particularly in large cities, have been increasing at an unprecedented rate because of the two main drivers: intensification of urbanization and rising living standards (NEERI 1994; Beede, D.N. and Bloom, D.E. 1995.; CPCB, 2000; UN 2000; Rathi, S., 2007). Lack of planning, poor or no segregation of waste at the source and poorly designed disposal systems, insufficient public and private funds, and corruption in the public sector characterize developing countries' patterns of SWM services (Adedibu, 1985; Diallo and Coulibaly, 1991; Gupta et al., 1998; Buenrostro et al., 2001). Further, the negative externalities generated by increasing levels of unmanaged solid waste are exacerbated by the inadequate provision of other basic infrastructure and services such as water supply, sanitation facilities, sewage system and transportation. If solid waste is not adequately managed, it is detrimental to property, scenery and aesthetic values, the environment, and in general to the quality of life.

Most attempts to improve solid waste management in cities in developing countries, like Ethiopia, have focused on the technical aspects of the service, although the proper management of solid waste requires information on the demand for the service of households in an area. As a result, the attempts made to solve the problem of solid waste in urban areas such as Addis Ababa have not achieved the desired goal. Thus, this study focuses on the investigation of the demand side aspects related to solid waste management.

The main objective of this study is to assess household willingness to pay extra for improved solid waste services in an urban centre of Hawassa. An attempt is

also made to discover the attributes and socioeconomic characteristics that influence households' decisions concerning solid waste service.

Among stated preference methods, the contingent valuation of public programs is the most frequently employed valuation tool in environmental economics. Several studies applied the contingent valuation method to estimate the economic value of improvement in solid waste service in Ethiopia (Baraki, H., 2003; Tolina, T., 2002; Walelegne, A. and Alebel, B., 2003). However, the contingent valuation method is inadequate to value a single attribute of a multi-attribute good and/or service, such as solid waste management service. A promising tool, instead, is choice modeling (also known as choice experiments (CE)) as it allows an investigation of the single attribute of a bundled good and also attempts to model the decision process of an individual or household in a particular context and is able to predict with great accuracy how individuals would react in a particular hypothetical situation (Louviere et al., 2000).

The study is expected to contribute to the limited stock of improved solid waste service valuation studies. To this end, choice experiment method is used to estimate public preferences for improved solid waste service. Though there are a number of contingent valuation studies focusing on WTP for improved solid waste service in developing countries, to our knowledge, this study is the first to apply 'choice experiment' to the subject of estimating the economic value of improved solid waste service in Ethiopia. Evidence shows that solid waste service in the big cities in Ethiopia, including Hawassa, is inadequate. The cities have a range of solid waste problems, including: inadequate waste collection systems, open dumping and other forms of improper final disposal, scavenging at landfill sites by waste pickers, and illegal dumping and the resulting environmental pollution (Baraki, 2003; Tolina, 2006; Walelegne, A. and Alebel, B. 2003). For instance, out of 15 regional cities in Ethiopia, only two have controlled solid waste disposal practice, and the municipality of a town with a

population of over 138,070 has only one truck for solid waste disposal (Degnet, A. and Maru, A., 2005).

The study applies a CE to elicit households' preferences for improved solid waste management service, by asking households to choose between different policy scenarios of improved solid waste services at different price levels.

The second section describes the choice model. Section 3 explains the choice experiment. The results will be discussed in section 4. Welfare estimates are reported in Section 5. Finally, section 6 concludes the paper.

2. The Choice Model

Preferences are modeled in terms of McFadden's (1974) Random Utility Model (RUM), allowing for a separation of utility (U_{ijt}^{c}) into a deterministic part (V_{ijt}^{c}) and a stochastic part (ε_{ijt}^{c}). Choice experiments fall in the class of attribute-based methods in which the deterministic part of utility for individual *i* for good *j* in choice task *t* is described in (1) as a linear function of its attributes X_{ijt} and other explanatory variables Z_{ijt} (Train, 2003):

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} = \beta X_{ijt} + \alpha Z_{ijt} + \varepsilon_{ijt} \quad \forall j \in D_{it} \qquad \textbf{(1)}$$

In each choice task the respondent is presented with a limited set of policy proposals D_{it}, each proposing an improvement in solid waste management. The stochastic term is assumed to follow an IID extreme value distribution of type I.

To account for preference heterogeneity, the preference parameters for the non-price attributes are allowed to vary across respondents, applying different mixing distributions. Equation (2) describes the random parameter logit (RPL)

probability of individual *i* selecting alternative *j* in choice task *t* over other choice alternatives *k*. The utility coefficients β vary according to individual (hence β_i) with density $\Delta(\beta_i \mid b)$ for the non-price attributes. This density can be a function of any set of parameters and represents in this case the mean and covariance of β in the sample population.

$$P_{ijt} = \int \left(\frac{\exp\left[(\beta_i X_{ijt} + \alpha Z_{ijt})\right]}{\sum_{j \in D} \exp\left[(\beta_i X_{ikt} + \alpha Z_{ikt})\right]} \right) \Delta(\beta_i \mid b) d\beta_i \qquad \forall j \in D_{it} \qquad \textbf{(2)}$$

RPL-models assume heterogeneity to be continuous over the interval spanned by the assumed distribution for the preference parameters (Scarpa et al., 2005). Treating preference parameters as random variables requires estimation through simulated maximum likelihood. Procedurally, the maximum likelihood algorithm searches for a solution by simulating draws from distributions with given means and standard deviations. Probabilities are calculated by integrating the joint simulated distribution. Recent applications of RPL-models have shown that this model is superior to the standard multinomial logit model in terms of overall fit and accuracy of welfare estimates (e.g., Breffle and Morey, 2000; Layton and Brown, 2000; Morey and Rossmann, 2003; Provencher and Bishop, 2004; Brouwer et al., 2010a).

Random parameter logit models account for respondent differences (preference heterogeneity) and repeated choices (Train, 2003). Even if unobserved heterogeneity is accounted for in a RPL-model, the model may fail to explain the sources of heterogeneity (Hynes et al., 2008). To this end, interactions of respondent specific household characteristics can be included with choice specific attributes in the utility function to improve the model fit (Revelt and Train, 1998). It is tested to what extent data from repeated individual choices can be combined into an aggregate choice model using the Swait and Louviere (1993) test procedure. As part of this procedure, equality of

scale parameters is tested. Scale parameters, and as a result choice variance, may differ across repeated choice sequences, for instance due to preference teaching (Brouwer et al., 2010b).

Finally, if a price attribute is included in the choice experiment, welfare estimates can be derived (e.g., Hensher et al., 2005). The welfare measure represents the monetary value arising from a change in the bundle of solid waste services, also referred to as the consumer surplus (CS). In the study presented here, the economic welfare implications are estimated from different solid waste service improvement policy scenarios.

3. The Experiment

In the choice experiment, respondents were presented with a series of possible solid waste service improvement scenarios differing in the: level of waste collection frequency per week per household, segregation of waste at source or not and whether adults or children less than 18 years old (this is the case in the study area, Hawassa) should be employed in providing the service at different levels of increase in the service charge. Respondents were asked to choose their most preferred policy alternative. Based on expert interviews and focus group discussions, three relevant attributes for solid waste services were selected together with their levels. Collection frequency of solid waste was extended to 1,2 and 3 days per week, segregating waste at the source was qualified as either needing sorting or no sorting at all, and the issue of who should engage in the service provision is described as either adults or children less than 18 years old. In addition, seven price levels were identified: an increase in the household's monthly waste service charge of 1, 5, 10, 15, or Birr[2]20.

[2] Birr is Ethiopia's national currency. At the time of the study, 1 Birr was equal to approximately 0.057 USD (cf. exchange rate … 15 May, 2012).

Alternative policy scenarios are created by combining these four variables based on their different attribute levels. Because respondents cannot be shown in all the choice options, the number of possible combinations was reduced to 24 individual profiles of 12 pair wise choice tasks presented to each respondent. The SPSS version 19 software was used to determine the mix of attribute levels for the choice sets.

Each choice card shows two hypothetical choice alternatives describing a future policy scenario along with the option to choose none of the two. Inclusion of this latter 'status quo' alternative is instrumental to estimate welfare measures that are consistent with demand theory (Bateman et al., 2003) and not to force respondents to choose the proposed alternatives. It was emphasized that respondents would not have to pay anything extra if they choose the opt-out. An example of a choice card is presented in Figure 1.

Figure 1: An example of choice card

Attribute	Option 1	Option 2	Current Situation
Collection frequency per week	2	1	1
Segregation of Waste (dummy:1 segregation is needed)	Segregation is not needed	1	Segregation is not needed
Who provides the service (dummy:1 adults)	Children less than 18 years old	Adults	Children less than 18years old
Increase in monthly service charge	Birr 10	Birr 15	Birr 0
I prefer	☐	☐	☐

The design of the choice experiment was first pretested and subsequently implemented in February 2012 through 201 in-person interviews in three zones in Hawassa city identified by the Hawassa Sanitation and Beautification Agency

as Misrak Wukro, Manaharia and Tabor. The response rate was 100 percent, which is not unusual for this kind of stated preference research in a developing country (Whittington, 1998). Although up-to-date statistical information about household characteristics is not available for the different zones, the zones differ considerably in terms of their socio-economic status. Misrak Wukro is considered relatively the poorest part of the city, whereas households in Manaharia and Tabor are better off. In each zone, first households getting door to door waste collection service were identified and secondly from this a random selection was made. A third sample selection criterion was that only women were to be interviewed as women are more concerned about domestic waste than their men counterparts though very few male respondents were included in the interview. Trained local enumerators were used for the interviews. After data screening, it was found that all the 201 interviews could be used in the analysis (68 from Misrak Wukro, 67 from Manaharia and 66 from Tabor).

4. Results

4.1 Sample Characteristics

Table 1 shows the socio-economic characteristics of the interviewed households. A majority of the respondents (81%) were female and respondents were, on average, 28 years old. Respondents were between 18 and 75 years old. Average monthly household income was Birr 2175. Given the average household size of 5, this equals a daily per capita net income of Birr 14.50(USD 0.83). This is lower than the World Bank's international (PPP-adjusted) poverty line of USD 1.25 per day. A larger proportion of the respondents (74.1%) have at least a primary level education.

Concerning the solid waste service characteristics, the average amount of solid waste disposed per household per day is about 2.5 kg. On average, a household pays Birr 3.65(USD 0.24) per week for disposing its waste. This is 3.95% of the monthly income of a household. The majority of the respondents (74%)

characterize the sanitation status of Hawassa city as fair. 85.1% of households in the study area use door to door waste collectors as a method of disposing their solid waste. In content, yard waste (vegetable peelings, onion seed coats, soil, dust, grasses, etc) dominates solid waste from the households, followed by papers and plastic bags.

Table 1: Key socio-demographic and solid waste service characteristics of the sample population

Variable	Mean	St.dev	Minimum	Maximum
Average age	28.52	10.99	18.00	75.00
Share of female respondents	0.81	0.39	0.00	1.00
Household income(Birr/ month)	2166.88	3093.83	88.00	25000.00
Average household size	4.93	2.18	1.00	12.00
Average monthly service charge per household	3.66	2.40	2.00	25.00
Average waste produced/ household/ week in "madabaria"[3]	1.18	0.76	0.25	5.00

4.2 The Choice Model

All 201 respondents were willing to pay extra money for improved solid waste services and completed all 12 choice tasks. No protest voters were encountered in the data, i.e. respondents who consistently chose the 'opt-out' alternative on all choice occasions. Across all 1920 choice occasions, the opt-out was chosen in 2.34 percent of the cases. For efficiency purposes, the models were estimated using a Halton sequence of 100 replications in a quasi-

[3] Madabaria is a 50kg sack. According to the door to door waste collectors, a "Madabaria" of solid waste weighs about 15kg.

Monte Carlo maximum likelihood simulation (Bhat, 2001) in NLOGIT version 4.0.

The RPL model result is presented in Table 2. Several possible interactions between the attributes and socio-demographic respondent characteristics were tested for their statistical significance. Three of them, the household size and the zones in which the respondents live (Zone 1 and Zone 3) were found significant. The coefficient of household size is significant and negative implying that households with larger family size dislike sorting of waste. This may be because they produce more waste and sorting could be costly in terms of the time it takes. It is highly likely that increasing collection frequency decreases the utilities of respondents from Zone 1 as they are relatively poor and produce less waste so that increasing collection frequency may not be needed. The third statistically significant household characteristic is Zone 3. Respondents from Zone 3 strongly support solid waste service that is provided by adults. A possible reason could be that households from Zone 3 are more aware than households from other zones that it is unethical and immoral to engage children less than 18 years old in solid waste service provision. This better awareness may also be the result of their higher standard of living (relatively higher income households) compared to those in other zones.

Table 2: Estimated RPL Model

Variable	Model including solid waste service attributes		Model including household characteristics	
	Coefficient estimate	**Standard error**	**Coefficient estimate**	**Standard Error**
ASC	6.556***	1.121	6.185***	0.990
Collection Frequency (1,2,3 extra days/week)	0.098***	0.041	0.156***	0.049
Standard deviation	0.184**	0.073	0.190*	0.071
Sorting(dummy: sorting is needed)	0.209***	0.091	0.621***	0.175
Standard deviation	1.340	0.132	1.355***	0.122
Who Provides Service (dummy: adults)	0.618***	0.078	0.522***	0.094
Standard deviation	0.798	0.200	0.727***	0.210
Waste Service Charge (1, 5, 10, 15, 20) Birr/month)	-0.061***	0.004	-0.061***	0.004
Waste sorting x family size	-	-	-0.085**	0.039
Who provides the service x living in Tabor	-		0.295*	0.149
Collection frequency x living in Misrak Wukiro	- -		-0.171*	0.092
Log likelihood function	-1728.029		-1716.968	
McFadden pseudo R-squared	0.348		0.352	
N	2412		2412	

Significance levels: * 10% ** 5% *** 1%.

The significant positive outcome of the alternative specific constant (ASC) in both models implies that respondents prefer change instead of no change from the current situation.

The attribute parameters are significant and have the expected signs. Households value the additional waste collection frequency, segregation of recyclable solid waste before disposing and that adults should participate in urban solid waste service provision. An increase in the solid waste service charge, as expected, is valued negatively, implying that the utility of the households decreases as the monthly service charge increases. The fact that the derived standard deviations of all the attributes are significant indicates that unobserved heterogeneity is captured in the random parameter specification. Based on these coefficient estimates marginal WTP and standard errors were calculated using the Krinsky-Robb (1986) method. Marginal WTP for one extra day of collection frequency is Birr 2.55(USD 0.15) per month, while marginal WTP for waste sorting, that is, segregation of recyclable solid waste is Birr 10.15(USD 0.60) per month. Further, respondents were willing to pay extra Birr 8.55(USD 0.50) if the service is provided by adults.

5. Economic welfare measures for solid waste service improvement policy scenarios

Based on the estimated model in Table 2 including household characteristics, the welfare implications of different solid waste service improvement policy scenarios were calculated. At present, households get their solid waste collected once per week by children less than 18 years of old. Most households do not segregate the solid waste into recyclable and non recyclable materials before damping. Several solid waste management services were considered and compared with the status quo. Table 4 presents the estimated mean WTP values associated with improvements in solid waste services for the average respondent. Standard errors are presented in brackets and are based on the

Krinsky-Robb (1986) procedure. WTP for the solid waste improvement policy scenarios are presented in Birr.

Table 3: Estimated WTP for solid waste service improvements per household per month

	Children provide the service without segregating the waste	Adults provide the service segregating the waste
	Birr	***Birr***
1 extra day per week service	3.20 (1.4)	16.63 (2.6)
2 extra days per week service	4.80 (2.09)	18.24 (3.1)

In cases where only collection frequency of solid waste service improves and children provide the service without sorting of recyclable solid waste, urban households are willing to pay, on average, a service charge of Birr 3.20 (USD 0.18). If adults provide the service sorting recyclable solid waste at the same time, the increase in the service charge households would be willing to pay varies between 80 and 130 percent depending on the extra days of solid waste service.

These values (WTP) can be aggregated across the population from which it was drawn in order to calculate a total economic value for the policy scenarios. This total economic value can subsequently be compared with the necessary investment and maintenance costs for the improvement of current solid waste services in the city of Hawassa.

6. Conclusions

Public access to reliable solid waste service is an essential component of improved human health, safe environment and sustainable development. Increasing level of municipal solid waste caused by urbanization and rapid

population growth poses a serious threat to environmental quality and human health. This study examined public preferences for improved municipal solid waste service in an urban context with the aim of estimating the nonmarket value of solid waste service improvement.

The study contributes to the limited stock of improved solid waste service valuation studies. Though there are a number of contingent valuation studies focusing on WTP for improved solid waste service in developing countries, to our knowledge, this study is the first to apply choice experiment to estimate public preferences for improved solid waste service in terms of willingness to pay in developing countries such as Ethiopia. This study estimated compensating surplus welfare measure by asking a random sample of households in Hawassa for their WTP for improved solid waste service in terms of collection frequency, whether segregation of waste is needed or not and whether children or adults should provide the service. In the study presented here, the economic welfare implications are estimated using different solid waste service improvement policy scenarios.

Currently, on average, a household pays Birr 3.65 (USD 0.24) per week for disposing its waste. This is 3.95% of the monthly income of the household. The average amount of solid waste disposed per household per day is about 2.5 kg. Most households in the study area use door to door collectors as a method of disposing their solid waste. Yard waste (vegetable peelings, onion seed coats, soil, dust, grasses, etc) dominates solid waste from the households, followed by papers and plastic bags.

It appears that all households in the study area are willing to pay extra for improved solid waste service. It is highly likely that increasing collection frequency decreases the utilities of respondents from Zone 1 as they are relatively poor and produce less waste so that increasing collection frequency may not be needed. Respondents from Zone 3 strongly support solid waste service that is provided by adults as they are better off and are probably more

aware than households from other zones that it is unethical and immoral to employ children less than 18 years old in solid waste service provision. Mean WTP for more reliable solid waste collection varies between 23% and 33% over and above the current monthly solid waste service charge. If the service is provided by adults segregating the waste into recyclables at the same time, it results in an almost twice as high additional WTP depending on the extra days of solid waste collection frequency.

When the estimated individual household WTP values of the total number of households in Hawassa (approximately 12,500) are aggregated, they vary from birr 473684 per year, if solid waste services are improved by working on average only one day per week, to Birr 657895 per year if solid waste service are improved by working on average two days per week. If adults provide the service segregating the waste into recyclables at the same time, the value of the total benefits equals birr 2736842. Discounted over a 25-year time period at a discount rate of 10% this amounts to a present value of approximately birr 2.5 million. This discounted value can be compared to the capital costs of any future investment decision in improved solid waste services in the city.

It can be concluded that households in Hawassa city support improvement plan in solid waste service in terms of collection frequency per week, whether segregating the waste into recyclables is needed or not and who should provide the service. Therefore, to improve the existing solid waste service for expanding households in Hawassa and similar cities in the country, these attributes can be used to design appropriate strategies to improve the current service and generate additional revenue as the households show a positive willingness to pay for the improvement plan. Moreover, the present value of the total benefits could then be compared with the present value of capital costs of this “ideal” option in order to calculate its net benefits. This economic value can be used in policy and project appraisals of improved solid waste service investment decisions.

References

Adedibu, A. A. (1985). A comparative analysis of solid waste composition and generation in two cities of developing nations. The Environmentalist, 5:123 -7.

Ahmed, S. A. and Ali, M. (2004). Partnership for solid waste management in developing countries: linking theories to realities. Habitat International, 28:467-469.

Atlaf, M. A. and Deshazo, J. R. (1996). Household demand for improved solid waste management: a case study of Gujranwala, Pakistan. World development, 24(25): 857-868.

Baraki, H. (2003). "Contingent valuation survey on households' Willingness to pay for improved solid waste collection and disposal: the case of Mekele town". The working paper series; Faculty of Business and Economics: Civil Service College, Addis Ababa, Ethiopia.

Bateman, I. J., Carson, R. T., Day, B., Hanemann, W. M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Ozdemiroglu, E., Pearce, D. W., Sugden, R., Swanson, S. (2003). Guidelines for the use of stated preference techniques for the valuation of preferences for nonmarket goods. Edward Elgar, Cheltenham.

Beede, D. N. and Bloom, D. E. (1995). The Economics of municipal solid waste, The World Bank Research Observer, 10(2): 113-50.

Bhat, C. R. (2001). Quasi-random maximum simulated likelihood estimation of the mixed multinomial logit model. Transportation Research Part B, 35: 677-693.

Breffle, W. and Morey, E. (2000). Investigating preference heterogeneity in a repeated discrete-choice recreation demand model of Atlantic Salmon fishing. Marine Resource Economics, 15:1-20.

Brouwer, R., Martín-Ortega, J. and Berbel, J. (2010a). Spatial preference heterogeneity: a choice experiment. *Land Economics, 86(3): 552-568.*

Brouwer, R., Dekker, T., Rolfe, J. and Windle, J. (2010b). Choice certainity and consistency in repeated choice experiments. *Environmental and Resource Economics, 46: 93-109.*

Buenrostro, O., Bocco, G., and Bernache, G. (2001). Urban solid waste generation and disposal in Mexico: A case study, Waste Management and Research, 19: 169-76.

CPCB (Central Pollution Control Board). (2000). Management of municipal solid waste (MSW), Ministry of Environment and Forests: Government of India.

Degnet, A. and Maru, A. (2005). Solid waste management services. *Ethiopian Journal of Economics*, 5: 59-61.

Diallo, S. and Coulibaly, Y. (1991). Urban waste in the slums of Bamako: Popular Recycling Activities in the Third World. Dakar, 1, 2: 69-88.

ENDA (Environmental Development Action) (1996). A report on environmental issues in Addis Ababa, Ethiopia.

Gupta, S., Krishna, M., Prasad, R. K., and Kansal, A. (1998). Solid waste management in India: Options and opportunities: Resource Conservation and Recycling, 24:137–154.

Hensher, D. A., Shore, N. and Train, K. (2006). Water supply security and willingness to pay to avoid drought restrictions. The Economic Record, 82(256): 56–66.

Hynes, S., Hanley, N. and Scarpa, R. (2008). Effects on welfare measures of alternative means of accounting for preference heterogeneity in recreational demand models. *American Journal of Agricultural Economics*, 90(4): 1011-1027.

Krinsky, I., and Robb, A. L. (1986). On approximating the statistical properties of elasticities. Review of Economics and Statistics, 68: 715–719.

Layton, D. and G. Brown (2000). Heterogeneous preferences regarding global climate change. Review of Economics and Statistics, 82, 616–624.

Louviere, J. J., D. A. Hensher, J. D. Swait and W. L. Adamowicz. (2000). *Stated choice methods: Analysis and applications*. Cambridge University Press, Cambridge.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior: Zarembka, P. (Ed.), *Frontiers in Econometrics*. Academic Press, New York.

Morey, E. R., and Rossmann, K. G. (2003). Using stated preference questions to investigate variations in willingness to pay for preserving marble monuments: Classic heterogeneity, mixed, and mixture models. Journal of Cultural Economics, 27(4): 229.

NEERI (National Environmental Engineering Research Institute). (1994). Solid waste management in greater Bombay, final report.

Provencher, B. and Bishop, R. C. (2004) Does accounting for preference heterogeneity improve the forecasting of a random utility model? Journal of Environmental Economics and Management, 48, 793–810.

Rathi, S. (2007). Optimization model for integrated municipal solid waste management in Mumbai, India. Environment and Development Economics, 12:105-21.

Swait, J. and Louviere, J. (1993). The role of the scale parameter in the estimation and comparison of multinomial logit models. *Journal of Marketing Research*, 30 (3): 305-314.

Revelt, D., Train, K. (1998). Mixed logit with repeated choices: households' choice of appliance efficiency level. Review of Economics and Statistics, 53:647–657.

Scarpa, R., Willis, K. G. and Acutt, M. (2005). Individual-specific welfare measures for public goods: a latent class approach to residential customers of Yorkshire Water. In: Koundouri. P. (ed.). *Econometrics informing natural resource management*. Edward Elgar Publishers, Cheltenham, UK.

Tolina T. (2006). Household's Willingness to pay for improved solid waste: the case of Adama Town, unpublished MSc thesis, Ethiopia.

Train, K. (2003). *Discrete Choice Models with Simulation*. Cambridge University Press.

UN (United Nations) (2000). State of the Environment in Asia and the Pacific: United Nations Economic and Social Commission for Asia and Pacific and Asian Development Bank. United Nations Publication, New York.

Walelegne, D. and Alebel, B. (2003). Public valuation for improved solid waste management in Addis Ababa: Affordability and willingness to pay Analysis. A paper presented on a conference, Addis Ababa, Ethiopia.

Whittington, D. (1998). Administering contingent valuation surveys in Developing Countries. World Development, 26(1): 21-30.

THE ROLE OF MICRO AND SMALL ENTERPRISES IN IMPROVING THE LIVELIHOOD OF THE POOR IN HAWASSA

Tadesse Ababu[1]

Abstract

The aim of this study was to assess the role of micro and small enterprises (MSEs) in improving the livelihood of the poor in Hawassa. Specifically, the study aims at assessing the role of MSEs in increasing employment, income and value of total assets to the poor as well as identifying factors that determine improvement in the standard of living of MSE operators in Hawassa. The study used primary data, which was collected using a structured questionnaire administered to sample MSE operators in four sub-cities in Hawassa. The methodology used in this study comprises descriptive and regression analysis. In the descriptive analysis, statistical measures like averages, percentages and standard deviation are used to see the trends of major variables over time while in regression analysis the Logit model is used to model the relationship between improvement in the standard of living of MSE operators and other variables influencing it. The findings of this study could be used in assessing the performance of MSEs in achieving their objectives. It was found that MSEs have contributed to the expansion of self-employment opportunities, increased income and value of total assets to the operators. The observed increase in the number of newly established small business enterprises that enable the operators to generate reliable income has led to improvement in their standard of living. The regression result indicates that age of MSE operators, training given to them and average monthly income from the MSE business are important determinants of improvement in the standard of living of MSE operators. The sign of the coefficients of these variables is positive and the coefficients are statistically significant. This shows that the probability of attaining improved standard of living of MSE operators increases with training given to them before the business and the rise in average monthly income from their businesses. The contribution of MSEs in expanding self-employment opportunities, increasing income and total value assets to the operators implies that the government should further strengthen and encourage the MSE schemes to reduce unemployment which is decisive to poverty alleviation.

Key words: Logit model; improving livelihood; micro and small enterprises; Hawassa

[1] tadesse.ababu88@gmail.com, P.O. Box 05
Lecturer, Department of Economics, Hawassa University

1. Introduction

Rapid migration of people from various parts of the region together with ever-increasing natural growth rate of population has aggravated the problem of unemployment in Hawassa city. “Urban migration and high population growth rates have made unemployment a critical problem for developing country governments, and donors have responded by financing the programs that develop microenterprises, which are meant to absorb a portion of this excess labor” (Fidler and Webster, 1996). This shows that urban migration and high population growth rate have aggravated the problem of unemployment not only in urban Ethiopia but also in urban areas of other developing countries as well.

The Ethiopian government has been taking various measures to promote the expansion of Micro and Small Enterprises (MSEs) in urban areas of the country by organising poor households into associations of MSE operators and providing them with credit facilities since they do not have access to credit from formal banks. In this respect, Solomon (1996), indicated that “Poor households pursuing micro-enterprises are denied access to institutional credit due to the high collateral and antiquated lending practices of the formal banks”. However, this statement is unacceptable because micro enterprises are denied access to credit from the formal banks not merely due to the antiquated lending practices of these banks, but rather due to the fact that the objective of these banks is far from helping the poor.

The poor engaged in MSEs have limited access to credit from the formal financial institutions in all developing countries in general and in Ethiopia in particular. Thus, a mechanism should be designed to make credit accessible to MSE operators thereby expanding self-employment opportunities to the poor in order to alleviate poverty.

The existing literature regards development of MSEs as a major tool of poverty reduction (e.g. Johnson and Rogaly, 1997; Khandker et al., 1995; Holt and Ribe,

1991; Dessing, 1990). However, there is a debate on this issue and there is no general consensus among scholars on the area. According to Fidler and Webster (1996), MSEs have a very limited access to credit from formal banks. Furthermore, an insufficient supply of credit is found to be a major constraint to MSEs in many developing countries. Thus, it has been argued that making credit available to the poor MSE operators is considered to be essential to alleviate poverty and promote economic development (Khandker et al., 1995). Hence, special support programmes should be designed and implemented to facilitate access to credit to MSE operators so as to enhance their productivity and income generating capacity to improve their standard of living.

The government of Ethiopia and some NGOs are involved in supporting the MSE operators. They regard MSE development a possible means to reach the poorest section of the society. Hence, MSEs are considered to be a major job creators and income generators to the poor. The provision of support to the poor MSE operators can be viewed as a strategy to enhance the role of MSEs in expanding employment opportunities to improve the livelihood of the poor. A specific case study is required to investigate the role MSEs in improving the livelihood of the poor. But at present, such a study is hardly found in the context of Ethiopia. This study was intended to fill this gap considering the case of MSE operators in Hawassa city. Therefore, the aim of this study was to assess the role of micro and small enterprises in improving the livelihood of the poor in Hawassa.

Given the limited research in this area, this study will provide essential information on the role of MSEs in improving the livelihood of the poor in Hawassa. In addition, the factors that may lead to improvement in the living standard of the MSE operators were also identified. This will help the concerned bodies and policy makers to design and implement effective MSE development schemes. Moreover, it may encourage researchers to conduct further research in this area in the future.

2. Methodology

This study uses primary data on the crosssection of MSE operators in Hawassa city. The data was collected using a structured questionnaire administered to the sample MSE operators. The sample design procedure involved three stages: selection of sample sub-cities, associations and MSE operators. From each sample sub-city, sample associations were selected. And finally, from each of the sample associations, sample MSE operators were chosen. In each of the above cases, simple random sampling technique was employed in sample selection. The MSE operators are the primary sampling units in this survey. Sample MSE operators were selected from four sub-cities viz., Bahil Adarash, Menaheria, Misrak and Tabor, using simple random sampling.

According to the list obtained from the MSE Development Process Team of Hawassa city, there were 600 MSE operators registered in the city until December 2010. A rule of thumb was used to determine the sample size to be 10% of the population. Accordingly, out of the total population of 600, 10% (60) of the MSE operators were selected using simple random sampling and the questionnaire was administered to them. This sample size is reasonable to generate the required data with a given level of precision.

The methodology used in this study is descriptive analysis, which deals with the description of economic conditions and regression analysis concerned with identification of factors determining improvement in the standard of living of MSE operators in Hawassa. In the descriptive analysis, statistical measures like averages, percentages and standard deviation were employed to see the trends of major variables over time while in the regression analysis the l*ogit model was* used to model the relationship between improvement in the standard of living of MSE operators and other variables influencing it.

In this study, the dependent variable, Y, is dichotomous. A dichotomous variable is a variable which takes only two values-either 0 or 1. In regression

analysis, the logit model was used since this is one of the relevant models in the case of dichotomous dependent variables.

The main reason for using the logit model for this dichotomous dependent variables case was due to the inefficiency of the Ordinary Least Squares (OLS) method. If one uses the OLS, which is called Linear Probability Model in this dichotomous dependent variable case, the following problems arise: 1) The error terms do not follow normal distribution; 2) The error terms are heteroscedastic; and 3) Possibility of estimated probabilities lying outside the (0,1) interval.

The Logit model shows that as the explanatory variable increases the probability that the dependent variable will occur (i.e. $Y_i = 1$) remains within the (0,1) interval. Based on such considerations, the following model was used:

$$Y_i = \alpha_1 + \beta_1 AR + \beta_2 ARSQ + \beta_3 SR + \beta_4 EL + \beta_5 EB + \beta_6 TB + \beta_7 AMIB + \beta_8 OISB + \epsilon_i \quad \textbf{(1)}$$

where, Y_i = 1 if the standard of living of an operator is improved after the business; 0 otherwise
α_1 = the vertical intercept
AR = Age of respondent
ARSQ = Age of respondent squared
SR = Sex of respondent: Dummy = 1 if a respondent is male; 0 otherwise
EL = Education level of respondent
EB = Business experience of respondent before the MSE business
TB = Training given to respondent before starting MSE business
AMIB = Average monthly income of respondent from the MSE business
OISB = Other income source of respondent after the business: Dummy = 1 if a respondent has other source of income after the business; 0 otherwise
ϵ_i = the error term

Since the variable education is qualitative in nature it is necessary to consider the mutually exclusive levels of education separately. These are: less than high

school (grade 1-8), high school (grade 9-12) and above grade 12. Thus, two dummies can be introduced to accommodate the 3 levels of education. Assuming that the two dummies for education level affect the intercept but not the slope in the regression of improvement in the standard of living on other explanatory variables, the following model can be used.

$$Y_i = \alpha_1 + \alpha_2 D_2 + \alpha_3 D_3 + \beta_1 AR + \beta_2 ARSQ + \beta_3 SR + \beta_4 EB + \beta_5 TB + \beta_6 AMIB + \beta_7 OISB + \epsilon_i \quad \textbf{(2)}$$

where, D2 = 1 if an operator has high school level education; 0 otherwise

D3 = 1 if an operator has above high school level education; 0 otherwise

And the other variables are as described in Equation (1) above.

It is necessary to impose the restriction that the error terms are uncorrelated, which means that there is no serial-correlation among the error terms, i.e. $Cov(\epsilon_i, \epsilon_j) = 0$, $i \neq j$ so as to proceed the regression. The maximum likelihood estimation technique is employed to estimate the model.

For simplicity, Equation (2) can be rewritten as follows:

$$Y_i = \alpha_1 + \alpha_2 D_2 + \alpha_3 D_3 + \beta_i X_i + \epsilon_i \quad \textbf{(3)}$$

where, X_i = AR, ARSQ, SR, EB, TB, AMIB, OISB;

$\beta_i = \beta_1, \beta_2, \ldots, \beta_6$;

And the other variables are as described in Equation (1) above.

$E(Y_i|X_i)$ can be interpreted as the conditional probability that the event will occur given X_i. Hence, $E(Y_i|X_i)$ gives the probability of an operator improving their standard of living after the MSE business.

Assuming $E(\epsilon_i) = 0$, in order to get unbiased estimators, one can obtain,

$$E(Y_i|X_i) = \alpha_1 + \alpha_2 D_2 + \alpha_3 D_3 + \beta_i X_i \quad \textbf{(4)}$$

Let P_i be the probability that $Y_i = 1$ and $1- P_i$ be the probability that $Y_i = 0$, then the variable Y_i has the following probability distribution.

Y_i	**Probability**
1	P_i
0	$1-P_i$
Total	1

$P_i = E(Y_i=1|X_i)$ where, Y=1 means an operator improved living standard after the business.

By definition of mathematical expectation, one can obtain the following result.

$$E(Y_i|X_i) = 0(1-P_i) + 1(P_i) = P_i \quad \textbf{(5)}$$

Comparing Equation (4) with Equation (5), one can equate.

$$E(Y_i|X_i) = \alpha_1+\alpha_2D_2+\alpha_3D_3+ \beta_2X_i = P_i \quad \textbf{(6)}$$

This shows that the conditional expectation of Equation (2) can be interpreted as the conditional probability of Y_i given X_i. The probability P_i must lie between 0 and 1 and one can have the restriction

$$0\leq E(Y_i|X_i) \leq 1 \quad \textbf{(7)}$$

This means the conditional probability must lie within the interval (0, 1).

But now consider the following representation of the operator's standard of living improvement after the business.

$$P_i = E(Y_i=1|X_i)= \frac{1}{1+e^{-(\alpha_1+\alpha_2D_2+\alpha_3D_3+\beta_iX_i)}} \quad \textbf{(8)}$$

For simplicity Equation (8) can be rewritten as:

$$P_i = \frac{1}{1+e^{-Z_i}} \quad \textbf{(9)}$$

where, $Z_i = \alpha_1+\alpha_2D_2+\alpha_3D_3+ \beta_iX_i$

If P_i, the probability of improvement in the standard of living of an MSE operator, is given by (5), then $1-P_i$, the probability of an MSE operator not improving living standard after the business, is

$$1-P_i = \frac{1}{1+e^{Zi}} \quad \textbf{.(10)}$$

Hence, it is possible to write

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \quad \textbf{.(11)}$$

Here, $\frac{P_i}{1-P_i}$ is the odds ratio in favour of improvement in the standard of living of an MSE operator.

Taking the natural logarithm of Equation (11) yields:

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = \alpha_1 + \alpha_2 D_2 + \alpha_3 D_3 + \beta_i X_i \quad \textbf{.(12)}$$

This shows that the log of the odds ratio (L), is linear both in the explanatory variables (X) and the parameters (β). L is called the logit, and hence, the name logit model is given to such models. Equation (12) was estimated using the Maximum Likelihood estimation technique with the help of Limdep version 8.

3. Data Analysis and Discussion of Results

3.1 General Characteristics of Respondents

As mentioned earlier, 60 sample respondents were randomly selected from 600 MSE operators using the list obtained from MSE and small business development support office in Hawassa as a sampling frame. Out of the total respondents, 41 (68.3%) are male while 19 (31.7%) are female. This reveals that the majority of the sample respondents were male. The following table shows the distribution of the sample respondents by age group.

Table 2: Distribution of respondents by age group

Age Group	Number	Percent
18 – 22	12	20.0
23 – 27	11	18.3
28 – 32	19	31.7
33 – 37	10	16.7
38 – 45	8	13.3
Total	60	100.0

As shown in Table 1 above, 19 (31.7%) of the respondents are in the age group 28–32 (age is expressed in completed years and the group is set arbitrarily). On the other extreme, 8 (13.3%) of the respondents are in the age group 38–45. This portrays that most of the respondents are the youth in the late 20s and early 30s (i.e. in the age group of 28-32).

As far as education is concerned, 24 (40.0%) of the sample respondents had completed high school education prior to their participation in the MSE business. On the other hand, 2 (3.3%) of them had completed first cycle primary education (i.e., Grade 1-4) while 14 (23.3%) of them had above high school level education. Among those who had completed high school education 5 (8.3%) completed grade 12 while 7 (11.7%) completed grade 9. Table 2

depicts the distribution of respondents by educational level in which they were categorized by the highest level of schooling completed.

Table 3: Distribution of respondents by the level of education completed

Category	Number	Percent
Grade 1 – 4	2	3.3
Grade 5 – 8	20	33.3
Grade 9 – 12	24	40.0
Above grade 12	14	23.3
Total	60	100.0

With respect to business experience prior to the MSE business, the survey result reveals that 43 (71.7%) of the respondents had business experience prior to their participation in this business. On the other hand, 17 (28.3%) of them had no business experience prior to their participation in the MSE business.

With regard to training given to MSE operators before the business, 40 (66.7%) of the sample respondents were given training before the business and 36 (60%) of them confirmed that the training was found to be relevant and useful to their business operations while 4 (6.7%) of them reported that the training was irrelevant to their business operations. In contrast, 20 (33.3%) of the respondents indicated that they were not given any training before their MSE business.

3.2 The Role of Micro and Small Enterprises

An assessment of the performance of the MSE operators enables to have an insight into their progress in business operations. Further, the knowledge about the progress of the MSE operators helps to analyse the role of the MSEs in improving the livelihood of the poor in Hawassa. Accordingly, the role of the MSEs will be analysed in the subsequent sections.

3.2.1 Employment Creation

The survey result shows that 23 (38.3%) of the sample respondents were unemployed prior to their participation in the MSE business. However, after their participation in the business, all of them became self-employed. Further, a new employment opportunity was created for 17 (28.3%) of the sample respondents in cobblestone road construction. These results suggest that the MSEs play a significant role in employment creation and unemployment reduction (see Table 3).

Table 4: Major types of respondents' activities before and after the MSE business

Type of activity	Before the business		After the business	
	Number	Percent	Number	Percent
Food processing	1	1.7	10	16.7
Wood/Metal works	6	10.0	12	20.0
Cobblestone worker	0	0	17	28.3
Selling fruits and vegetables	0	0	4	6.7
Construction works	0	0	5	8.3
Miscellaneous	30	50.0	12	20.0
Unemployed	23	38.3	0	0
Total	60	100.0	60	100.0

Out of the total sample respondents only 1 (1.7%) of them were engaged in Food processing prior to their participation in the MSE business while 10 (16.7%) were engaged in the same activity after the business. All of the respondents engaged in this activity were female.

This shows that MSEs played a significant role in expanding small business opportunities to female operators. It also suggests that there is a room for improvement in the living condition of at least some female MSE operators

since the launching of the MSEs development scheme in Hawassa as the respondents themselves confirmed during the course of the survey.

In general, a satisfactory performance of the MSEs in the area of employment creation to the poor reveals the contribution of the MSEs is significant in improving the livelihood of the poor in Hawassa. Essentially, the MSEs development scheme has empowered most of the sample respondents to participate in the marketing process thereby enabling them to ensure self-reliance in their small business operations.

3.2.2 Increasing Income and Value of Total Assets

It is evident that the promotion of equity is one of the benefits of all MSEs development schemes in general and that of Hawassa in particular. As described in the previous section, the findings of this study regarding the creation of employment opportunities to the MSE operators revealed that MSEs have a positive contribution to income generation and increased value of total assets after the business. This is because the expansion of self-employment opportunities could normally lead to increased income and value of total assets of the operators.

As far as income after the MSE business is concerned, the survey revealed that 15 (25.0%) of the sample respondents reported an average monthly income of below Birr 450 and another 15 (25.0%) reported an average monthly income ranging from Birr 450-850 while 5 (8.3%) of them reported an average monthly income of above Birr 1650. The mean of average monthly income from the MSE business is about Birr 924.17 and roughly over 27 (45%) of the sample respondents earn an average monthly income above the mean. The standard deviation is Birr 2 036.50 indicating a big disparity among the respondents' average monthly income from the MSE business.

In general, 27 (45%) of the sample respondents were able to generate an average monthly income above the mean from the MSE business. Generating this amount of income from small business operations is not easy and can be regarded as a positive contribution of the MSEs in income generation. The survey result reveals that only 18 (30%) of the sample respondents get additional income from sources other than the MSE business. This implies that the majority of respondents obtain reliable income from the MSE business. As a result, the MSEs played a key role in generating sufficient income to most of their operators. From these results, one can infer that MSEs have registered advancement in income generation to their operators.

With regard to total value of assets, out of the total sample respondents, only 6 (10%) had total value of assets ranging from 5 001-10 000 prior to their participation in the MSE business. However, after the MSE business 18 (30%) of the sample respondents have the value of total assets in the same range. Further, the number of sample respondents who have the value of total assets above Birr 10 000 is doubled after the MSE business as shown in Table 4.

Table 4: Distribution of respondents' present value of the value total assets

Present value of the value of total assets	Before the business		After the business	
	Number	Percent	Number	Percent
Below Birr 500	15	25.0	3	5.0
500-1 500	10	16.7	2	3.3
1 501-3 000	13	21.7	12	20.0
3 001-5 000	8	13.3	9	15.0
5 001-10 000	6	10.0	18	30.0
Above 10 000	8	13.3	16	26.7
Total	60	100	60	100

These results suggest that the MSEs play a significant role in increasing the value of total assets to their operators. In general, increased income together with increased value of total assets of MSE operators would normally lead to

increased wealth to the operators, which in turn, could lead to improvement in their standard of living. Thus, MSEs play a crucial role in improving the livelihood of their operators in urban Ethiopia in general and in Hawassa city in particular.

3.2.3 Promoting Savings

Saving is expected to help in smoothing income of the respondents, which paves the way for accumulation of surplus. In this connection, Fidler and Webster (1996) indicated that "Specifically, saving services enable the poor to accumulate even very small surpluses that can be used at a later date to ride out dips in income or respond to emergencies." Furthermore, one can argue that incorporating saving services in the MSEs support scheme plays an important role in generating sufficient funds to enhance the development of MSEs in order to ensure sustainability of their operations.

The survey result indicated that only 15 (25%) of the sample respondents had saving accounts before the business while 36 (60%) acquired saving accounts after the business. There is about 35% increase in the number of respondents who use saving accounts after the MSE business. Thus, the performance of the MSE operators in saving mobilisation is satisfactory since the majority (60%) of the sample respondents have saving accounts after launching of MSE business. In fact, efforts should be directed towards designing and implementing saving mobilisation strategies to disseminate the culture of saving among the operators so that MSEs play a key role in poverty reduction. In this respect, Holt and Ribe (1991) noticed that "... credit alone cannot reduce poverty, but that well-designed and implemented savings and credit schemes can be effective instruments of poverty reduction".

3.2.4 Increasing Consumption Expenditure

An increase in the income of MSE operators after participation in the MSE business leads to a rise in household consumption expenditure under normal circumstances. This means that if average monthly income from the MSE business increases, there will be a corresponding increase in the monthly household consumption expenditure, other things remaining the same. However, the probability of improvement in the livelihood of the MSE operators will be reduced if the operators cover increased consumption expenditure using income from the MSE business.

But the reverse will occur if the increased consumption expenditure is financed using income generated from other sources. In other words, if the operators do not spend any thing for consumption so that other household members fully cover consumption expenditure, the likelihood of success in improving the livelihood of the MSE operators normally increases unless they are extravagant.

The survey showed that 14 (23.3%) of the sample respondents had an average monthly household consumption expenditure of below Birr 400 prior to the MSE business. However, after the business only 2 (3.3%) of the respondents had an average monthly household consumption expenditure of below Birr 400. On the other hand, the number of respondents with average monthly household consumption expenditure ranging from Birr 551-850 and 851-1250 has increased from 12 (20.0%) to 16 (26.7%) and from 10 (16.7%) to 15 (25%), respectively, after the business. Above all, the number of respondents with an average monthly household consumption expenditure above Birr 1250 has increased from 8 (13.3%) to 18 (30.0%) after the MSE business. The mean average monthly consumption expenditure of sample respondents prior to the MSE business is about Birr 732.20 while the standard deviation is Birr 1272.80 indicating that there is a big disparity among the respondents' average monthly consumption expenditure. The mean average monthly consumption expenditure of sample respondents after the MSE business is Birr 1130 while the standard deviation is Birr 1909.20, again indicating that there is a big disparity among the respondents'

average monthly consumption expenditure. In effect, from these results, one can conclude that the MSEs played a significant role in increasing monthly household consumption expenditure of the respondents.

3.3 Estimation Results of the Logit Model

To identify the determinants of improvement in the standard of living of the MSE operators after the business, the Logit model was estimated using LIMDEP VERSION 8.0. It is obvious that the problem of heteroscedasticity is common in cross-sectional data. Further, model specification errors can also lead to serious problems in the estimation of dichotomous dependent variable models. The model to be estimated was considered to take care of the problem of heteroscedasticity and specification errors. The homoscedastic model was estimated but neither specification error nor heteroscedasticity was detected in the data set and the result is presented in Table 5.

Table 5 Maximum Likelihood Estimates of Logit Model

Number of observations	60
Log likelihood function	-24.60328
Restricted Log likelihood	-38.19085
Chi-squared	27.17514

Variable	Coefficient	Standard Error
Constant	-21.2890**	8.5768
Age of Respondent	1.3320**	0.5538
Age of Respondent Square	-0.0216*	0.0091
Sex of Respondent (Dummy)	0.6515	0.9036
Experience before MSE Business (Dummy)	-1.0456	0.9444
Training before MSE Business (DummY)	1.4267***	0.8233
Average monthly income after business	0.2703*	0.0010
Other income source after the business (Dummy)	-0.0992	0.8055
High school level education (Dummy)	-0.2694	0.8257
Above high school level education (Dummy)	0.5020	1.2201

*Significant at 1%, **Significant at 5% and ***Significant at 10% level of significance

The estimation result of heteroscedasticity corrected version of the logit model indicates that the Likelihood Ratio statistic having a chi-squared distribution with 9 degrees of freedom is statistically significant at 1% level of significance. From this result, one can conclude that the estimated model fits the data very well.

The age of MSE operators is positively related to improvement in their standard of living after the business. This is consistent with a priori expectations and the coefficient of this variable is statistically significant at 5% level of significance. The square term for the age of operators was added to test for non-linearity and it was found that age follows the predicted trend. This means that the square of age of operators is negatively related to improvement in their standard of living after the MSE business as expected and its coefficient is statistically significant.

Sex of operators is positively related to improvement in their standard of living after the MSE businesses indicating that being a male tends to enhance the probability of improved standard of living of operators after the business. But the coefficient of this variable is statistically insignificant.

Business experience of MSE operators acquired prior to their participation in the business is negatively related to improvement in the standard of living of operators after the businesses and inconsistent with a priori expectations. However, the coefficient of this variable is statistically insignificant. This reveals that the business experience that operators acquired in various ways prior to their participation in the MSE business does not influence improvement in the standard of living of operators after the business.

The training given to operators prior to the MSE business is positively related to improvement in the standard of living of operators after the businesses, which is consistent with a priori expectations. The coefficient of the variable is statistically significant at 10% level. This shows that the training given to

operators before the MSE business tends to increase the probability of improved standard of living of operators after the MSE business operations. In fact, this finding is consistent with the common sense hypothesis and economic theory in general.

Average monthly income of operators from the MSE business is positively related to improvement in the standard of living of operators after the businesses, which is consistent with a priori expectations. The coefficient of this variable is statistically significant at 1% level. This shows that an increase in the average monthly income of operators from the MSE business tends to enhance improvement in the living standard of operators. This finding is consistent with the common sense hypothesis and economic theory.

On the other hand, availability of other income sources for MSE operators after the business is negatively related to improved standard of living of operators, which is consistent with a priori expectations. This implies that if the operators are engaged in other income generating activities, it is highly likely that they will spend less time on the MSE business. This tends to reduce the probability of generating more average monthly income from the MSE business which, in turn, results in reduced probability of attaining improved standard of living of operators with the help of the MSE business. However, the coefficient of this variable is statistically insignificant.

High school level education is negatively related to improvement in the standard of living of MSE operators after the business while above high school level education is positively related to the improvement in the standard of living of MSE operators after the business. Both of these variables do not have a priori expected signs and the coefficients are statistically insignificant.

This result suggests that high school level and above high school level education do not have significant influence in improving the standard of living

of micro and small business operators since individuals with more education can earn higher income by engaging in other types of activities.

In general, the regression result summarized above reveals that the age of respondents, training given to the respondents before the MSE business, and the average monthly income of respondents from the MSE business are found to be more important determinants of improvement in the standard of living of the MSE operators after the business.

3. Conclusion and Recommendations

3.1 Conclusion

The findings of this study summarised in section 3.2 could be used in assessing the performance of MSEs in improving the livelihood of the poor. It was found that the MSEs have contributed to the expansion of self-employment opportunities to the poor in Hawassa.

The MSEs have also positively contributed to income generation to their operators. The observed increase in the number of newly established small enterprises that enable the operators to generate reliable income to ensure the sustainability of MSEs has led to improvement in their standard of living.

Furthermore, the regression result indicates that age of MSE operators, training given to the operators before the MSE business and average monthly income from the MSE business are found to be the most important determinants of improvement in the standard of living of MSE operators. The signs of the coefficients of these variables are positive as expected and the coefficients are statistically significant. This shows that the probability of attaining improved standard of living of MSE operators increases with the age of operators, training given to the operators before starting the business and the rise in average monthly income of operators from the MSE business.

In general, the identification of factors influencing improvement in the standard of living of MSE operators is indispensable in designing and implementing better MSEs development programmes throughout the country in the future. This paves the way for improvement in the standard of living of the poor in different parts of the country so as to ensure poverty alleviation at large.

3.2 Recommendation

On the basis of the findings of the study, some suggestions can be made. The positive contribution of MSEs in the expansion of small business opportunities and income generation to the operators implies that MSEs play a crucial role to curtail the prevailing problem of unemployment in the country in general and in Hawassa city in particular. To this end, the government should further strengthen and encourage such MSE schemes in order to reduce unemployment which is decisive to poverty alleviation.

It is necessary to test the stability of the observed relationships among the variables used in the analysis of factors that determine improvement in the standard of living of MSE operators over time. A one-time analysis of the relationship among these variables may not be sufficient to make generalizations about the relationship that is expected to prevail at all times in the future. As a result, it is necessary to undertake further research in this area with more representative samples drawn from all parts of the country.

References

Dessing, M. (1990). "Support of Micro-enterprises: Lessons for Sub-Saharan Africa," World Bank Technical Paper No. 122, Africa Technical Department, The World Bank, Washington, D.C.

Fafchamps, Marcel. (1994). "Industrial Structure and Microenterprises in Africa," the *Journal of Developing Areas*, Vol. 29, No. 1, Western Illinois University, pp. 1-30.

Fidler, P. and Webster, L. (1996). "The Informant Sector and Micro-finance Institutions in West Africa," World Bank Regional and Sectoral Studies, the World Bank, Washington, D.C.

Greene, W. H. (1997). *Econometric Analysis*, 3rd ed, Prentice-Hall, Inc., U.S.A.

Gujarati, D. N. (1995). *Basic Econometrics*, 3rd ed, McGraw-Hill Inc., Singapore.

Holt, S. L and Ribe, H. (1991). "Developing Financial Institutions for the Poor and Reducing Barriers to Access for Women," World Bank Discussion Paper No 117, The World Bank, Washington, D.C.

Johnson, S. and Rogaly, B. (1997), *Microfinancing and Poverty Reduction*, Oxfam (U.K and Ireland).

Johnston, J., and Dinardo, J. (1997). *Econometric Methods*, 4th ed, McGraw-Hill Inc., Singapore.

Khandker, S. R, Baqni, K., and Zahed, K. (1995). "Grameen Bank Performance and Sustainability," World Bank Discussion Papers No. 306, the World Bank, Washington, D.C.

Maddala, G. S. (1983). *Limited Dependent and Qualitative Variables in Econometrics*, Cambridge University Press, U.S.A.

Mead, D. C. and Liedhlom, C. (1998). "The Dynamics of Micro and Small Enterprises in Developing Countries," *World Development*, Vol. 26, No. 1, pp. 61-74.

Ministry of Trade and Industry. (1997). Micro and Small Enterprises Development and Promotion Strategy, Addis Ababa.

Solomon, D. (1996). "Credit to Poor Households: The Case of Financing Micro-enterprises in Debre Brehan Town, North Shoa, Ethiopia," the Ethiopian Economy: Poverty and Poverty Alleviation, Proceedings of the Fifth Annual Conference on the Ethiopian Economy, Addis Ababa, pp. 307-324.

Wilson, S. and Adams, A.V. (1994). "Self-employment for the Unemployed: Experience in OECD and Transitional Economies," World Bank Discussion Paper No. 263, the World Bank, Washington, D.C.