

NORWEGIAN UNIVERSITY OF LIFE SCIENCES



Abstract

While the expansion of Microfinance institutions throughout the third world is clear, the policy ramifications are not. As in many countries in Sub-Saharan Africa, program credit impact assessment has come under much scrutiny in Ethiopia. However, non-classical measurement error, self selection into the program, lack of valid exclusion restrictions, violation of key ignorability-of-treatment assumption coupled with difficulty of finding good identification strategy when conditional independence fails, complicates the identification of the causal effects of Microfinance. In this paper, the researcher identifies the impact of Microfinance on income and non-income indicators of poverty in the rural areas of the Tigray region of Ethiopia by using two rounds of regional representative household survey data that were collected in 2006, and more recently in 2010. In particular, the researcher studies whether microfinance credit is reducing poverty, helps the poorest of the poor and the amount of malnutrition reduced because of microfinance credit. In order to consistently identify the causal effect of participation in Microfinance and compare the results, the researcher uses two new estimators called Klein and Vella (KV) and minimum biased estimator along with the standard Heckman bivariate normal (BVN) selection model. The researcher finds consistent evidence of causal effect of participation in Microfinance on reducing child malnutrition and increasing annual per capita consumption expenditure when applying the three estimators. More importantly, the study has shown that the poorest of the poor are benefiting more from Microfinance credit program than the moderate poor rural households in Tigray. Findings also suggest that around 3% of the reduction in the gap of severe poverty in Tigray is made possible by program credit. Results show how Social Welfare programs aimed at poverty alleviation among those living in severe poverty can affect child malnutrition outcomes, which goes beyond the standard poverty measures of consumption and income.

Key Word: *Microfinance, Poverty, Household, Treatment, identification strategy, non-classical measurement error, self selection, valid exclusion restrictions, income and non-income poverty measures and violation of key ignorability-of-treatment, Tigray, Ethiopia*

Acknowledgments

First and for most I am ever grateful to God, the Creator, Savor and the Guardian and his mother St. Marry, and to them I owe my very existence and help me during this research journey, and indeed, throughout my life.

Next, I would like to extent my gratitude to my outstanding supervisor Associate Professor Mette Wik. Your supports, guidance, advice throughout the research journey, as well as your painstaking effort in proof reading the drafts, are greatly appreciated.

I would like extent my heartfelt gratitude to Professor Stein Holden for teaching me Scientific Research, supporting me in all aspects, critical comments and suggestions to successfully accomplish my thesis.

The Norwegian Government and Norwegian University of Life Science (UMB) generously financed my scholarship. I want to greatly acknowledge such benevolence of both. I also want to extent my thanks to Mekelle University, Ethiopia, for providing me a study leave and making me for this day. Special thanks to Seid Hassen (PhD student) for your support, comforting approach, keeping me in track in writing this thesis, understanding, encouragement to pursue my study and many more things.

I want to thank my best friend Joeri Smits. Indeed, without your unreserved suggestions and supports, I would not be able to accomplish the journey. Thanks Joeri. The experience has been an interesting and rewarding one. I will not forget you! Gentle Nederlandse man!

I would like to thank Bethelhem Legesse for your comforting approach and unreserved guidance in cleaning the data used in this study. I am also indebted to forward my gratitude to my friend and classmate Gebresilase Hailu for taking care of me especially during the great Western Winter. I wish you all the best in your future career and *blessings* upon your growing and lovely son, Nahom

Of course, my journey would not have been possible without Teame Hailemariam Tedla, a friend, colleague and classmate. Teame, you were at my right side when

people were digging my tomb and conspiring to spoil my future. You are my intelligence chief. You demonstrated yourself a man. Enough!!!

This thesis is dedicated to my mother, who taught me that the best kind of knowledge to have is that which is learned for its own sake. Emiye, thank you so much for your unconditional support throughout my life, remembering me in your prayer, dedicating your life to raise me and living for me. Emiye, you are an extraordinary mother who brighten my aspirations.

My most special thanks are reserved to Selam Gebremeskel (Wude) for taking care of me. I would like to forward my gratitude to Selame for your understanding and support during the whole year. Your support and encouragement was in the end what made this dissertation possible

Dr. Tilahun Abebaw, Ermias Andargie, Belachew Andargie(Tilaye), Abebe Kebede, Kidane G/her, Yesuf Mohammed, Alem Araya, Dr. Guush Berhane, Professor Daniel Millimet, Hosaena Ghebru, Dr. Zaid Negash, Dr. Zenebe Gebreegziabher, Dr. Gebrehawaria Gebreegziabher, Dr. Belaineh Legesse, Dr. Olvar Bergland, Hailai Abera, Kondwani Nyirongo and Fikru Kefialew, I thank you all for helping me at different times.

Achamyeleh Tamiru
May 2011
Ås, Norway

Table of Contents

Page number

Abstract	ii
Acknowledgment.....	iii
1. Introduction	1
2. Background	6
Credit.....	9
Agricultural input loan.....	9
Civil servant loan	9
Rural Package /Household centered/ loan	10
Conclusion.....	12
3. Theory and Literature Review.....	13
Definitional and conceptual issues.....	13
What is microfinance?.....	13
Microfinance and its' impact on the poor.....	15
Childhood Malnutrition and Income	18
4. Data, Empirical Identification and Estimation Strategy	20
Description of the panel data set.....	20
Data organization process.....	21
Description of variables used in the study	23
Quantitative identification Methods and Estimation Specification	27
Program Evaluation Specification and Heckman bivariate normal selection (BVN) estimator	27
Millimet's Estimator	29
Klein & Vella (2009) Estimator	32
Foster-Greer-Thorbecke poverty gap Estimator	33

Linear Regression Framework.....	36
5. Analysis, Key Findings and Relevant Discussions.....	37
Summary Statistics of Basic household information.....	37
Summary statistics of basic household information in 2006	37
Summary Statistics of basic household information in 2010	38
Econometrics Estimation.....	42
Estimation Results.....	43
Effect of credit on poverty reduction (prevalence of stunting)	43
Effect of credit in reducing the gap of malnutrition (stunting)	46
Who is benefiting from program credit in Tigray?	47
6. Conclusion	50
References.....	52
Appendices.....	57
Appendix I. Village Dummy significant test.....	57
Appendix II. Spearman's rank correlation coefficients test	58
Appendix III. Pearson product-moment correlation	59
Appendix IV. Household Questionnaire	60
Appendix V. Plot Level Questionnaire.....	75
Appendix VI. Health Questionnaire.....	81

List of Tables

Table I. Description of Variables used in the study.....	23
Table 1. Household information by credit participation in 2006	37
Table 2. Household information by credit participation in 2010	38
Table 3. Effect of Program credit Participation on stunting reduction	43
Table 4. Effect of Program credit Participation on consumption expenditure per capita	44

Table 5. Estimation of the amount of malnutrition reduced because of DECSI	46
Table 6a. Estimation of ATE and ATT for the moderate poor	48
Table 6b. Estimation of ATE and ATT for the poorest of the poor	48

List of Figures

Figure 1. A simple causal chain from microfinance to poverty alleviation	13
Figure 2. The relationship between annual consumption expenditure per capita and height-for-age z-score for the entire sample	40
Figure 3. Pattern of relationship between total consumption expenditure and height-for-age z-score	42

List of Acronyms

ATE- Average Treatment Effect
ATT- Average Treatment Effect on the Treated
ATU- Average Treatment on the Untreated
BVN- Heckman bivariate normal
DECSI- Dedebit Credit and Savings Institution
FGT- Foster-Greer-Thorbecke
IV- Instrumental Variable
KV- Klein and Vella
MB-BC- Minimum biased-Biased corrected
MFI- Microfinance Institution
OLS- Ordinary least square
RCT- Randomized Control Trials
SSA- Sub Saharan Africa

1. Introduction

Microcredit— broadly speaking, the provision of loans to very small businesses-- is an increasingly common weapon in the fight to reduce poverty and promote economic growth (Karlan and Zinman, 2009). Lack of access to credit is a key obstacle for economic development in poor countries. As a counter-offensive against poverty, therefore, several microfinance schemes have gone operational around the world, providing financial access to millions of poor people both in rural and urban areas, and the term Microfinance has become a development catchword since 1970s. The microfinance revolution got considerable momentum around the world in the last two and half decades. Marking such a peak, the UN declared 2005 a 'Microcredit' year and Mohamed Yunus and his Grameen Bank won the 2006 Nobel Peace Prize. This signals the ways in which microfinance has shaken up the world of international development (Berhane Tesfay, 2009). Today's microfinance institutions have been established based on Grameen's modality. Grameen shaped the modern industry of microfinancing (De Aghion et al., 2007).

Tigray regional state of Ethiopia is one of the hardest hit regions in Ethiopia by recurrent droughts that are characterized by food shortages, famines and excess mortality (Webb et al., 1992). Moreover, many of Ethiopia's historical cross-boundary wars (e.g., the 1896 and 1935 Italian invasion), recent civil wars (e.g., the protracted civil war that ended in 1991) and border conflicts (e.g., the 1998-2000 with Eritrea) took place in this region. Coupled with decades of poor governance all of this resulted in environmental and ecological imbalances in the region, which are manifested in degraded lands, poor resource bases, and population pressure, which led to further land fragmentations and mismanagement and hence to an even poorer performance of agriculture, also relative to the national average (Woldehanna, 2000). Studies indicate that close to 50 per cent of households in the region produced less than their annual food requirements in 1997 and 2000 (Hagos, 2003). In 2005, around 48 percent of the population of Tigray was unable to meet the basic requirement of consumption ((MoFED), 2006).

The earliest microfinance attempt in Ethiopia started in 1994 by a local NGO, the Relief Society of Tigray (REST). This has developed into the present day Dedebit Credit and Saving Institution (DECSI), following the legal framework provided by the national

proclamation in 1996 (proclamation 40/96)(Berhane Tesfay, 2009)¹. DECSI, the attention of this study, was primarily focused on providing credit services and other financial services (e.g., saving) to poor ‘credit constrained’ farmers in Tigray. As of today, the program has reached all villages in the Tigray region.² The operation of DECSI in Tigray serves as a basis for this study.

Microfinance practitioners, policymakers, and donors around the globe have ambitious goals for expanding access to credit in the march against poverty. Yet, despite often-grand claims about the effects of microcredit on borrowers and their businesses, there is relatively little convincing evidence on microfinance impacts. Hence, little is known about where the impacts are the strongest (Karlan and Zinman, 2009).

Non-randomized empirical evaluations of microcredit impacts are typically complicated by classic endogeneity problems; e.g., client self-selection and lender strategy based on critical unobserved inputs like client opportunity sets, preferences, and aptitude (Karlan and Zinman, 2009). Another weakness of existing impact studies, which is rarely mentioned, is the fact that they use income or expenditure as outcome variables. These measures are likely to be subject to measurement errors that are correlated with the true latent variables, that is, non-classical measurement errors. In a recent simulation study, (Millimet, 2010) showed that even small degrees of non-classical measurement error in the dependent variable can dramatically bias coefficients. This makes the identification of the causal effects of such programs difficult (ibid).

There is also a growing concern amongst academicians that the expectations of microfinance are not being met. Rigorous research approaches, employing randomized trial designs, have begun to suggest that microfinance may not be the golden bullet that many had hoped (Stewart R et al., 2010).

The methodological rigor of various impact studies varies considerably. Westover (2008) in general indicates the lack of stringent, rigorous impact studies, with many

¹ *REST was transformed into a quasi-private ‘business oriented’ microfinance institution in 1997 and subsequently renamed as DECSI since 1997. DECSI was established based on the same principles as the Grameen bank.*

² *This study will cover sixteen villages that are all covered in the program.*

impact studies done by Microfinance Institutions (MFIs) themselves that are case- and locale-specific, and qualitative in nature. They also tend to rely heavily on anecdotal evidence. (De Aghion et al., 2007) and (Cotler and Woodruff, 2008) reviewed impact studies and found that those with the largest methodological flaws tended to find the strongest positive impacts of microfinance³. The bottom line is that there is really weak academic evidence that microcredit reduces poverty (Roodman, 2009).

Moreover, there exists little evidence in the literature that reported microfinance's distributional impact, i.e. whether the poorest of the poor or the moderate poor are benefited, across the distribution of outcomes as increasing in the outcome does not per se mean that poverty is reduced.⁴ A program's distributional impacts can be evaluated by examining the program effects for households or individuals across the range of *outcome variables*, which might include household per capita income, consumption expenditure or nutritional status. The impact on poorer households as compared with wealthier households is particularly interesting in the context of programs that aim to alleviate poverty. Hence, examining the distributional impact is an important insight in evaluating the performance of microfinance ((Araujo et al., 2008); (Gugerty and Kremer, 2008); (Mansuri and Rao, 2004); (Platteau, 2004)).

DECSI prides itself on providing credits to the poor in Tigray living in absolute poverty. Berhane Tesfay (2009) found out that microfinance credit significantly raised annual per capita household consumption. A recent assessment of the impact of microfinance, based on survey households' poverty indicators, reported that albeit some momentary impacts, poverty is rampant in the study areas, even in the presence of micro-finance programs (Hailai, 2010). While DECSI 's quick expansion of its network throughout the region is clear, the policy ramifications are not. In addition, the amount of poverty reduction that can be attributed to DECSI's intervention in Tigray is

³ *One evidence, for example, is a study by HAGOS, F., HOLDEN, S. & PENDER, J. 2006. The Effect of Program Credit on participation in off-farm employment and welfare of rural households in Northern Ethiopia: Agricultural University of Norway. They used an instrument for the endogeneous treatment, in their case the choice to participate in to the microfinance program as the treatment dummy, by interacting the number of adult labor in the household with the village dummy and used the interacted term as an instrument for the endogeneous treatment variable. However, adult male labor is not likely to satisfy the excludability assumption, as it directly affects household's income or the outcome equation.*

⁴ *One noticeable evidence has been reported by KARLAN, D. S. & ZINMAN, J. in their paper entitled Expanding microenterprise credit access: Using randomized supply decisions to estimate the impacts in Manila.*

not yet explored. This study explored some of these unknowns based on data obtained from a case study area.

In addition, this research attempts to contribute to a small, but substantive as well as methodologically significant, literature in the area of microfinance impact evaluation.

In light of the above discussion, the primary evaluation questions to guide the inquiry are as follows as applied to the Tigray region:

1. Does Microfinance reduce rural poverty?
2. By how much has DECSI reduced the poverty of poor rural households?
3. Who has benefited from Microfinance across the distribution of outcomes?

In order to answer these questions, the researcher used the data that come from the 2006 and 2010 survey rounds conducted in 16 communities in the Tigray Region, Northern Ethiopia.

Instead of relying on using only one estimator, the researcher proposes to use a combination of estimators (based on household survey data for 2 rounds) to arrive at the answers set in this research Paper. The estimators used are Heckman bivariate normal selection model (BVN), a new estimator called bias corrected inverse-probability of weighting estimator (IPW) or simply called biased –corrected estimator and Klein and Vella (KV) estimator.

The researcher investigated these issues using household survey data collected in Tigray Region of Ethiopia, where the local Microfinance institution prides itself on providing credits to the poor. It can be cautiously concluded Microfinance credit has a positive impact; specifically it reduces child malnutrition and increases annual per capita consumption expenditure. In addition, the researcher cautiously investigated that the poorest of the poor are benefiting more from participation in program credit than the moderate poor rural household in Tigray.

The remaining parts of this paper are organized as follows. The second section of the paper presents information about DECSI's program details such as interest rate determination, repayment frequency, joint or individual liability, number of clients the MFI has, eligibility criteria, loan sizes and loan use restrictions. The third part of the

paper presents a brief overview of the underlying theory and literature relevant for the study. The fourth part describes the data and introduces the empirical identification and estimation strategy of the paper. The fifth part presents the key findings and relevant discussions, and the last part concludes.

2. Background

The attention of this study is impact evaluation of a local microfinance institution called Dedebit Credit and Saving Institutions (DECSI), operating in the Tigray regional state of Ethiopia. Tigray is the most northern region of Ethiopia, bordering in the north with Eritrea, in the west with the Sudan and in the south and east, respectively, with the *Amhara* and *Afar* regional states of Ethiopia⁵.

Subsistence agriculture is the main stay of the rural population in Tigray. It includes mainly crop, livestock and mixed farming. Farming systems are characterized by traditional ways of doing things. Labor and animal power is the main inputs in production. Irrigation is limited and production depends on short-season annual rainfall. With the exception of the southern plateau that enjoys an additional short rainy season, the *Belg* (March-May), the principal rainy season in this region is the *Kiremt* (June-September) season. This season typically belongs to the monsoon rainy season of the semi-arid, *Sudano-Sahelian* dry land belt of Africa that extends from the west (Atlantic Ocean) to east (Ethiopia and Eritrea), which is characterized by erratic rainfall and recurrent droughts (Segele and Lamb, 2005).

Historically, this is one of hardest hit regions in Ethiopia by recurrent droughts. Of the 39 major recorded droughts in the last 200 years in the country that are characterized by food shortages, famines and excess mortality, more than half of them occurred in parts of the country that include this region (Webb, et al., 1992). Moreover, many of Ethiopia's historical cross-boundary wars (e.g., the 1896 and 1935 Italian invasion), recent civil wars (e.g., the protracted civil war that ended in 1991) and border conflicts (e.g., the 1998-2000 with Eritrea) took place in this region. Coupled with decades of poor governance, all of this resulted in environmental and ecological imbalances in the region, which are manifested in degraded lands, poor resource bases, and population pressure, which led to further land fragmentations and mismanagement and hence to an even poorer performance of agriculture, also relative to the national average (Woldenhanna and Oskam, 2001).

To reverse this situation and help the poor in Tigray, the Relief Society of Tigray (REST)

⁵ See the map online at: <http://www.maplandia.com/ethiopia/tigray/>

was established in 1978⁶ and has been engaged in development programs principally in environmental rehabilitation, agricultural development, aid, social development, rural water supply and credit and saving services (Borchgrevink et al., (2003)). The pillar objectives of these programs are to improve the economic situation of the low income and poorest people in the Tigray Region. Besides, to accomplish independence based on bona fide participation of the people. By embarking upon and surmounting the core grounds and consequences of poverty through advancing sustainable rural development (Hailai, 2010).

Note that, although lending to poor people through NGOs is not new, microfinance in its present form, i.e., providing financial services with business orientation and REST platform⁷, is a recent phenomenon in Ethiopia (Berhane Tesfay, 2009).

In 1993, **REST** (Relief Society of Tigray), the main NGO in the region, launched a socio-economic poverty survey in rural areas. Lack of access to credit appeared as one of the major obstacles to the rehabilitation of the region and its development. This marked the birth of Dedit Credit and Saving Institution (DECSI).

This program of credit is created to help increase agricultural production, stimulate the local economy, reduce the influence of moneylenders and increase incomes of the poor. The first operations began in 1994 and the organization will be legally recognized in 1996 as part of the first law on microfinance in Ethiopia enacted that year. During its growth, DECSI received financial support from Novib (Netherlands), Norwegian Peoples Aid and SOS FAIM (Belgium and Luxembourg). Today, DECSI's operation is limited to Tigray, northern region of Ethiopia and it has over 460,000 customers and as such DECSI is regarded as one of the four largest MFIs in Africa (Wikipedia, 2010).

Since its establishment in 1994, DECSI has been providing the following three loan types: Regular, Agricultural Input and Agricultural Package Loans. Besides, it provides

⁶ *The Relief Society of Tigray was founded as a humanitarian organization in 1978, three years after the war between the central government of Mengistu Haile Mariam and the Tigrayan People's Liberation Front began. REST's mandate was to assist drought- and war-affected people living in the areas of Tigray under the control and administration of the TPLF.*

⁷ *By DECSI's Platform, it means the range of services Financial DECSI is currently rendering. These services are discussed in later part of this chapter.*

saving services such as compulsory deposit of group and center saving, voluntary deposit from loan clients and the public at large and Pension Payments. Recently, DECSI has expanded its services particularly in the area of Agricultural Input and Agricultural Package Loans (mainly individual) and enterprise loans(Hailai, 2010).

With this background information, the following part gives information about DECSI's program details such as interest rate, repayment frequency, joint or individual liability, number of clients the DECSI has, eligibility criteria, loan sizes and loan use restrictions.⁸

As mentioned earlier, the broad objectives of DECSI are:

- ✚ To improve food security at household levels both in the rural and urban areas of the region.
- ✚ To create job opportunities to the unemployed parts of the population through promoting micro, small and medium enterprises in the region.
- ✚ To stimulate the local economies through offering adequate and efficient financial services and build financially sound and sustainable institutions.

To achieve these key objectives, DECSI has designed the following strategies:

- ✚ Confer priority to agricultural sector in the rural and Micro and Small scale Enterprises (MSEs) in the urban areas.
- ✚ Use high community participation for the success of financial services of DECSI.
- ✚ Ensure that women get priority for financial services.
- ✚ Integrating the DECSI program with whole set of development programs in the region.
- ✚ Secure and achieve sustainable financial income required to cover the institution's operational expenses.
- ✚ Give prior attentions to saving mobilization.

Though clients vary according to the type of product services, the target groups are identified as

- ✚ Community members working to come out of poverty;
- ✚ The poorest of the poor capable of generating income (productive poor);

⁸ This Part is taken from DECSI publication entitled *Brief Overview On Decsi Achievements*. It is available online at www.decsi.com.et

- ✚ Owners of micro, small and medium enterprises.

As to the area coverage, when the institution commenced operation in 1994, it had branches in eight woredas⁹ of the region with only 31 employees. Currently it is providing its services through functionally decentralized 138 branches. The current number of staff has also reached 2000. Moreover, it has opened branches in Addis Ababa and Gonder while it is planning to commence remittance¹⁰ services from abroad.

At this time, DECSI is rendering four types of financial services.

1) Credit

Currently there are 4 types of loans /products/ in Dedebit Microfinance and the size and loan period varies according to the type of loan.

Regular loan

- ✚ It is a loan provided to regular clients of Dedebit Microfinance.
- ✚ It is a loan provided through group guarantee and the minimum number of a group is three.
- ✚ The maximum period of loan is 3 years.
- ✚ Currently there are 60,619 clients benefiting from the service.
- ✚ Birr 160 million outstanding balance is in possession of clients under the service.
- ✚ The maximum loan amounting Birr 10,000 is given to clients who brought real and measurable results in their lives.

Agricultural input loan

- ✚ This product is given 100% for purchase of agricultural inputs like fertilizers and selected seeds.
- ✚ The loan is given in collaboration with Rural Development Bureau and the collateral scheme is still similar with that of the regular loans.
- ✚ As of December 2008, over Birr 5 million outstanding loan balance is in the hands of 38,455 farmers

⁹ It is an administrative unit equivalent to a province.

¹⁰ A remittance is a transfer of money by a foreign worker to his or her home country.

Civil servant loan

- ✚ Civil servants are simultaneously among the beneficiaries of regular loans
- ✚ Currently as of December 2008, Birr 34.5 million outstanding loan is in the hands of 20,211 civil servants
- ✚ Civil servants take loan to cover education fees, for house construction and for purchase of house furniture
- ✚ Civil servants should bring a support and letter of guarantee from their employer which indicates the amount of their salary and other relevant information
- ✚ The loan allowed is maximum of 5 months salary

Rural Package /Household centered/ loan

- ✚ This product consists about 70% of the institution's resources.
- ✚ Intentionally or unintentionally, this service is linked to safety net program in the region.
- ✚ This product service is maintained to attain food security at household level through diversifying the household income.
- ✚ At present 100% of the loan is particularly provided to rural households for buying various agricultural package components.
- ✚ The loan is provided with guarantee from the Rural Development Bureau of the regional state.
- ✚ Currently 313,598 active household clients possess outstanding loan balance of Birr 693.7 million.
- ✚ The loan period is 1-4 years.
- ✚ The maximum amount of loan can go up to Birr 10,000

Before extending the aforementioned loan services, DECSI has the following criteria as screening devices to screen out potential clients:

- ✚ Clients should primarily convince themselves to use the loan appropriately and repay it on time.
- ✚ Clients with clean track record history.
- ✚ Above 18 years of age and productive.
- ✚ People with good credit disciplines and no mental problems.
- ✚ The clients should be permanent residents of their respective areas.
- ✚ Projects financed should be feasible and marketable.

In addition, DECSI examines the important screening role groups (groups lending contract) may provide. This is a scheme where borrowers from the same group are jointly responsible for each other's performance.

With its group loan (with a ceiling of Br. 10000¹¹), DECSI consider all rural households as poor and eligible. In urban areas, it provides group loans to poor households who organize themselves into a group of at least three people. Group loans, by definition, are provided for Productive Purposes (i.e., consumption loans, educational loans, ... are not included) although in practice borrowers divert loans to unintended uses.

DECSI also has package loans¹² that are extended on individual basis, but guaranteed by the regional government up to a certain amount. They also have enterprise loans. Moreover, they extend loans to salaried persons.

DECSI provides loans based on different modalities including group collateral, guarantee documents, and on individual basis. All household packages, business and housing loans are given individually with some sort of actual guarantees.

Concerning repayment frequency, DECSI has different policy of repayment depending up on the type of loan given. This section presents the repayment duration of some of the loan products of DECSI. For regular type of loan, a loan type where the maximum loan amounting is Birr 10,000 that is given to clients who brought real and measurable results in their lives. The maximum period of this type of loan is three years.

The repayment frequency for Agricultural input loan is a period of 1 year or per one harvesting season. The duration Rural Package /Household centered loan is 1-4 years and a maximum amount of loan can go up to Birr 10,000. The Urban package loan, the maximum amount of loan provided is Birr 5,000, can extend over a period from 1 to 3 years. Moreover, it is not allowed to use the money obtained by clients outside of the intended purpose of the loan, which is stated in the contract statement between the client and DECSI.

¹¹ 1.00 USD = Br.16.6968 as of march 26, 2011

¹² This loan is provided with guarantee from the Rural Development Bureau of the regional state. It is linked with safety net program in the region. This product service is maintained to attain food security at household level through diversifying the household income.

The final point to be mentioned is the interest rate setting by DECSI. DECSI charges a commercial declining interest rate ranging from 9.9 to 18 percent depending on the type and risk characteristics of the product.

- ✚ All interests are calculated on remaining balances.
- ✚ The interest is meant to cover administrative costs, cost of fund, default and inflation.

The interest paid for saving/deposit/ is 4 percent and still open for any changes when necessary. This is low compared to the ten times higher interest rate moneylenders ask in the area (Woldehanna, 2002).

The remaining financial services rendered by DECSI are Savings, Local Money Transfer and Pension Payment. Detail treatment of these operations by DECSI is not presented here, as these operations are not the interest of the researcher in this paper.¹³

Conclusion:

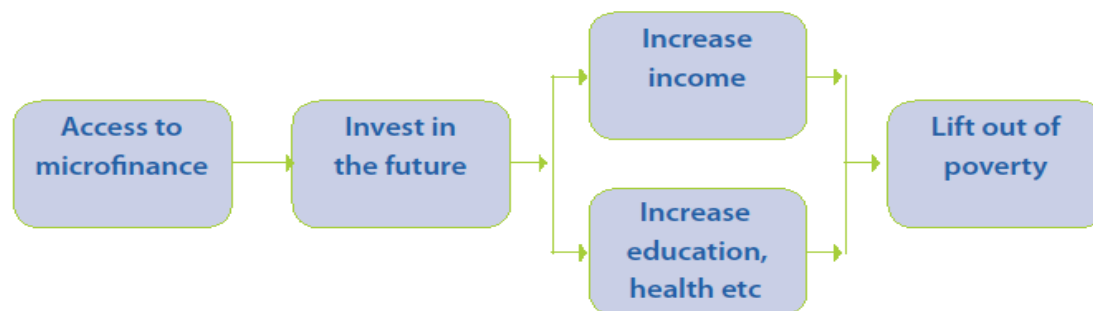
Besides the nice institutional setting of DECSI and its endeavor to pull out the poor in Tigray from the tentacles of poverty and backwardness, studies indicated that close to 50 per cent of households in the region produced less than their annual food requirements in 1997 and 2000 (Hagos, 2003). Even after a decade of DECSI's presence, in 2005, around 48 per cent of the population of Tigray was unable to meet the basic requirement of consumption ((MoFED), 2006). This shows that Poverty is part of life in Tigray, even after DECSI, and hence calls for further focused impact evaluation studies on whether DECSI, if it has an observed impact, is supporting the poorest of the poor in Tigray. The point of focus for this study is therefore to evaluate whether DECSI is supporting the poorest of the poor in Tigray.

¹³ For detailed information related to these operations and other important aspects of DECSI, see <http://www.decsi.com>.

3. Theory and Literature Review

Definitional and conceptual issues

This section will explore the definitional and conceptual issues surrounding microfinance and poverty. In the simplest terms, the idea is that micro-credit and microsavings allow the poor to invest their money in the future, increase their incomes and ‘lift themselves out of poverty’. This simple causal chain is represented in Figure below. These days’ researchers and practitioners are unpacking this chain in this review, and develop a more complex evidence-based understanding of how microfinance may (or may not) have positive impacts on the poor(Stewart R et al., 2010).



Source: Stewart (2010)

Figure 1. A simple causal chain from microfinance to poverty alleviation

What is microfinance?

The term ‘micro-credit’ was first coined in the 1970s to indicate the provision of loans to the poor to establish income-generating projects, while the term ‘microfinance’ has come to be used since the late 1990s to indicate the so-called second revolution in credit theory and policy that are customer-centered rather than product-centered (Elahi and Rahman, 2006). But the terms ‘micro-credit’ and ‘microfinance’ tend to be used interchangeably to indicate the range of financial services offered specifically to poor, low-income households and micro-enterprises ((CGAP, 2010);(Brau and Woller, 2004)). Microfinance principally encompasses micro-credit, micro-savings, micro-insurance and money transfers for the poor. Microcredit, which is part of microfinance, is the practice of delivering small, collateral-free loans to usually unsalaried borrowers or members of cooperatives who otherwise cannot get access to credit ((CGAP, 2010); (Adjei et al., 2009)).

Like anyone else, poor people need an array of financial services to help them deal with a range of short- to long term consumption needs and the ups and downs of income and expenses, to make use of opportunities, and to cope with vulnerabilities and emergencies. The needs of the poor for financial services have been categorized into three groups, namely life-cycle needs that can be anticipated (like marriage, burial and education), unanticipated emergencies (like sickness, loss of employment, death of a breadwinner, floods), and opportunities (like investing in a new business, buying land, financing short term working capital requirements for buying such things as improved seeds, fertilizer, pesticide, insecticide etc.) (Matin et al., 1999).

The spectrum of financial services available to meet these needs include investment (savings), lending (credit services), insurance (risk management) and money transfers. But the poor's access to formal financial services is limited, and the services available do not acknowledge the diverse requirements of the poor (Matin et al., 1999). Instead, poor people tend to juggle financial relationships with various financial institutions and with friends and family – to have the flexibility and reliability they need (Collins and Morduch, 2010).

The poor people depend on various types of formal and informal community funding, credit unions, moneylenders, co-operatives, self-help groups and associations (like accumulating savings and credit associations, rotating savings and credit associations, burial societies), and financial NGOs. In addition, with commercial financial institutions considering ways in which to provide financial services to the poor in a profitable manner, microfinance services are now provided by a whole spectrum of role players. To categorize the various financial institutions, (Matin et al., 1999) created a three-by-three matrix, with one axis comprising the financial service components (savings, credit and insurance) and the other axis the providers (informal, formal, and semi-formal providers). (Rutherford and ActionAid, 1996) Rutherford and ActionAid (1996) based his categorization on the type of service as well as whether it is owned and managed by the users themselves or other providers, while Staschen's typology, (Staschen, 1999), is based on the source of funds. The reality then is a mix of financial services accessed by poor people from a variety of service providers, depending on local knowledge, history, context and need (Matin et al., 1999).

Microfinance and its' effect on the poor

Once poor people do access financial services, the question of outcome arises. One of the crucial debates in the microfinance literature is expressed by Brau and Woller (2004) as the trade-off between financial self-sufficiency and sustainability, the depth of outreach, and the social welfare of service recipients. Roodman (2010), refers to the latter as 'judging microfinance by whether it reduces poverty, increases freedom, builds industries' (Stewart R et al., 2010).

With the most important goal of microfinance being reducing poverty, changes in income levels of individuals and households are often used as a measure of the impact of microfinance ((Johnson and Rogaly, quoted in (Makina and Malobola, 2004))). But (Wright, 1999) highlights why income levels cannot be the only measure: increasing income does not per se mean that poverty is reduced, as it depends on what the income is used for. Further, the long-held conceptualization of poverty and who the poor are has changed. For example, in the 1950s to 1970s, during the era of agricultural credit to small-scale and marginal (male) farmers, poverty was defined as lack of income and vulnerability to income fluctuations, but in the 1980s up to the mid-1990s, the poor were defined as mostly female micro-entrepreneurs who should be empowered. And more recently, the poor are defined as diverse vulnerable households with complex livelihoods (Matin et al., 1999). The outcomes used to measure the impact of microfinance on the poor also then have to take into account these changed conceptualizations of poverty and who the poor are (Stewart R et al., 2010). One typical conceptualization of impact on poverty is evaluation of outcome distributional impact. This dimension of impact evaluation is central to this research.

Following these arguments, studies of the impact of microfinance on the poor should consider different outcome variables. These could include increased consumption, income stability and income growth, reduced inequalities, health and education outcomes, nutrition improvements, employment levels, empowerment indicators, reduced vulnerability to shocks, strengthened social networks, and strengthened local economic and social development, and can vary according to who has been reached by these microfinance services (e.g. women, the poorest) (Stewart R et al., 2010). Kabeer (2003) refers to such dimensions of impact as cognitive, behavioral, material, relational and institutional changes. There are also some further issues that impact studies should not only look at individual and/or household-level impacts, but also

look at impacts on the community, economy and national levels ((Brau and Woller, 2004) and(Kabeer, 2003)).

Since the 1970s, and especially since the new wave of microfinance in the 1990s, microfinance has come to be seen as an important development policy and a poverty reduction tool (Stewart R et al., 2010). Some argue that microfinance is a key tool to achieve the Millennium Development Goals (MDGs) (Littlefield and others; and World Savings Bank Institute quoted in (Stewart R et al., 2010)). The assumption is that if one gives more microfinance to poor people, poverty will be reduced. But the evidence regarding such impact is challenging and controversial, partly due to the difficulties of reliable and affordable measurement, of fungibility¹⁴, the methodological challenge of proving causality (i.e. attribution), and because impacts are highly context-specific (Brau and Woller, 2004). Part four of this paper discusses in detail the methodological challenges of impact evaluation.

Questions regarding the impact of microfinance on the welfare and income of the poor have therefore been raised many times (e.g. (Berhane Tesfay, 2009, Hailai, 2010, Makina and Malobola, 2004, Santen, 2010)). Despite various studies, ‘the question of the effectiveness and impact on the poor of microfinance programs is still highly in question’ (Westover, 2008). Roodman and Morduch, as quoted in (Stewart R et al., 2010) reviewed studies on micro-credit in Bangladesh, and similarly conclude that ‘30 years into the microfinance movement we have little solid evidence that it improves the lives of clients in measurable ways’. Even the World Bank report Finance (2007) indicates that ‘the evidence from micro-studies of favorable impacts from direct access of the poor to credit is not especially strong.’ Recently this debate became heated when the findings of two randomized controlled trials (RCTs)¹⁵ in the Philippines and India by the Massachusetts Institute of Technology’s Jameel Poverty Action Lab (Banerjee and others; Karlan and Zinman quoted in (Stewart R et al., 2010))

¹⁴ *This refers to the inability to tie particular funds to particular expenditure and changes in well-being.*

¹⁵ *RCTs are seen by many as the gold-standard methodology for assessing impact. In RCTs, steps are taken to remove potential biases and isolate the true impact of the specific intervention (such as microfinance services). These primarily include randomisation to intervention (i.e. those who receive the service) and control (i.e. comparison) groups, the collection of data before and after the intervention is implemented, and careful consideration of sample size to ensure sufficient evidence to conclude on impact. Some argue that RCTs are the best way to measure the impact of microfinance programmes and improve product design. Nevertheless, RCTs require forward planning, with the intervention delivered as part of the study – rather than retrospective evaluation of an existing programme. Furthermore, long-term outcomes are expensive to follow up, and there can be ethical concerns about withholding interventions from the control group (KARLAN, D., GOLDBERG, N. & COPESTAKE, J. 2009. 'Randomized control trials are the best way to measure impact of microfinance programmes and improve microfinance product designs.'. *Enterprise Development and Microfinance*, 20, 167-176.*

raised questions about the impact of microfinance on improving the lives of the poor. These studies did not find a strong causal link between access to microfinance and poverty reduction for the poor. The results of these first RCTs in the field of microfinance have spawned a heated debate (ibid).

The main value proposition put forward on behalf of micro-credit for the last quarter century is that it helps lift people out of poverty by raising incomes and consumption, not just smoothing them. So far, there are no very strong evidence that this particular proposition is true (Stewart R et al., 2010). This debate between researchers and practitioners continues to rage on blogsites (Roodman, 2010) and in the media (e.g. Boston (Bennett, 2009), (Economist, 2009), Financial Times (Hedaya, 2009), The Seattle Times (Helms, 2010), New York Times (MacFarquhar, 2010). And a new book by (Hulme et al., 2010), “Just give money to the poor” complicates the debate by calling for cash transfers, rather than credit, directly to the poor. There is clearly a need for rigorous systematic reviews of the evidence of the impact of microfinance on the poor (Stewart R et al., 2010).

With the micro-credit movement having its origin in Asia in the 1970s, much has been written about its thinking, practices and impacts there. In contrast, there is relatively little known about microfinance in sub-Saharan Africa (SSA) to where the micro-credit movement spread in the 1980s, and where it became stronger in the 1990s (Stewart R et al., 2010). SSA is the poorest region in the world, according to the new multidimensional poverty index developed by Oxford University (Alkire and Santos, 2010) featured in the UNDP’s 2010 Human Development Report.(Klugman et al., 2010). With microfinance institutions aiming to serve the poor, SSA is an important region to consider when reviewing the impact of microfinance (ibid).

Regarding impact studies on microfinance in SSA using comparative study designs, there is only one RCT on the impact of micro-savings that has been completed so far (Dupas and Robinson quoted in (ibid)). The Poverty Action Lab is currently involved in two further impact studies for the Microfinance and Health Protection Initiative: one in Benin, and the other is a village savings and loans programme in Ghana. There is also a larger body of impact studies employing non-comparison evaluation designs – both non-experimental and quasiexperimental in nature. Yet, little systematic and rigorous evidence has been provided and assessed the nature of the evidence of the impact of microfinance on the poor in SSA (ibid).

Even though the literature on how distributional impacts of social programs can be measured is rich, there exist few research works on MFI's distributional consequences at the household level. Furthermore, the amount of poverty reduction made possible out of the intervention by MFI is not yet explored.

Based on the literature review, the following hypotheses are constructed:

H1: DECSI has an impact in reducing Rural Poverty in Tigray.

H2: The impact in terms of poverty reduction is stronger for the moderately poor than the poorest of the poor.

Childhood Malnutrition and Income

In many ways, the approach taken to measure childhood undernutrition has much to recommend itself. It measures effective nutritional status, not just inputs, it is built up from individual data, usually with good and transparent sampling procedures and measurement protocols (due particularly to the standardized Demographic and Health Surveys), and it focuses on children who tend to be particularly vulnerable to nutritional deficiencies. It not only allows the production of aggregate indicators, but identification of particularly hard hit groups and can easily be used as a monitoring device for policy purposes(Klasen, 2008).

Anthropometric measures consist of three different indicators; stunting, wasting, and being underweight. These indicators offer insights into different dimensions of nutritional problems. Wasting (low weight for height) is an indicator of acute undernutrition particularly relevant in famines and to monitor acute food shortages, stunting (low height for age) is an indicator of chronic undernutrition focusing on persistent nutritional deficiencies, and underweight (low weight for age) a summary indicator combining both facets (Bloss et al., 2004).

While all agree that environmental factors are much more significant than genetic differences in explaining differences in anthropometric shortfall between populations, quite a few studies suggested that genetic differences are important enough to be considered, particularly for international comparisons of anthropometric shortfalls(Gunther and Klasen, 2009).

Regarding the impact of income, income poverty, and income growth on undernutrition, theoretical considerations suggest a close linkage. More resources at the household level improve the ability of household members to acquire more calories, and of parents to invest more in the nutrition and health of their children. These linkages will likely be larger at an aggregate level than at household-level, as higher per capita incomes also tend to increase investments in public services in the areas of health, nutrition, water and sanitation, and social protection, three which are other important factors influencing hunger and childhood mortality (Klasen, 2008). There are studies indicating that the effects of income on nutrition outcomes are stronger than mortality outcomes and stronger links between income and undernutrition of under six children. One noticeable example using household survey data from 12 countries (Haddad et al., 2003) reported that an increase in income at the household and national level implies reduction of child malnutrition. However, this result is contestable. There are reports showing that nutrient elasticities with respect to income may be close to zero (Behrman and Deolalikar, 1987). Therefore, whether higher incomes imply a reduction of child malnutrition is an empirical question.

Given this paucity, this study (centered around one of the MFI's in SSA, DECSI) tries to provide (if available) evidence of impact, i.e. whether DECSI is impacting the poor people it seeks to serve, map out distributional effects across outcomes sought, and estimates the amount of poverty reduction made possible using robust identification strategies of impacts. The empirical identification and estimation strategy of the paper is the subject matter of part four.

4. Data, Empirical Identification and Estimation Strategy

Description of the panel data set

This study used household survey data collected in Tigray Region, Northern Ethiopia in two rounds (2006 and 2010) on an average sample of 400 households. The household surveys were conducted to improve the understanding of the livelihood situation in Tigray and present facts to the attention of policymakers in their attempts to reduce poverty.

The household surveys include, among others, household basic characteristics, plot level information, credit and saving information, information on malaria and safety nets programs.

Four of the five administrative zones - Southern, Eastern, Central, and Northwestern- that cover most of the highlands of Tigray are included in the household survey. This comprises eleven Woredas (districts) of which sixteen villages are sampled from each zone. From each village 25 households were randomly selected from the village list, and a standardized questionnaire, designed by Mekelle University in collaboration with the Norwegian University of Life Sciences (UMB), covering the above-mentioned issues, was administered.

In addition to the standardized questions, the 2006 and 2010 household survey included additional questions on anthropometric issues of households, for example.

The logic of the sampling scheme is as follows. The survey took place in the Tigray Regional State, which contains five administrative zones. To achieve better representation, sampling was done in two stages. First, stratified by altitude (mainly highlands), agricultural potential, population density, and access to infrastructure (mainly market, credit, and irrigation), four Tabias were selected from each zone. A tabia contains a group of villages. One village is selected from each sample Tabia (Hagos et al., 2006). The study covered 16 communities purposively stratified by population density, market access, (non) presence of an irrigation development project and their location in the four different zones in the region: central, eastern, southern and western. The following section presents the data organization process, the variables description and limitation of the data used in this study.

Data organization process

Actually, the household surveys conducted in Tigray Region was in five rounds (1998, 2001, 2003, 2006 and 2010) on an average sample of 400 households. However, in the first three survey rounds, the standard questionnaires did not contain information regarding anthropometric status of the households, which serve the basics of this paper. It was later in the 2006 survey round that question regarding the anthropometric measures of the households were recognized and incorporated. Even in 2006, not all households were asked to provide anthropometric information. Only 211 households out the total surveyed in that round were asked for anthropometric information.

In this paper, the malnutrition of under six children is used to indicate the poverty status of a particular household member. One indicator showing this is stunting¹⁶ (a measure of low height for age) which indicates chronic under nutrition focusing on persistent nutritional deficiencies (Klasen, 2008). There is a recommendation in the public health literature that the calculation of stunting indicator (for comparison and policy purpose) is best suited in a study population of less than 6 years of age¹⁷. The reason is that there are no (genetic) differences between populations in their growth and weight development between 0 and 6 years (ibid). This rule of thumb sounds a solution to, at least in this paper, the most widely discussed problem in Applied Econometrics, i.e. inconsistency of estimates.

Moreover, there are recommendations in the literature concerning which anthropometric indicator is best suited for various program durations. Simondon(2010), suggested that Stunting prevalence (or simply stunting) is a best suited indicator for impact evaluation of Long-term intervention programs (programs that stay more than two years, such as DECSI) (Simondon, 2010). Hence, in this paper, stunting is used as indicators of children's nutritional status and the z-score throughout this paper refers to the height-for-age z-score.

To interpret this indicator and serve the purpose of this research, an indicator variable called Z-score is generated. Z-score is calculated as the difference between the

¹⁷*Even though this appeared to be the consensus view, it is not a rule universally accepted by everyone, particular for international comparisons of anthropometric shortfalls.*

relevant anthropometric indicator of a child and the median of a reference population, divided by the standard deviation of the reference population. If this Z-score is below -2, severe malnutrition is presumed; if it is below -3, severe under nutrition is presumed (UNICEF, 1998). Accordingly, the researcher calculated the Z-score of all children between 0 and 6 years in the 211 households¹⁸ using stata. After calculating the anthropometric z score using the 2006 survey data set, only 102 out of 211 sample unit of the 2006 data set remained for the final analysis. The dramatic reduction in the sample size to be used in the final analysis has happened after calculating the z score of the height by age anthropometric indicator. The sample size shrunk from 211 to 102 due to the following two reasons:

- ✚ Due to the fact that some households do not have children between 0 and 6 years of age and hence they are dropped out of the sample used for the final analysis.
- ✚ Extreme (i.e. biologically implausible) z-scores, for height by age anthropometric indicator, are flagged according to the following system: height-for-age z-score (zlen) are biologically feasible in the $-6 \leq zlen \leq 6$ range. Accordingly, individual Z-score values out of the above allowable range are dropped and these individuals are excluded from the sample. This process contributes to the reduction of the sample size in the final analysis as only those observations in the above allowable stated range of z-score are included in the sample.

The above process of data organization works in a similar fashion for the survey round conducted in 2010. Accordingly, 124 households are used for the final analysis¹⁹.

Furthermore, it is worth mentioning that whenever there is more than one child under the age of 6 and the nutrition anthropometrics indicator of all the children fall in the desired range, the younger child's anthropometrics information is used in the regression framework of this paper.

¹⁸ The anthropometric indicators is calculated using stata on the basis of specific WHO Global data base on child growth and malnutrition reference data (MUAC-for-age) or 2006 CDC reference data set available online at: <http://www.who.int/nutgrowthdb/>

¹⁹ Millimet's estimator (with missing data) has an option of reweight the individuals with complete data to more nearly approximate the distribution in all subjects included in the sample.

Before leaving this section, it is appropriate to tell the total number of observations used in this paper. After organizing the data according to the procedures discussed above, the total number of observations that are obtained from the two surveys rounds sum up to 225; 102 observations are obtained from the 2006 survey round and the remaining 124 observations are taken from the 2010.

Description of variables used in the study

In order to obtain consistent estimate of program credit intervention, the researcher tried to control variables that might have logical connection with the dependent variable and that affect the probability of participating in program credit.

The following are the variables controlled to estimate the impact of program credit in Tigray.

Table I. Variables and their description

Variable	Description
<i>anycredit</i>	This is the treatment dummy variable for participation in credit, 1 if the person participated in a program credit (take credit from DECSI), 0 if not;
<i>hhhage</i>	Household head age in years
<i>hhhage2</i>	The square of the age variable;
<i>hhhsex</i>	Dummy variable for household's sex, 0 for females, 1 for males;
<i>hhsiz</i>	Household size;
<i>education</i>	Dummy variable for educational level of household head:0 for illiterate, 1 for literate;
<i>oxen</i>	Number of oxen possessed by the household (it is not an argument in the treatment effects model);
<i>landsize</i>	Land size in hectares owned by the household (it is not an argument in the treatment effects model);
<i>irrigd</i>	Dummy variable for access to irrigation: 0 if the household does not have access to irrigated land, 1 if the household has access to irrigated land;
<i>ffw</i>	Safety nets participation dummy: 0 if the household did not participate in a safety net program, 1 if the household did participate in a safety net program;

<i>anyshock</i>	Dummy variable for experience of shock: 0 if the household did not experience any shocks, 1 if the household did experience a shock;
<i>distroad</i>	distance to road (walking distance in minutes);
<i>distranspo</i>	distance to transport center (walking distance in minutes);
<i>disthealth</i>	distance to health center (walking distance in minutes);
<i>distmkt</i>	Distance to market center(walking distance in minutes)
<i>Samredummy</i>	village dummy variable: 1 if the household resided in Samre village, 0 if not;
<i>Mahberedummy</i>	Mahberedummy: village dummy variable: 1 if the household resided in Mahibere Genet village, 0 if not;
<i>Maialemdummy</i>	village dummy variable: 1 if the household resided in Mai Alem village, 0 if not;
<i>Seretmdummy</i>	1 village dummy variable: if the household resided in Seret village, 0 if not;
<i>Kihenmdummy</i>	village dummy variable: 1 if the household resided in Kihen village, 0 if not;
<i>Genfelmdummy</i>	village dummy variable: 1 if the household resided in Kihen village, 0 if not;
<i>Embaasmenamdummy:</i>	village dummy variable: 1 if the household resided in Emba Asmena village, 0 if not
<i>Hagereselamdummy</i>	village dummy variable: 1 if the household resided in Hagere Selam village, 0 if not;
<i>Debdebodummy</i> ²⁰	village dummy variable: 1 if the household resided in Debdebo village, 0 if not;
<i>Maikeyahtidummy</i>	village dummy variable: 1 if the household resided in Maikeyahti 0 if not:
<i>Adiselamdummy</i>	village dummy variable: 1 if the household resided in Adisalem village, 0 if not;
<i>Hadegtidummy</i>	village dummy variable: 1 if the household resided in Hadegti village, 0 if not;
<i>Tsaedaamboradummy</i>	village dummy variable: 1 if the household resided in Tsaeda Ambora village, 0 if not;

²⁰ This village is used as a reference village

<i>Adimenabrdummy</i>	village dummy variable: 1 if the household resided in Adi menabir village, 0 if not;
<i>Maiadrashadummy</i>	village dummy variable: 1 if the household resided in Mai Adrasha village, 0 if not;
<i>Mekonidummy</i>	village dummy variable: 1 if the household resided in Mekoni village, 0 if not;

In addition, in this study, two outcome variables are compared: *percapitacons*- annual consumption expenditure per capita and *_zlen*- length/height-for-age z-score. Both outcome variables are alternately used as a dependent variable in the regression equations that identify the impact of microcredit in Tigray (that answered the first research question) and only *_zlen* is used to answer the last two research questions²¹.

Before leaving the section on description of variables used in the study, it is worth making some final comments on this way of looking at the variables used in this study. The first point is about the inclusion of village dummies as regressors in the study. This is done based on the recommendation from public health literature that failure to control geographic variation (geographically dispersed program) has the potential to substantially bias the effect of a program on the severity of stunting (Morris et al., 2000). Besides, the researcher tested the overall significance of the villages dummies (see Appendix I) and found that the village dummies are jointly significant at 5% level.

Another point to mention here is that this research deviates from earlier research on the same topic, especially over the inclusion of some covariates (such as cultivated land size and number of oxen possessed by the household) that are affected by the treatment. Wooldridge (2005) showed that the inclusion of covariates that are themselves affected by the treatment violates the ignorability-of-treatment assumption (assumed in estimating treatment effects and that can be violated when certain factors, such as the above, are included among the covariates).

Researchers such as Berhane Tesfay (2009), Zewde(2009) and Hailai(2010) controlled cultivated land size and number of oxen possessed by the household in their study of the impact of credit in Tigray. However, controlling variables (such as those in the program credit type of treatments, especially when applying propensity-score

²¹ *The reason is that income measures are likely to subject to non-classical measurement error.*

methods) that are themselves affected by the treatment, violates a key assumption in the treatment effect violates the ignorability-of-treatment assumption: conditional on observed covariates, let X be a K -vector of observed covariates, treatment indicators, say T and the counterfactual outcomes, Y_i are independent. A weaker version of this assumption is conditional mean independence (Wooldridge, 2005).

Access to credit (increased liquidity) is likely to affect households' propensity to rent-in land. In addition, households may use the credit to buy agricultural inputs such as oxen. Renting in land and buying of oxen in turn affect quantity of agricultural investment and then affect the outcome variable, volume of agricultural production and income/consumption at the household level. This simple linkage provides a simple demonstration of how access to credit affects households propensity to rent-in land and buy oxen, which are likely to raise agricultural production and hence income (which is a potential outcome variable). To substantiate the claim of the researcher using empirics, the following evidences can be mentioned. Boucher discovered some increase in land market activity, as a result of the access of the rural poor to credit (Boucher et al., 2005). In addition, access to credit is an important determinant for buying oxen and the introduction of and ox-traction technology as the initial capital requirements to own these are substantial(Hesse and Runge-Metzger, 1999). From this evidences, it is likely that inclusion of these controls in the program credit impact evaluation study generally violates the key ignorability assumption.

Furthermore, the two surveys that give rise to the data set used in this study contain questions to households concerning the purpose that households obtain credit from DECSI. Accordingly, out of the total sample units considered in the study, 76 households answered that they used the money to rent in land for agricultural purposes. Moreover, 55 households responded that they used the money to buy oxen. This clearly shows that including these controls violates the key ignorability assumption as these controls themselves are affected by the treatment (access to credit)²².

²² In addition, Pearson product-moment correlation test between the two controls and treatment dummy is included in appendix three. The test t -statistics is not large enough to reject the null hypothesis that there is no correlation between access to credit and amount of cultivated land. The test t -statistics is also not large enough to reject the null hypothesis that there is no correlation between access to credit and number of oxen possessed by the household.

Hence, in this study, unlike in the previous studies in Tigray on the same topic, variables such as cultivated land size and ownership of oxen are not included as an argument in estimating treatment effects, both ATE and ATT as its inclusion is likely in violation of the key ignorability-of-treatment assumption.

Quantitative identification Methods and Estimation Specification

The following section details the econometric methodology of the study: Millimet’s Estimator, Heckman bivariate normal selection model (BVN), Klein and Vella (KV) estimator, Foster-Greer-Thorbecke poverty gap estimator and Linear Regression Framework that are used to attain the objectives of this research.

Program Evaluation Specification and Heckman bivariate normal selection (BVN) estimator

Below is a simple treatment specification that distinguishes between households in the control group and households in the treatment group. This specification measures the overall impact of uptake of microcredit, comparing households in the control group to clients of DECSI in the treatment group. Equation (1) shows the regression equation:

$$Y_i = \alpha + \beta * \text{treatment}_{dummy_i} + \phi * \text{controls}_i + u_i \quad (1)$$

for $i = 1, 2, \dots, N$

The outcome (Y_i) measures such as consumption, income or malnutrition status of individual i are regressed on a treatment dummy that takes the value of one if a household belongs to the treatment group, i.e., client of DECSI, and a value of zero otherwise. Further, a set of variables controls_i account for observable characteristics. A detailed description of the controls_i included is given in part five of the paper.

In order to estimate the effect of the treatment_dummy , as well as test for robustness, the researcher proposed the following set of estimators or specifications as different specifications add robustness to the findings.

The first estimator to estimate the treatment effect that is used in this research is the standard Heckman bivariate normal selection (BVN) estimator that provides a consistent estimate of the treatment effect.

Heckman make the following assumption in order to identify the BVN: potential outcomes and latent treatment assignment are additively separable in observables and unobservables (Millimet and Tchernis, 2009). Specifically, Millimet assumed:

$$\begin{aligned} Y_0(X) &= XB_0 + \varepsilon_0 \\ Y_1(X) &= XB_1 + \varepsilon_1 \\ T^* &= h(X); h(x) = X\gamma + \mu \\ T &= \begin{cases} 1 & \text{if } T^* > 0 \\ 0 & \text{otherwise} \end{cases} \end{aligned} \quad (2)$$

then,

$$Y_i = X_i B_0 + X_i T_i (B_1 - B_0) + B_{\lambda 0} (1 - T_i) \left[\frac{\phi(X_i \gamma)}{1 - \Phi(X_i \gamma)} \right] + B_{\lambda 1} T_i \left[\frac{-\phi(X_i \gamma)}{\Phi(X_i \gamma)} \right] + \eta_i \quad (3)$$

where $\phi(\cdot) / \Phi(\cdot)$ is the inverse Mills' ration, η is a well-behaved error term, and

$$B_{\lambda 0} = \rho_{0\mu} \sigma_0 \quad (4)$$

Equation 4 is just the product of correlation between errors of treatment and outcome equation for the untreated, ρ_{0u} , (*which is potential selection on unobservable*) and the standard deviation of variance of the error, which gives the extent (untreated) of unobservables, σ_0 . The expression gives selection on unobservables (Millimet and Tchernis, 2009)²³.

$$B_{\lambda 0} = \rho_{0\mu} \sigma_0 + \rho_{\delta\mu} \sigma_\delta \quad (5)$$

Equation 5 is the total selection on observables and unobservables. The second expression of Equation 5 gives selection on observables given that the agent has a latent variable T^* that is above threshold (which is the selection on observables when treated).

Upon estimating the BVN selection model, the Average Treatment Effect (ATE) and the Average Treatment effect of the Treated (ATT) are given as follows (Millimet and Tchernis, 2009):

$$ATE = \bar{X} (\hat{B}_1 - \hat{B}_0) \quad (6)$$

$$ATT = \bar{X}_1 (\hat{B}_1 - \hat{B}_0 + \hat{B}_{\lambda 1} \left[\frac{\phi(X_i \hat{\gamma})}{\Phi(X_i \hat{\gamma})} \right]_1) \quad (7)$$

²³ See for example, Millimet (2009) for a discussion.

Where \bar{X}_1 and $[\frac{\phi(X_i\hat{\gamma})}{\Phi(X_i\hat{\gamma})}]_1$ are the sample means of X and the selection correction term, respectively, in treatment group.

However, if the assumptions of the BVN model do not hold, or if the BVN model is poorly identified, then a more robust specification is called for that perhaps perform better than BVN in practice.

Millimet's Estimator

The program evaluation literature has expanded rapidly over the past decade. Recently, social welfare programs and their impact have come under much scrutiny by researchers and practitioners. The knowledge concerning methods that are designed to provide consistent estimates of some measure of the causal effect of a binary treatment under conditional independence, as well as typical Instrumental Variable (IV) methods imposing an exclusion restriction, is relatively well developed. However, researchers are less informed about how to proceed when conditional independence fails and the usual type of exclusion restrictions is unavailable. Moreover, the lack of experimental evidence, combined with non-random selection into these programs, makes identification of the causal effects of such programs difficult (Millimet and Tchernis, 2009).

Heckman's selection model is only identified as the sample size tends to infinity, hence it produces biased estimates if no valid exclusion restrictions are available, as shown by Sartori (Sartori, 2003). In addition, the Heckman procedure does not allow estimating impacts when essential heterogeneity is present. Essential heterogeneity is likely to be present whenever there are negative or positive individual specific gain from treatment and individuals select into treatment based on these gains (Millimet and Tchernis, 2009). Millimet argued that the assumption of essential heterogeneity is more likely to be present in an applied setting and he showed the bias resulted in estimating ATE, ATT and ATU in the presence of selection on unobservables and essential heterogeneity.

In the cases like the credit program, this difficulty is exacerbated by the apparent lack of exclusion restrictions. Millimet compared, in his estimation of treatment effects without an exclusion restriction: with an Application to the Analysis of the School Breakfast Program via Monte Carlo study several existing estimators that do rely on

exclusion restrictions for identification and come up with a new estimator called bias corrected inverse-probability of weighting estimator (IPW) or simply called biased-corrected estimator (ibid). Millimet's essentially illustrates the usefulness of his new estimator when analyzing the causal effects of binary treatments. By applying his new estimator, Millimet found consistent evidence of causal effects in his application to a US school breakfast program. In general, Millimet proposed that his new estimation approach could be used when unconfoundedness is not likely to hold and essential heterogeneity is likely to exist, but one lacks a valid exclusion restriction.

Armendáriz and Morduch, as quoted in (Berhane Tesfay, 2009), noted that borrowers select themselves into the program by joining a group of their choice on which the MFI decides to grant a loan based on its own criteria and in some cases borrowers self select in to MFI based on observed and unobserved 'initial' household characteristics.

According to Czura,(Czura, November 2010) the inability of poor households to cope with negative income shocks and their vulnerability to risks differ across MFI client households. Major shocks the client households faced were drought and flooding, death of a household member, loss of employment, and theft. If households select into credit treatment as a reaction to these adverse household-specific shocks, then we have (negative) selection on unobservables, violating the conditional independence assumption (ibid). Furthermore, these unobservables are time varying, violating the assumptions of the fixed effects and first difference estimators.

In light of the above discussion, in this study, the researcher uses the Millimet estimator to consistently estimate whether DECSI supports poor households in reducing their poverty and malnutrition status. The researcher's logic behind using Millimet's estimator to identify the impact of credit are twofold: the absence of a valid exclusion restriction for the credit dummy in the microcredit literature and the notion that both selection on unobservables and essential heterogeneity are likely to be present among the farm households operating in Tigray. As noted above, Millimet's estimator estimates the impact of a binary treatment when one lacks a valid exclusion restriction and it allows us to estimate impacts in the presence of essential heterogeneity and when conditional independence assumption fails, which is not possible using the Heckman estimator.

Millimet's (2010) estimator is based on the normalized inverse probability weighted estimator of Hirano and Imbens (Hirano and Imbens, 2001). Millimet's estimator

corrects the bias of Hirano-Imbens using the BVN estimator to help estimate the bias. He derived an expression for the bias under selection on unobservable and essential heterogeneity and minimized this bias for his first estimator (minimum biased estimator (MB) in order to identify average treatment effect (ATE). Accordingly, ATE of MB is given as:

$$\hat{\tau}_{MB, ATE} = \left[\sum_{i \in \Omega} \frac{Y_i T_i}{\hat{P}(X_i)} / \sum_{i \in \Omega} \frac{T_i}{\hat{P}(X_i)} \right] - \left[\sum_{i \in \Omega} \frac{Y_i (1-T_i)}{1-\hat{P}(X_i)} / \sum_{i \in \Omega} \frac{(1-T_i)}{1-\hat{P}(X_i)} \right] \quad (8)$$

Where

- ✚ $\hat{\tau}$ = The causal effect of the treatment (T = 1) relative to the control (T = 0)
- ✚ $\Omega = \{i | \hat{P}(X_i) \in C(P^*)\}$
- ✚ P= some value of the propensity score
- ✚ T= treatment Dummy
- ✚ Y= outcome variable
- ✚ X= a set of Controlled variables
- ✚ P^* = the value of P(X) that minimizes the bias of the ATE, referred to as the bias minimizing propensity score (BMPS) and denoted P(X), is not fixed; rather, it depends on the values of $\rho_{0\mu}\sigma_0$ and $\rho_{\delta\mu}\sigma_\delta$.
- ✚ $\delta = \varepsilon_1 - \varepsilon_0$ is the unobserved, individual-specific gain from treatment
- ✚ and C(P) denotes a neighborhood around P. In the estimation below, we defined C (P^*) as:

$$C(P^*) = \{\hat{P}(X_i) | \hat{P}(X_i) \in (\underline{P}, \bar{P})\} \quad (9)$$

Where $\underline{P} = \max\{0.02, P^* - a_\theta\}$, $\bar{P} = \min\{0.98, P^* + a_\theta\}$, and $a_\theta > 0$ is the smallest value such that at least θ percent of both the treatment and control groups are contained in Ω . For example, if we set $\theta = 0.05$, $a_{0.05}$ the smallest value such that 5% of the treatment group and 5% of the control group have a propensity score in the interval (\underline{P}, \bar{P}) . Thus, smaller values of θ should reduce the bias at the expense of higher variance. Note, here that observations with propensity scores above (below) 0.98 (0.02), regardless of the value of θ are trimmed, to prevent any single observations from receiving too large of a weight (Millimet, 2010).

Here, the set Ω is unknown since, in general, P^* is unknown. To estimate the set Ω , Millimet proposed to estimate P^* assuming:

- I. (A1) Potential outcomes and latent treatment assignment are additively separable in observables and unobservables

$$\begin{aligned}
Y(0) &= g_0(X) + \varepsilon_0; \text{ let } g_0(X) = XB_0 \\
Y(1) &= g_1(X) + \varepsilon_1; \text{ let } g_1(X) = XB_1 \\
T^* &= h(X) - \mu; h(x) = X\gamma \\
T &= \begin{cases} 1 & \text{if } T^* > 0 \\ 0 & \text{otherwise} \end{cases}
\end{aligned}$$

- II. (A2) $\varepsilon_0, \varepsilon_1, \mu \sim N_3(0, \Sigma)$: where

$$\Sigma = \begin{bmatrix} \sigma_0^2 & \rho_{01} & \rho_{0\mu} \\ & \sigma_1^2 & \rho_{1\mu} \\ & & 1 \end{bmatrix}.$$

and functional forms for $g_0(X)$, $g_1(X)$, and $h(X)$ using Heckman's bivariate normal (BVN) selection mode. Up on estimating the BVN selection model and the respective ATE and the ATT, if the assumptions of the BVN model do not hold, the bias of using BVN is given as:

$$\begin{aligned}
\widehat{B_{ATE}}[P^*] &= [\widehat{\rho_{0\mu}}\widehat{\sigma}_0 + (1 - P^*)\widehat{P}_{\delta\mu}\widehat{\sigma}_\delta] \left[\frac{\phi(\Phi^{-1}(P^*))}{P^*(1-P^*)} \right] \\
\widehat{B_{ATE}}[0.5] &\approx -1.6 * \widehat{\rho_{0\mu}}\widehat{\sigma}_0.
\end{aligned} \tag{10}$$

Then, Millimet's biased corrected estimators, denoted MB-BC that perform better in practice are given by:

$$\begin{aligned}
\widehat{tMB - BC, ATT}[P^*] &= \widehat{tMB, ATE}[P^*] - \widehat{B_{ATE}}[P^*] \\
\widehat{tMB - BC, ATT}[P^*] &= \widehat{tMB, ATT}[P^*] - \widehat{B_{ATT}}[P^*]
\end{aligned} \tag{11}$$

Shortly, Millimet's estimator can be called an approach that uses BVN to correct the bias in the Hirano-Imbens estimator that requires unconfoundedness.

In addition, Millimet's procedure can be used as a robustness check to the Heckman procedure and based on that, if the two procedures produce similar estimates, this would add robustness to the findings (that is confirmed by the two estimators) about the impact of microfinance in Tigray.

Klein & Vella (2009) Estimator

For comparison to the previous estimators, the research also employs the estimator of

Klein and Vella(2009), shortly called KV. Millimet’s parametric implementation of this estimator relies on a similar functional form assumption to the BVN estimator in the absence of heteroskedasticity, but effectively induces a valid exclusion restriction in the presence of heteroskedasticity (Millimet and Tchernis, 2009). To identify this estimator, Millimet develop a latent treatment assignment is now given by

$$T^* = X\gamma - u^*$$

where $u^* = S(X)u$ and u is drawn from a standard normal density. In this case, the probability of receiving the treatment conditional on X is given by

$$P(T = 1|X) = \Phi\left(\frac{X\gamma}{S(X)}\right). \quad (12)$$

Assuming $S(X) = \exp(X\delta)$, the parameters of (12) are estimable by maximum likelihood (ML), with the log-likelihood function given by

$$\ln\mathcal{L} = \sum_i [\ln\Phi\left(\frac{X\gamma}{\exp(X\delta)}\right)]^{T_i} \left\{ \ln[1 - \Phi\left(\frac{X\gamma}{\exp(X\delta)}\right)] \right\}^{1-T_i} \quad (13)$$

where the element of δ corresponding to the intercept is normalized to zero for identification.

The ML estimates are then used to obtain the predicted probability of treatment, $\widehat{P}(X)$, which may be used as an instrument for T in equation (3) excluding the selection correction terms. Note, even if $S(X) = 1$, $\widehat{P}(X)$, remains a valid instrument since it is non-linear in X . However, since the non-linearity arises mostly in the tails, identification typically relies on a small fraction of the sample. On the other hand, if $S(X) \neq 1$, then the KV approach effectively induces a valid exclusion restriction as $Z \equiv X/S(X)$ is frequently linearly independent of X (Klein and Vella (2009) as quoted in (Millimet and Tchernis, 2009)).

In Short, the KV estimator uses constructed instruments ($\widehat{P}(X)$) that can be used as an instrument for the endogenous treatment dummy, T to identify the treatment effect.

Foster-Greer-Thorbecke poverty gap Estimator

In addition, in this study, the researcher also wants to study to what extent has DECSI reduced the poverty of poor rural households in Tigray, Ethiopia. To answer this question, the first step is to start from the usual treatment effects model. The structure of the model can be given as:

$$Y_i = \alpha + \beta * \text{treatment}_{dummy_i} + \phi * \text{controls}_i + u_i \quad (14)$$

for $i = 1, 2, \dots, N$

Where:

- ✚ Y_i is the income, consumption expenditure or nutritional status of individual i ;
- ✚ $\text{treatment}_{dummy_i}$ is the treatment indicator;
- ✚ controls_i is a set of additional covariates.

If the coefficient on the treatment indicator is positive and statistically significant, it shows that microcredit is contributing towards poverty reduction. In the literature, there are studies showing that DECSI in Tigray improves the lives of borrower clients. This study has at its center testing of this hypothesis. However, the question of how much poverty reduction was made possible by the DECSI in Tigray is not known in this equation and in the literature.

Next is re-specifying the above model, to fit the question of how much poverty or malnutrition reduction is made possible by the Microfinance intervention. It can be modified as:

$$Y_i = \beta * T + \phi * X + \mu_i \quad (15)$$

where:

$$Y = \begin{cases} \left(\frac{Z-Y_i}{Z}\right)^2, & \text{if } Y_i < Z \\ 0, & \text{if } Y_i \geq Z \end{cases}$$

In this formulation,

- ✚ Z is the cut off point (in this study it is the cut off point of severe malnutrition). From the public health literature, a height-for-age z-score of less than -2 indicates the situation of severe malnutrition.
- ✚ Y_i is the individual height-for-age z-score;
- ✚ T is the treatment indicator;
- ✚ X is a set of other covariates.

In the above equation, the value $\left(\frac{Z-Y_i}{Z}\right)^2$ is the individual component of FGT, Foster-Greer-Thorbecke, metric (Foster et al., 1984), which is a generalized measure of poverty within an economy. The FGT formulae is given by:

$$\frac{1}{N} \sum_{i=1}^H \left(\frac{Z-Y_i}{Z}\right)^\alpha \quad (16)$$

Where:

- ✚ Z is the cut off point of severe malnutrition²⁴;
- ✚ N is the number of people in an economy;
- ✚ H is the number of poor (those with incomes at or below z);
- ✚ Y_i are height-for-age z-score and;
- ✚ α is a "sensitivity" parameter.

From this aggregate index, the researcher take out $(\frac{Z-Y_i}{Z})^\alpha$, this measures the amount of z-score necessary to bring everyone stunted right up to the cut off point of severe malnutrition, which is raised to the power α to capture inequality among the poor. It is a static measure, however, if there is a survey data for some years, one can calculate this value in each year for every surveyed individual and use it as outcome variable in regressions of this kind. Accordingly, the coefficient of the treatment dummy (controlling other things) β is the average reduction in severe malnutrition by this measure caused by borrowing for a random household. In order to calculate the amount of reduced malnutrition achieved by DECSI over the time of the survey the researcher multiply β with the proportion of the poor that have borrowed²⁵:

$$\widehat{PR} = \frac{\sum_{t=1}^T \sum_{i=0}^m (\frac{Z_t - Y_{it}}{Z_t})^2}{\sum_{i=1}^T \sum_{i=0}^n (\frac{Z_t - Y_{it}}{Z_t})^2} \hat{\beta} \cdot 100$$

Where n is the sample size in survey round $t = 1,2$ and m is the number of borrowers that borrow in survey round $t = 1,2$. \widehat{PR} is the percentage change in poverty/severe malnutrition that can be attributed to the microfinance intervention, which is the question of interest in study.

In this study, poverty is defined as individual FGT measure with $\alpha=2$: In equation (14) $\alpha=2$ is used because this measure captures both the extent of poverty (the number of poor) as well as the depth of poverty (the poverty gap).

²⁴ In this study Z(cut off point) gives the self-sufficiency standard of living of individual i. The researcher investigated the gap in poverty using anthropometric data of under six children.

²⁵ This is given by the ratio of the number of borrowers to the total of borrowers and non-borrowers in the survey.

Linear Regression Framework

Understanding how gains from the microcredit might vary by individual or household economics status (such as individuals income level, household expenditure status, or nutritional status) is considered important by Policy makers. Indeed, even if the mean program effect were significant, whether the program had a significant beneficial or detrimental effect might vary across the distribution of targeted households(Khandker et al., 2009). Accordingly, the third objective of this research is therefore the investigation of who is benefiting from DECSI.

There are a number of ways to present the distributional impacts of a program in the literature (Khandker et al., 2009):

One method, that is to be deployed in this research, is to examine how the program impact varies across different individuals or households. In a linear regression–based framework, heterogeneous program impacts can be represented by varying the intercept α , the coefficient β , or both on the program or treatment variable T_i , across individuals $i = 1, \dots, N$:

$$Y_i = \alpha_i + \beta_i * T_i + \phi_i * X + \mu_i \quad (17)$$

The researcher divided the sample of households and individuals into different demographic groups (such as by the status of child malnutrition) and run the same regression of T_i on Y_i separately on each group. For identification purpose, equation 17 is estimated using the three estimators discussed in this part.

The next part of the paper presents the process of data organization for the study, description of the variables used in the study, key findings and relevant discussions.

5. Analysis, Key Findings and Relevant Discussions

Summary Statistics of Basic household information

The following section present summary statistics of basic household information such as age of the household head, annual consumption expenditure per capita, operated land size in hectare owned by the household, oxen position by the household, distance to major infrastructural facilities (such as road and health centers) and child nutritional status at the household level in both 2006 and 2010.

Summary statistics of basic household information in 2006

The following tables present basic household information of those households participating in the 2006 survey and that are considered in this research.

Table 1. Household information by credit participation in 2006

Case 1: Summary statistics of households that did not participate in program credit

Variable	No. of Obs.	Mean	S.D.	Quantiles				
				Min	.25	Mdn	.75	Max
hhhage	62	48.94	12.39	28.00	39.00	48.00	55.00	83.00
hhsize	62	6.73	2.16	2.00	5.00	7.00	8.00	12.00
oxen	62	1.16	0.91	0.00	0.00	1.00	2.00	3.00
landsize	62	1.08	0.69	0.12	0.44	1.02	1.50	3.00
distroad	62	75.89	62.34	5.00	30.00	60.00	120.00	240.00
distranspo	62	72.74	67.37	5.00	25.00	50.00	120.00	240.00
disthealth	62	62.13	48.65	2.00	30.00	40.00	90.00	180.00
distmkt	62	142.34	88.14	15.00	60.00	150.00	180.00	480.00
_zlen	62	-2.22	2.09	-5.93	-3.44	-2.15	-0.78	5.91
percapitacons ²⁶	62	571.80	311.49	0.00	362.02	483.24	717.77	1420.49

Source: Survey data (2006-2010)

²⁶percapitacons is measured in Ethiopian currency, Birr where 1.00 USD = Br.16.6968

Case2: Summary statistics of households that participated in program credit

Variable	No. of Obs.	Mean	S.D.	Quantiles				
				Min	.25	Mdn	.75	Max
Hhhage	40	49.00	11.99	29.00	40.50	50.00	56.50	76.00
hhsize	40	6.62	1.84	3.00	5.00	7.00	8.00	11.00
oxen	40	0.93	0.94	0.00	0.00	1.00	2.00	3.00
landsize	40	1.15	1.01	0.09	0.48	0.73	1.75	5.00
Distroad	40	66.25	51.81	5.00	30.00	50.00	90.00	180.00
distranspo	40	86.50	72.95	2.00	27.50	60.00	165.00	240.00
Disthealth	40	60.50	43.95	5.00	30.00	40.00	100.00	160.00
dismkt	40	179.90	87.79	20.00	135.00	180.00	240.00	360.00
_zlen	40	-2.99	1.83	-5.80	-4.60	-3.08	-1.72	1.35
percapitacons	40	733.70	413.07	239.14	423.20	622.25	845.04	1959.98

Source: Survey data (2006-2010)

Summary Statistics of basic household information in 2010

The two tables below present basic household information of the households participated in the 2010 survey and that are incorporated in this research.

Table 2. Household information by credit participation in 2010

Case 3: Summary statistics of households who did not participate in program credit

Variable	No. of obs.	Mean	S.D.	Quantiles				
				Min	.25	Mdn	.75	Max
hhhage	68	46.28	11.60	26.00	38.50	45.50	53	81
hhsize	68	6.38	1.90	2.00	5.00	6.50	8	12
oxen	68	1.25	1.00	0.00	0.00	1.00	2	4.00
landsize	68	1.27	1.15	0.00	0.50	1.00	1.50	5.75
distroad	68	45.01	41.92	2.00	15.00	37.50	60	210
distranspo	68	52.94	48.90	0.00	15.00	40.00	60	180
disthealth	68	48.68	43.88	5.00	20.00	30.00	60	180
dismkt	68	162.79	86.17	0.00	120.00	180.00	180	360
_zlen	68	-1.65	2.07	-5.62	-3.21	-2.18	-0.36	3.74
percapitacons	68	1700.84	978.46	230.3	1005.07	1523.62	2163.11	6092

Source: Survey data (2006-2010)

Case 4: Summary statistics of households who did participate in program credit

Variable	No. of Obs.	Mean	S.D.	Quantiles				
				Min	.25	Mdn	.75	Max
hhhage	56	48.45	12.89	29.00	38.00	46.50	54	87
hhsz	56	7.18	1.44	3.00	6.50	7.00	8	10
oxen	56	1.18	1.47	0.00	0.00	1.00	2	10
landsize	56	1.11	0.65	0.25	0.62	0.98	1.50	2.50
distroad	56	49.80	43.52	2.00	27.50	40.00	60	240
distranspo	56	70.62	53.62	2.00	30.00	60.00	105	240
disthealth	56	46.70	31.38	5.00	25.00	40.00	60	120
distmkt	56	155.89	80.34	5.00	105.00	180.00	180	420
_zlen	56	-1.21	2.55	-5.53	-2.85	-1.73	0.24	5.17
Percapitacons	56	1700.89	722.26	528.11	1213.14	1574.20	2168.04	3468

Source: Survey data (2006-2010)

The above tables show the pattern of poverty measured with non-income (*_zlen*-length/height-for-age z-score) and income (in this case consumption expenditure per capita) indicators between in 2006 and 2010 between participants and non-participants of DECSI. Depending on which measures used (nutritional status of under six versus annual consumption expenditure per capita) the researcher come to quite different conclusions about household's poverty in Tigray and program credit participation status particularly in 2006.

In 2006, non-income (steady indicator) poverty indicator shows that on average children are more severely malnourished in households participating in program credit (z-score of -2.99) as compared to households not participating (-2.22). This result can be interpreted as the microcredit in Tigray is at least targeting amongst the poorest as against to the moderate poor. Note that the classification of the moderate poor and the poorest of the poor is based on the sheer size of z-score (the mean values of z-score), the interquartile range of z-score and the quantile measures. The classification of the poorest of the poor and the moderate poor using the mean value of z-score and the interquartile range is straightforward. The quantile gives the measure of the center of the distribution of the values of a variable. The lower and upper quantiles (0.25 and 0.75, respectively) and the middle value of the ordered data (Mdn) as measure of variation shows (see table 1) that the participant households have lower values of z-score (of all quantile measures) as compared to non-participant households. This justifies the just of the targeting by DECSI. However, this targeting of

the poorest of the poor does not guarantee that the poor of the poor are appreciating the benefits of being treated. The issue of identification whether the poorest of the poor are benefiting from participation in the program credit is the subject matter of the later econometric analysis part of this paper.

In 2010, one can see that nutritional status of average under six children showed improvements (from an average height-for-age z-score of -2.99 in 2006 to an average height-for-age z-score of -1.21 in 2010 for households participating in program credit). In addition, the wellbeing of children seems to be much better in 2010 than that of 2006 also for households who did not take part in program credit. To rigorously deal with these findings, one can take one step ahead to statistically identify the impacts and test the validity of the estimates.

Furthermore, in order to get insights into the relationship between the nutritional status of under six children (height-for-age z-score) and annual consumption expenditure per capita, the researcher presented the relationships using the following graphs.

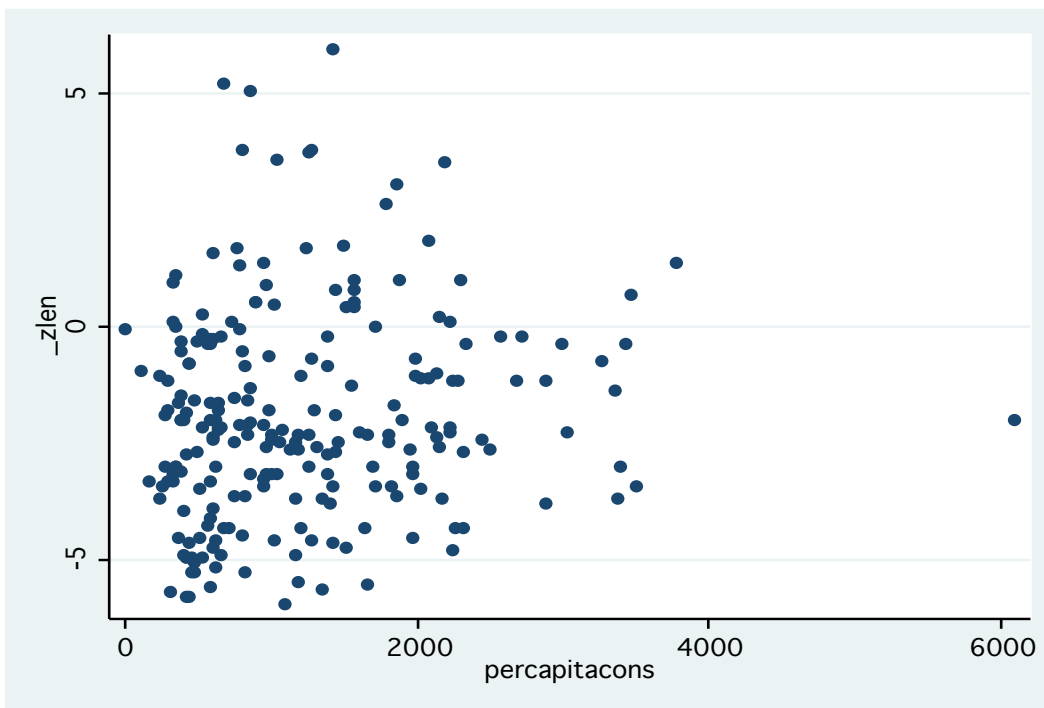
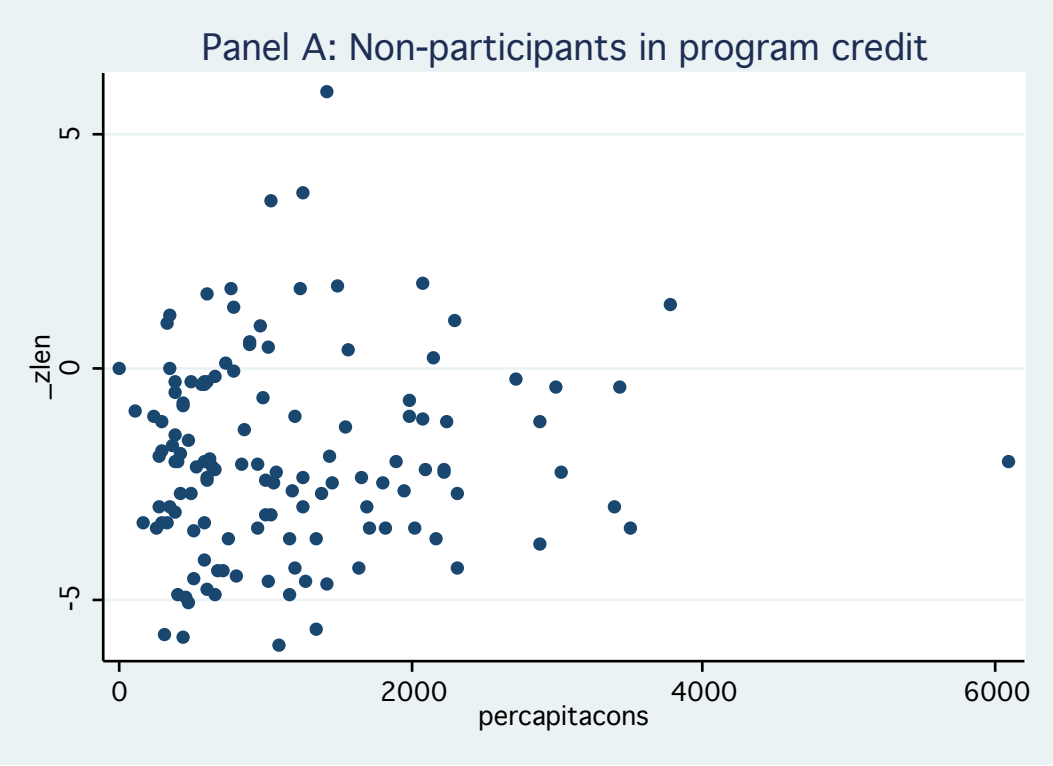


Figure 2. The relationship between annual consumption expenditure per capita and height-for-age z-score for both 2006 and 2010 data

As can be seen in the figure above, the relationship between income and non-income measures of poverty is not as such clear for the entire set of participants and nonparticipants for the two survey rounds. To further explore the two relationships, especially in the presence of program credit, the researcher presented the following graph that shows the relationship between the two measures for non participants and participants in the presence program credit as follows:



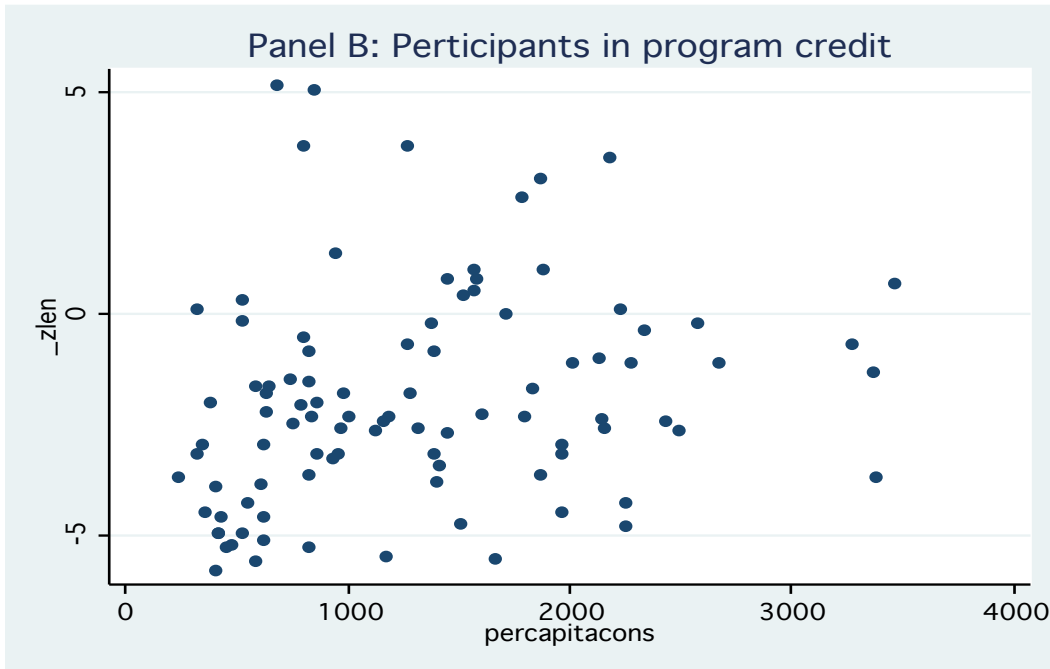


Figure 3. Pattern of relationship between total consumption expenditure and height-for-age z-score for non-participants and participants

Using the information presented in panel A and panel B, one can understand that observations are more spread out in panel B (with program credit) than in panel A. To explain this more clearly, Spearman and Kendall correlations test (see appendix II) is conducted. The null hypothesis, H_0 : $_zlen$ and $percapitacons$ are independent is rejected at 5% level in favor of the alternative hypothesis. The conclusion is that the nutritional status of under six children is positively correlated (under treatment) with consumption expenditure per capita. However, for non-participants, the test shows that there is no correlation between nutritional status of under six children and their consumption expenditure per capita.

Econometrics Estimation

This part of the paper presents the Econometrics analysis part of the research. In this part, answers of the fundamental research issues raised in part I are provided. The flow of the presentation is organized according to the organization of the research questions. Accordingly, the presentation starts by answering the first research question, i.e. whether program credit in Tigray is helping rural poor households in reducing poverty. In order to provide a reliable and a dependable answer to this question, the researcher employed a set of three estimators. The first estimator is the traditional Heckman Selection or some times called Heckman's bivariate normal (BVN)

selection estimator. One point here is worth mentioning. That is the researcher used the BVN estimator without an instrument. Technically speaking, BVN estimator is identified without an instrument from the nonlinearity of inverse mills ratio. Millimet (2010) in his simulation showed that BVN is identified without an instrument because the inverse mills ratio is nonlinear. The second is the estimator of (Klein and Vella, 2009), called KV estimator. This estimator uses the same functional form as the BVN, except that it uses a constructed instrument (that is estimable by maximum likelihood (ML)) that can be used as an instrument for the endogenous treatment dummy; however, it effectively induces a valid exclusion restriction in the presence of heteroskedasticity (Millimet, 2010). The third estimator is the Millimet (2010) estimator, sometimes called biased –corrected estimator.

Estimation Results

Effect of credit on poverty reduction (prevalence of stunting)

Table 3 below shows the effect of program credit on the severity of malnutrition as measured by Z score (height-by-age measure of malnutrition status of a child) using the aforementioned estimators.

Table 3. Effect of Program credit Participation on stunting reduction

Estimator	Using z-score as an outcome variable	
	ATE	ATT
KV-IV	2.755 [-7.407, 7.737]	2.755 [-7.407, 7.737]
BVN	2.373 [-4.975, 6.051]	0.774 [-3.561, 3.405]
MB-BC _{0.05}	2.295 [-4.698, 6.227]	1.866 [-6.113, 5.872]
MB-BC _{0.25}	2.389 [-4.873, 5.809]	0.916 [-5.580, 4.976]

Notes: Treatment is defined as participation in program credit. The three estimators use the same set of covariates defined in the Description of variables section. 90% empirical confidence (that means at a level of 10%) intervals in brackets are obtained using 250 bootstrap repetitions. KV = Klein and Vella estimator; BVN = Heckman bivariate normal selection model; MB-BC = bias-corrected estimator and the 0.05 or 0.25 under MB-BC gives at least 5 or 25 percent of both the treatment and control groups are contained in the propensity score interval that minimizes the bias in estimating ATE and ATT.

Table 4. Effect of Program credit Participation on consumption expenditure per capita

Using consumption expenditure per capita as an outcome variable		
Estimator	ATE	ATT
KV-IV	2946.141 [1.9e+03, 7690.062]	2946.141 [1.9e+03, 7690.062]
BVN	2681.906 [849.903, 3411.771]	1612.310 [408.093, 2140.605]
MB-BC 0.05	2650.867 [821.550,3452.521]	2458.962 [1.0e+03,3458.538]
MB-BC 0.25	2636.139 [837.640,3306.803]	2585.279 [751.770,3345.211]

Notes: The three estimators use the same set of covariates defined in the description of variables section.

From the above estimation result, the estimators give positive impact of program credit in improving in height-for-age z- score (table 3) and in increasing in consumption expenditure per capita (table 4) in Tigray. Because the BVN estimator does not allow for essential heterogeneity (which does hold in reality) especially when applied to sample size and that of the KV is harder to explain the economic meaning behind the identification (Jurajda, 2007), the researcher opted to use the results of Millimet’s estimators for interpretation of the results. In addition, KV estimator has a restrictive assumption in it identifies impacts based on the variance of heteroskedasticity of the error term of the treated and the untreated. Because of this identifying assumption, if the unobservables of the treated (μ_1) and non-treated (μ_0) are equal, the ATT and ATE parameters are all the same in the table above.

Allowing the random draw to differ in treated and untreated states are critical to allowing for unobserved heterogeneity in how people respond to treatment. There is, however, a special case where the parameters may be equal even if $\mu_1 = \mu_0$, that is, when

$$E(\mu_1 - \mu_0 | \text{Control}_i, T) = 0.$$

Under this restriction, T is uninformative on $\mu_1 - \mu_0$, but it is not necessarily the case that $\mu_1 = \mu_0$. The conditional mean restriction might be satisfied if agents making the participation decisions (e.g. households) do not act on $\mu_1 = \mu_0$ in making the decision, perhaps because they do not know anything about their own idiosyncratic gain from

participating in the program at the time of deciding whether to participate. In this special case, there is ex post heterogeneity in how people respond to treatment, but it is not acted upon ex ante (Todd, 2007).

Moreover, Millimets biased-corrected estimator is identified without exclusion restriction and does allow essential heterogeneity in identification.

The ATT above can be interpreted as a 1.866 z-score improvement in height-for-age resulting from the Program credit (DECSI) in Tigray, when 5% of the treatment and control groups are contained in the propensity score interval that minimizes the bias). When 25% of the treatment and control groups are contained in the propensity score interval that minimizes the bias, participating in program credit improves the height-for-age z-score by 0.916 z-score unit. Using the same logic, one can interpret the effect of access to credit in increasing annual consumption expenditure per capita. Accordingly, access to credit increases annual consumption expenditure per capita on average by 2458.96 Birr for the participants as compared to those who did not participate in program credit in Tigray.

On the other hand, the ATE measures the average causal difference in outcomes (height-for-age z-score and annual consumption expenditure per capita) under the treatment and under the control. As can be seen from table 3 and table 4, ATE is positive and significant at 10% level²⁷.

This analysis demonstrates that a credit DECSI achieved gains of 1.866 Z-scores of height-for-age to its beneficiaries in Tigray (in terms of reducing the prevalence and severity of malnutrition (stunting)) and an average increase of annual consumption expenditure per capita by 2458.96 Birr. However, this estimate is unstable due to the wide confidence interval of the estimate and caution should be given while the interpreting the findings. This is the major limitation of this paper²⁸.

²⁷ The stata code for this estimator is designed at 10% level and the program does not report the level of significance.

²⁸ Other limitations of the paper are the following: Some well-nourished children might be wrongly classified as undernourished because they have genetically short parents while others might be misclassified as well nourished even though they are undernourished but this does not show up in their height due to genetically tall parents. Hence, genetic variability among the families is another limitation of this study.

On top of these, *Small sample size* is another limitation of the paper.

Effect of credit in reducing the gap of malnutrition (stunting)

The second research question of this paper is the extent of poverty gap filled by DECSI, i.e., how big is the reduction in severe malnutrition of children living in Tigray due to DECSI. Severe malnutrition might be a sign of severe poverty (below poverty line income) and reducing severe malnutrition can be taken as reduction of poverty. Hence, this research question can be rephrased as how much poverty reduction has been achieved by DECSI in the time span of the two surveys?

To answer this question, the researcher transformed the height-for-age z-score into the standard Foster-Greer-Thorbecke, of poverty. The generation of this measure (fgtZ-Score) can be shown as:

$$\text{fgtZ - score} = \begin{cases} \left(\frac{-2 - Z_i}{Z}\right)^2, & \text{if } z_i < -2 \\ 0, & \text{if } z_i \geq -2 \end{cases}$$

Z-Score = -2 is a cut-off point where the height-for-age z-score of less than -2 indicates the situation of severe malnutrition (stunting) or severe poverty.

Using fgtZ as dependent variables against a set of covariates used to answer research question one and estimate the regression using the above family of estimators gives the following result.

Table 5. Estimation of the amount of malnutrition reduced because of DECSI

Using fgt Z-score as an outcome variable	
Estimator	β
KV-IV	-0.558 [-0.498, 0.477]
BVN	-0.029 [-0.212, 0.274]
MB-BC _{0.05}	-0.065 [-0.339, 0.434]
MB-BC _{0.25}	-0.049 [-0.333, 0.450]

Notes: The three estimators use the same set of covariates defined in the description of variables section.

Using the three estimators, coefficient β indicates the average reduction in malnutrition (a positive impact of microfinance) for an under six child whose parents choose to take loan from DECSI. To get the percentage coefficient of reduction in poverty (malnutrition) because of credit from DECSI, one can multiply β with the proportion of the poor that have borrowed:

$$\widehat{PR} = \frac{\sum_{t=1}^T \sum_{i=0}^m \left(\frac{-2 - Z_{it}}{Z_t}\right)^2}{\sum_{t=1}^T \sum_{i=0}^n \left(\frac{-2 - Z_{it}}{Z_t}\right)^2} \hat{\beta} \cdot 100$$

Where n is the sample size in survey round $t = 1,2$ and m is the number of borrowing that borrow in survey round $t = 1,2$. \widehat{PR} is the percentage change in reducing in malnutrition or poverty that can be attributed to the microfinance intervention, which is the question of interest in study. Using the data of this study, \widehat{PR} can be estimated as follows:

$$\widehat{PR} = \frac{10.19}{21.8} * -0.065 * 100 = -3.03\%$$

This result is interpreted as follows: only 3.03% of the reduction in the gap of the severe malnourishment (stunted) or sever poverty in Tigray is made possible by DECSI. Like in the first estimation, the confidence interval of this estimate is relatively large.

Who is benefiting from program credit in Tigray?

The last research question of this paper is who is benefiting most from DECSI program credit. In order to answer this question, the researcher divided the survey sample into two, based on the height-for-age- z-score taking $z=-2$ as a dividing line. Those below z-score of -2 are those who a have stunted child and those who are above the -2 height-for-age z-score have a child who was well nourished. We can consider the two categories as the poorest of the poor and moderately poor respectively. Using the two categories, the researcher estimated independent regressions for each group. The following tables show the estimating of the treatment effects for each of the two groups:

Table 6a. Estimation of program credit participation on z-scores for the moderately poor

Using z-score as an outcome variable		
Estimator	ATE	ATT
KV-IV	1.889 [-4.817, 4.326]	1.889 [-4.817, 4.326]
BVN	0.732 [-2.751, 2.318]	0.244 [-1.956, 1.357]
MB-BC _{0.05}	0.367 [-2.763, 2.162]	0.089 [-3.891, 2.285]
MB-BC _{0.25}	0.313 [-2.674, 2.082]	0.179 [-3.590, 1.814]

Notes: The three estimators use the same set of covariates defined in the description of variables section.

Table 6b. Estimation Effect of program credit participation on z-scores for the poorest of the poor

Using z-score as an outcome variable		
Estimator	ATE	ATT
KV-IV	3.566 [-10.149, 8.112]	3.566 [-10.149, 8.112]
BVN	1.641 [-4.209, 6.041]	0.530 [-3.059, 3.270]
MB-BC _{0.05}	1.604 [-4.714, 6.299]	1.777 [-5.163, 5.689]
MB-BC _{0.25}	1.912 [-4.021, 5.905]	1.095 [-5.155, 5.839]

Notes: The three estimators use the same set of covariates defined in the description of variables section.

Using the above two tables, all the estimators consistently estimated the fact that the poorest of the poor are benefiting more than the moderately poor from the program credit in Tigray. This result is in line with many poverty reduction strategies in developing countries. ATT on the poorest of the poor (1.777 height by-age z-score improvement due to credit) is stronger than the ATT of the moderately poor (with ATT of 0.089 height by-age z-score improvement due to credit).

Based on this analysis, it can be cautiously concluded that the poorest of the poor are benefiting more from DESCI credit program than the moderate poor rural household in Tigray. The results should be interpreted with caution, as the confidence intervals are large and typically uninformative in the sense that they contain both positive and negative values for the coefficient of interest.

6. Conclusion

In this paper, the researcher investigated the effect of Microfinance on child malnutrition and annual consumption expenditure per capita at the household level using three best available impact assessment identification strategies. Two of the three estimators; KV and Millimet's minimum biased estimator, are new estimation strategies of the causal effects that are designed to provide consistent estimates of causal effect of a binary treatment when conditional independence fails.

In this study, the researcher aims to reduce non-classical measurement error that dramatically bias coefficients and is likely to arise when income or expenditure are used as outcome variable by proposing height-for-age z-score as an outcome variable, which is less likely subject to measurement error. Furthermore, the researcher tried to touch the effect of microfinance credit in reducing poverty using child malnutrition outcomes as it is obvious that poverty measures goes beyond the standard welfare measure of consumption and income, which are likely subject to non-classical measurement error.

In addition, the researcher uses Foster-Greer-Thorbecke poverty gap estimator, which is a generalized measure of poverty within an economy to measure nutritional shortfalls using under six children anthropometric data and calculate the amount of reduced in malnutrition achieved by microcredit from DECSI.

In the preceding analysis of the impact of program credit, the three estimators offer a coherent picture of the causal effect of the program. Specifically, the researcher finds a positive and statistically significant association between program credit and child nutritional improvements when using estimators that require conditional independence, mainly BVN. The association remains positive, but becomes smaller, when minimum-biased estimator, that does not require conditional independence, is used. This conclusion follows using child malnutrition and annual per capita consumption expenditure outcome variables. Moreover, it is discovered that around 3 % of the reduction in the gap of the severe malnourishment of under six children is made possible by DECSI. Finally, consistent with the objectives of most microfinance institutions, the researcher finds that the poorest of the poor are benefiting more from DECSI credit program than the moderately poor rural households in Tigray.

Finally, future analysis into the impact of participation in microfinance on other outcome variables, such as indicators of poverty and acute malnutrition of children under six (*wasting* and *underweight*) as well as adults body mass index indicators, will provide policymakers with better information about the potential benefits of program credit.

References

- (MOFED), M. O. F. A. E. D. 2006. Ethiopia: building on progress, a Plan for Accelerated and Sustained Development to End Poverty (PASDEP).
- ADJEI, J. K., ARUN, T. & HOSSAIN, F. 2009. The Role of Microfinance in Asset-Building and Poverty Reduction: The Case of Sinapi Aba Trust of Ghana. *Brooks World Poverty Institute Working Paper Series*.
- ALKIRE, S. & SANTOS, M. E. 2010. *Acute multidimensional poverty: a new index for developing countries*, University of Oxford, Poverty and Human Development Initiative.
- ARAUJO, M. C., FERREIRA, F. H. G., LANJOUW, P. & ZILMER, B. 2008. Local inequality and project choice: Theory and evidence from Ecuador. *Journal of Public Economics*, 92, 1022-1046.
- BEHRMAN, J. R. & DEOLALIKAR, A. B. 1987. Will developing country nutrition improve with income? A case study for rural South India. *The Journal of Political Economy*, 95, 492-507.
- BENNETT, D. 2009. Billions of dollars and a Nobel Prize later, it looks like "microfinancing" doesn't actually do much to fight poverty. *Boston Globe*, 20.
- BERHANE TESFAY, G. 2009. *Econometric analyses of microfinance credit group formation, contractual risks and welfare impacts in Northern Ethiopia*. Proefschrift Wageningen, s.n.].
- BLOSS, E., WAINAINA, F. & BAILEY, R. C. 2004. Prevalence and predictors of underweight, stunting, and wasting among children aged 5 and under in western Kenya. *Journal of tropical pediatrics*, 50, 260.
- BORCHGREVINK, AXEL, JO HELLE-VALLE & WOLDEHANNA, T. (2003). Credible Credit Impact Study of the Dedebit Credit and Savings Institution (DECSI)", Tigray, Ethiopia. *Norwegian Institute of International Affair*.
- BOUCHER, S. R., BARHAM, B. L. & CARTER, M. R. 2005. The Impact of. *World Development*, 33, 107-128.
- BRAU, J. C. & WOLLER, G. M. 2004. Microfinance: A comprehensive review of the existing literature. *Journal of Entrepreneurial Finance and Business Ventures*, 9, 1-26.
- CGAP, W. 2010. *The Challenge for Islamic Microfinance* [Online]. <http://www.cgap.org/>. 22 March, 2011].
- COLLINS, D. & MORDUCH, J. 2010. Reimagining the Unbanked.

- COTLER, P. & WOODRUFF, C. 2008. The Impact of Short-Term Credit on Microenterprises: Evidence from the Fincomun-Bimbo Program in Mexico. *Economic Development and Cultural Change*, 56, 829-849.
- CZURA, K. November 2010. Impact Assessment of Microfinance in Sri Lanka: A Household Survey of Microfinance Clients in 5 Selected ProMiS Partner Microfinance Institutions. *Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH German Technical Cooperation*. Sri Lanka: Promotion of the Microfinance Sector (ProMiS).
- DE AGHION, B. A., ARMEND-RIZ, B. & MORDUCH, J. 2007. *The economics of microfinance*, The MIT Press.
- ECONOMIST 2009. Microcredit may not work wonders but it does help the entrepreneurial poor. *The Economist*.
- ELAHI, K. Q. I. & RAHMAN, M. L. 2006. Micro-credit and micro-finance: functional and conceptual differences. *Development in Practice*, 476-483.
- FOSTER, J., GREER, J. & THORBECKE, E. 1984. A class of decomposable poverty measures. *Econometrica: Journal of the Econometric Society*, 761-766.
- GUGERTY, M. K. & KREMER, M. 2008. Outside funding and the dynamics of participation in community associations. *American Journal of Political Science*, 52, 585-602.
- GUNTHER, I. & KLASSEN, S. 2009. Measuring chronic non-income poverty. *Poverty dynamics: interdisciplinary perspectives*, 77.
- HADDAD, L., ALDERMAN, H., APPLETON, S., SONG, L. & YOHANNES, Y. 2003. Reducing child malnutrition: How far does income growth take us? *The World Bank Economic Review*, 17, 107.
- HAGOS, F. 2003. *Poverty, institutions, peasant behavior and conservation investment in northern Ethiopia*. PhD Thesis, Agricultural University of Norway.
- HAGOS, F., HOLDEN, S. & PENDER, J. 2006. The Effect of Program Credit on participation in off-farm employment and welfare of rural households in Northern Ethiopia: Agricultural University of Norway.
- HAILAI, A. 2010. *Can Microfinance Help to Reduce Poverty?* Master of Science degree in Economics, Mekelle University.
- HEDAYA, H. 2009. Perhaps microfinance isn't such a big deal after all. *Financial Times*
- HELMS, B. 2010. Microfinancing changes lives around the world –measurably. . *The Seattle Times* 7 April.
- HESSE, J. & RUNGE-METZGER, A. Ox traction in a long-term perspective: policy implications of a socio-economic study in Ghana. 1999.

- HIRANO, K. & IMBENS, G. W. 2001. Estimation of causal effects using propensity score weighting: An application to data on right heart catheterization. *Health Services and Outcomes Research Methodology*, 2, 259-278.
- HULME, D., HANLON, J. & BARRIENTOS, A. 2010. *Just Give Money to the Poor: The Development Revolution from the Global South*, Kumarian Pr.
- JURAJDA, Ä. 2007. Lecture Notes on Identification Strategies.
- KABEER, N. 2003. Wider Social Impacts: Assessing the 'Wider' Social Impacts of Microfinance Services: Concepts, Methods, Findings. *IDS Bulletin*, 34, 106-114.
- KARLAN, D., GOLDBERG, N. & COPESTAKE, J. 2009. 'Randomized control trials are the best way to measure impact of microfinance programmes and improve microfinance product designs.'. *Enterprise Development and Microfinance*, 20, 167-176.
- KARLAN, D. & ZINMAN, J. 2009. Expanding credit access: Using randomized supply decisions to estimate the impacts. *Review of Financial Studies*.
- KHANDKER, S., KOOLWAL, B. & SAMAD, H. 2009. Handbook on Impact Evaluation. *Handbook on Impact Evaluation*, 1, 1-239.
- KLASEN, S. 2008. Poverty, undernutrition, and child mortality: Some inter-regional puzzles and their implications for research and policy. *Journal of Economic Inequality*, 6, 89-115.
- KLEIN, R. & VELLA, F. 2009. A semiparametric model for binary response and continuous outcomes under index heteroscedasticity. *Journal of Applied Econometrics*, 24, 735-762.
- KLUGMAN, J., RODRÍGUEZ, F. & CHOI, H.-J. 2010. Human Development Report: New Controversies, Old Critiques. *Human Development Report UNDP*.
- MACFARQUHAR, N. 2010. Banks making big profits from tiny loans. *New York Times*
- MAKINA, D. & MALOBOLA, L. 2004. Impact assessment of microfinance programmes, including lessons from Khula Enterprise Finance. *Development Southern Africa*, 21, 799-814.
- MANSURI, G. & RAO, V. 2004. Community-based and-driven development: A critical review. *The World Bank Research Observer*, 19, 1.
- MATIN, I., HULME, D. & RUTHERFORD, S. 1999. Financial services for the poor and poorest Deepening understanding to improve provision.
- MILLIMET, D. & TCHERNIS, R. 2009. *Estimation of Treatment Effects Without an Exclusion Restriction: with an Application to the Analysis of the School Breakfast Program*.

- MILLIMET, D. L. 2010. The Elephant in the Corner: A Cautionary Tale about Measurement Error in Treatment Effects Models.
- MORRIS, S. S., FLORES, R. & Z'NIGA, M. 2000. Geographic targeting of nutrition programs can substantially affect the severity of stunting in Honduras. *The Journal of nutrition*, 130, 2514.
- PLATTEAU, J. P. 2004. Monitoring Elite Capture in Community Driven Development. *Development and Change*, 35, 223-246.
- ROODMAN, D. 2009 New Challenge to Studies Saying Microcredit Cuts Poverty. *David Roodman's Microfinance Open Book Blog*[Online]. [Accessed March 21st, 2011 at 23:36 March 21, 2011].
- ROODMAN, D. 2010. You can't have it all. *David Roodman's Microfinance Open Book Blog*[Online].
- RUTHERFORD, S. & ACTIONAID 1996. *A critical typology of financial services for the poor*, Actionaid.
- SANTEN, R. M. V. 2010. Microfinance as a Poverty Reduction Policy.
- SARTORI, A. E. 2003. An Estimator for Some Binary-Outcome Selection Models without Exclusion Restrictions". *Society for Political Methodology*, 11, 111-138.
- SEGELE, Z. & LAMB, P. 2005. Characterization and variability of Kiremt rainy season over Ethiopia. *Meteorology and Atmospheric Physics*, 89, 153-180.
- SIMONDON, K. B. 2010. Anthropometric indicators for impact evaluation of food security programmes. Institut de Recherche pour le Développement.
- STASCHEN, S. 1999. Regulation and Supervision of Microfinance Institutions: State of Knowledge. *GTZ, Eschborn*.
- STEWART R, VAN ROOYEN C, DICKSON K, MAJORO M & T, D. W. 2010. What is the impact of microfinance on poor people? London: Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre), Social Science Research Unit at the Institute of Education, University of London.
- TODD, P. E. 2007. Evaluating social programs with endogenous program placement and selection of the treated. *Handbook of development economics*, 4, 3847-3894.
- UNICEF 1998. The State of World's Children: Focus on Nutrition. New York: UNICEF.
- WEBB, P., VON BRAUN, J. & YOHANNES, Y. 1992. *Famine in Ethiopia: policy implications of coping failure at national and household levels*, Intl Food Policy Research Inst.

- WESTOVER, J. 2008. The record of microfinance: The effectiveness/ineffectiveness of microfinance programs as a means of alleviating poverty. *Electronic Journal of Sociology*, 12.
- WIKIPEDIA. 2010. *DECSI (Dedebit Credit and Savings Institution)* [Online]. Wikimedia Foundation, Inc.,. [Accessed 28 Sep 2010 2010].
- WOLDEHANNA, T. 2000. *Economic analysis and policy implications of farm and off-farm employment : a case study in the Tigray region of Northern Ethiopia*. PhD Thesis, Wageningen University.
- WOLDEHANNA, T. A. O., A 2002. The development and constraints of micro and small-scale enterprises and the need for member-based rural financial intermediation in rural Tigray. *Proceeding of the microfinance workshop held* Mekelle: Mekelle university.
- WOLDENHANNA, T. & OSKAM, A. 2001. Income diversification and entry barriers: evidence from the Tigray region of northern Ethiopia. *Food Policy*, 26, 351-365.
- WOOLDRIDGE, J. M. 2005. Violating Ignorability of Treatment by Controlling for Too Many Factors. *Econometric Theory*, 21, 1026-1028.
- WRIGHT, G. A. N. 1999. Examining the impact of microfinance services-increasing income or reducing poverty? *Small Enterprise Development*, 10, 38-47.

Appendices

Appendix I. Village Dummies significance test

Variable	Ordinary Least Square	Heckman Estimation
Samredummy	-6.423 -24567.68	-1.103* -1.18
Mahberedummy	0.178 -0.64	0.731* -0.96
Maialemdummy	-6.423 -18571.42	0.255* -0.96
Seretmdummy	0.761** -0.44	-0.543 -0.73*
Kihenmdummy	1.156*** -0.52	-0.32 -0.78
Genfelmdummy	-0.222 -0.42	0.408* -0.72**
Embaasmenay	-0.744* -0.49	-0.393 -0.74
Hagereselay	-1.110* -0.67	1.845*** -0.92
Adiselamduy	0.864** -0.5	1.006* -0.85
Hadegtidummy	0.26 -0.48	-0.752 -0.83
Tsaedaambo	0.371 -0.46	-0.059 -0.79
Adimenabrduy	-0.655* -0.41	0.073 -0.67
Maiadrashay	0.227 -0.43	0.637 -0.76
Mekonidummy	0.889*** -0.4	2.430**** -0.67
Maikeyahtiy	-0.257 -0.47	-0.403 -0.79
Prob > F	0.0001	
R-squared	0.1836	
Adj R-squared	0.1253	
Prob > chi2		0.006
Number of Observations	226	226

*: Significant at 25%; ** significant at 10%; *** significant at 5%; **** significant at 1%. Note: Beneath each parameter coefficient are robust standard errors.

Appendix II. Spearman's rank correlation coefficients test

Table I. Spearman's rank correlation coefficients test for participants

Statistics	Value
t-statistics	2.1474
Prob > t	0.0328

Ho: _zlen and percapitacons are independent

Table II. Spearman's rank correlation coefficients test for non-participants

Statistics	Value
Spearman's rho	0.01
Prob > t	0.88

Ho: _zlen and percapitacons are independent

Appendix III. Pearson product-moment correlation

Table I. Pearson product-moment correlation test between cultivated land size and program credit

Np= 96 p= 0.42
Nq=130 q= 0.58

Coefficient	t-value	P>t	df
-0.0273	-0.4093	0.027	224

Np=number of observations for anycredit=1, p= proportion of p
Nq= number of observations for anycredit=0, q= proportion of q
The test is valid at 5 % level

Table II. Pearson product-moment correlation test between cultivated land size and number of oxen possessed by the household

Np= 96 p= 0.42
Nq=130 q= 0.58

Coef	t-value	P>t	df
-0.0605	-0.9071	0.045	224

Np = number of observations for anycredit=1, p= proportion of p
Nq= number of observations for anycredit=0, q= proportion of q
The test is valid at 5% level

Appendix IV. Household Questionnaire

MASTERS PROGRAM: 2010 NOMA FELLOWS NORWEGIAN UNIVERSITY OF LIFE SCIENCES IN COLLABORATION WITH MEKELLE UNIVERSITY HOUSEHOLD QUESTIONNAIRE		
The information collected will be used for research purposes. It will be treated as confidential and will not be used by tax authorities or others to assess the need for food aid or other assistance.		
Zone		
Woreda		
Tabia		
Kushet		
Household ID		
Name of household head		
<u>Distance to woreda town (walking minutes)</u>		
<u>Distance to local market (walking minutes)</u>		
<u>Distance to primary school (walking minutes)</u>		
<u>Distance to secondary school (walking minutes)</u>		
<u>Distance to all weather road (walking minutes)</u>		
<u>Distance to transporatation service (walking minutes)</u>		
<u>Distance to health center (walking minutes)</u>		
<u>Distance to grain mill</u>		
<u>Distance to nursery site</u>		
<u>Distance to protected water source(walking minutes)</u>		
<u>Distance to tap water(walking minutes)</u>		
Enumerators:		Dates interviewed
First interview:		
Second interview:		
Third interview:		

HOUSEHOLD NAME: _____						HH id: _____		
Farm household survey: Household Expenditures								
Expenditure on farm inputs EC 1994-95								
Item	Quantity	Own prod.	Purchased	Price	Unit	Tot. Expend.	Where bought	source of cash
Seed, teff								
Seed, wheat								
Seed,maize								
Seed, barley								
Seed, sorghum								
Seed, chickpea								
Seed, Millet								
Seed, Fava bean								
Seed, pea								
Seed, Latyrus								
Seed, others								
Seed, vegetables								
Seed, Pepper								
Other tree seedling.								
Fertilizer: Urea								
Fertilizer: DAP								
Herbicide								
Pesticide								
Tools/equipment								
Manure								
Hired oxen								
Animal salt								
Animal medicine								
Animals bought								
Animal feed:								

Grass								
crop residue (hay stover, etc.)								
Unit: 1) kg; 2) Shember; 3)Minilik; 4) mishe; 5)others. Specify								
Where bought: 1: from neighbour, 2: within kushet, 3: local market, 4: woreda market, 5: trader visiting village								
Source of cash: 1: ownsavings, 2:formal credit, 3:informal credit,4:sale of own production, 5:sale of assets,6: other specify.								
Have you obtained credit to pay for farm inputs or for farm investments? 1) YES, 0) NO. A69 If yes, give details for the 3 last years:								
Source	Year	Purpose		Amount	Repayment conditions			
					Frequency	Duration	Interest	completed
Have you over the last 3 years received credit for Nonagricultural investments								

If you want, are you able to obtain credit for	Yes/No	Source	Max amount	Interest rate	Duration	Comment	
a. Investment							
in farm inputs							
in oxen purchase							
in other business							
b. Consumption							
c. Family events							
						Yes=1	No=0
If you have already received credit for some purpose, are you able to obtain more loans before paying back what you have already obtained? Yes/no							
Are you member of a credit association?							
If yes, do you prefer to get credit on individual basis?							
Has any member in your credit group defaulted?							
If yes, what were the consequences?							
Does any one in the HH save/put money in any of the following?							
<i>DECSI</i>							

<i>Equb</i>		
<i>Edir</i>		
<i>Nearby Bank</i>		
<i>At home</i>		
<i>Others,specify</i>		

HOUSEHOLD NAME:					HH id: _____						
Farm household survey: Household Consumption Expenditures (last year)											
Commodity	Quantity			Quantity	Where	Per	Price	Unit	Own prod. Cons. Value	Cash Consump. Expenditure	Total Value of Consumption
	Own Prod	Free food	FFW	Bought	bought		Birr				
Teff											
Wheat											
Barley											
Maize											
Sorghum											
Millet											
Faba Bean											
Latyrus											
Chick Pea											
Pea											
Linseed											
Lentile											
other, specify											
Fruites											
Banana											
Mango											
Papaya											
Avocado											
Guava											
Vegetables											
Pepper											
Cabbage											
Onion											
Potato											
Tomato											

Other vegetables											
Garlic											
Coffee											
Spices											
Quantity: Number of units. Per: 1:week, 2:month, 3:season,4: year.											
Unit: 1:Kg, 2:pieces, 3:sheets,4:litre, 5:bags, 6:bundles 7:others, specify etc.											
Total expenditure: Includes value of own production. Cash expenditure: On purchased quantity											
Own production: Market value (Birr) of own production.											
Where bought: 1: from neighbour, 2: within Tabia 3: local market, 4: distant market, 5: trader visiting village											

Farm household survey: Household Consumption Expenditures (continued)											
Commodity	Quantity Own Prod	Free food	FFW	Quantity Bought	Where bought	Per	Price Birr	Unit	Own prod. Cons. Value	Cash Consump. Expenditure	Total Value of Consump tion
Beef											
Sheep											
Goat											
Chicken											
Eggs											
Milk											
Butter											
Sugar											
Cooking oil											
Salt											
Tea											
Clothing											
Shoes											
Blanket/bedsheet											
Umbrella											
Soap/Wash.p.											
Fuelwood											
Kerosene											

Batteries											
Mobile phone											
Radio											
Corrugated iron											
Furniture											
Travel/Transport											
School fees											
School books etc.											
Health/Medicine											
Income tax											
Land tax											
Religious contribution											
Ceremonies											
Jewelry											
House rent											
House construction											
Cigarettes/Tobacco											
Electricity											
Wood materials											
Leisure (drinks, candies, lotteries etc.)											
Quantity: Number of units. Per: 1:week, 2:month, 3: season ,4: year.											
Unit: 1:Kg, 2:pieces, 3:sheets,4:litre, 5:bags, 6:bundles 7:others, specify etc.											
Total expenditure: Includes value of own production. Cash expenditure: On purchased quantity											
Own production: Market value (Birr) of own production.											
Where bought: 1: from neighbour, 2: within Tabia 3: local market, 4: distant market, 5: trader visiting village											

HOUSEHOLD NAME: _____	HH id: _____													
------------------------------	--------------	--	--	--	--	--	--	--	--	--	--	--	--	--

Farm household survey: Crop Selling Activities

Crop	Kushet				Local market					Woreda market:				
	Qty	Price/unit	Month sold	Income	Qty	Price/unit	Where ?	Month sold	Income	Qty	Price/unit	Where ?	Month sold	Income
Teff														
Wheat														
Barley														
Maize														
Sorghum														
Millet														
Oats														
Faba Bean														
Latyrus														
Chick pea														
Lentile														
Linseed														
Pea														
Pepper														
Potato														
Tomato														
Banana														
Mango														
Papaya														
Avocado														
Guava														
Pepper														
Cabbage														
Onion														
Carrot														
Tomato														
Garlic														
Coffee														

Eucalyptus														
Means of transport to the different markets:						Local market:		Distant market:						
Frequency of visit to the different markets:	(Per month)					Local market:		Distant market:						

HOUSEHOLD NAME:					HH id:					
Farm household survey: Livestock Production Activities										
Animal type	Stock	Stock	Stock	Born during	Died during	Slaughtered	Bought	Sold during	Months in	Milk per
	2 years ago	1 year ago	Current	EC 2001/02	EC 2001/02	EC 2001/02	EC 2001/02	EC 2001/02	milking (2001/02)	day (EC2001/02)
Cattle										
Milking cow										
Other cows										
Oxen										
Heifer										
Bulls										
Calves										
Sheep										
Goats										
Horses										
Mules										
Donkeys										
Camel										
Chicken										
Bee hives										
Source of cash to buy the livestock										

Farm household survey: Livestock Selling Activities EC														
2001-02														
Animal/	Village Market				Local Market					Distant market				
Product	Qty	Price/ unit	When sold	Income	Qty	Price/ unit	Where	When sold	Income	Qty	Price/ unit	Where	When sold	Income
Cattle														
Milking cow														
Other cows														
Oxen														
Heifer														
Bulls														
Calves														
Sheep														
Goats														
Horses														
Mules														
Donkeys														
Chicken														
Butter														
Milk														
Meat														
Eggs														
Skins														
Animal dung														
Honey/Wax														
Reasons for selling livestock last year?														
1	To cover food expense						4	To cover land tax						
2	To cover clothing and schooling expenses						5	Others. Specify						
3	For wedding and other social expenses													

Farm household survey: Livestock Selling Activities EC 2001-02														
Animal/	Village				Local Market					Distant market				
Product	Qty	Price/ unit	When sold	Income	Qty	Price/ unit	Where	When sold	Income	Qty	Price/ unit	Where	When sold	Income
Cattle														
Milking cow														
Other cows														
Oxen														
Heifer														
Bulls														
Calves														
Sheep														
Goats														
Horses														
Mules														
Donkeys														
Chicken														
Butter														
Milk														
Meat														
Eggs														
Skins														
Animal dung														
Honey/Wax														
Reasons for selling livestock last year?														
1	To cover food expense													
2	To cover clothing and schooling expenses													
3	For wedding and other social expenses													
4	To cover land tax													
5	Others. Specify													

Farm household survey: Other Sources of Income 2001 -02 E.C)									
Source	Input quantity	Input costs	Who earned	Where /to whom	When/Period	Quantity	Price/Wage	Income	Years of Experience
Hiring out oxen									
Hire out labour									
Labour exchange									
Assistance received									
Assistance given									
Rent out land									
Employment									
Cash support									
Migrant income									
Remittance Income									
Assistance from relatives									
Government Transfers									
Gifts									
Sale of firewood									
Sale of Handicraft									
Sale of beverages									
Petty trade									
Grain mill									
Other business/services									

Source	Number of months/yr worked	how many person in the hh	Who earned (hh member id)	Input quantity (total labor mandays)	Output Quantity (food in kg or days of work) per year		price/wage (price of wheat per kg or daily payment rate of CFW)		Total income
					unit	quantity	unit	price	
Food for Work									
Food Aid									
Cash for Work									
OFSP(Other Food Security Program)									

Employment: permanent job locally, Hire out labour: temporary job locally, Migrant income: temporary job outside community member by household Remittance income: Money sent by relatives permanently living elsewhere

What durable commodities and implements does the household have?									
Household Assets	Number now	Year bought	Number bought	Price	Current value	Need replacement (# of years)		Implements Owned 1998 EC	Source of cash
		Latest	last year						
Farm implements									
Plough									
Donkeycart/horsecart									
Plough parts									
Hoe									
Sickle									
Hammer									
Ax									
Spade									
Wheelbarrow									

Other production assets:									
Irrigation equipment									
Irrigation well									
Irrigation pump									
Pond									
Assets									
Furniture									
Radio/cassetplayer									
Wrestwatch									
Bicycle									
Stove									
House with iron roof									
Hut									
Kitchen house									
toilet*									
Jewelry									
Mobile phone									
Source of cash: 1:Sale of output, 2:Remittances, 3:Credit, 4:Sale of food from FFW, 5:Sale of livestock, 6:Savings, 7:Others, specify									
*Whether the household has toilet or not should be verified by the interviwer									

Appendix V. Plot Level Questionnaire

Household Name:	Interviewer:	GPS Coordinates for home of household:	Altitude (masl)
Household Id. No.:	Date of Interview:	1.	
Kushet:	Tabia:	2.	

Does the household have a land certificate? 1=Yes 0= No If yes, Year (EC) of receiving the certificate: _____

Land certificate information (copy information from land certificate), If no, why no certificate? 1=Did not collect it, 2=No land at that time, 3=Too small land, 4=Land was not registered, 5=Tabia did not give me, 6=Lost it, 7=Other, specify

Registration number on certificate: _____

Full name (owner): _____ Sex of owner: _____

Is owner current head of household? Yes No If no, relationship between listed owner and hhhead: HHhead is.....

Family size when land was allocated: _____ The time when the last land allocation was made: _____

The number of plots allocated:

Plot No.	The name of the place where the plot is located	Distance (minutes)	Soil depth of the plot (Deep=1, medium=2, or shallow=3)	Plot size in Tsimdi	Measure plot size in Tsimdi	The plot is Adjacent to.....	GPS Coordinates	Altitude (Elevation)	Origin of plots	Who decide on plots	Who work on plots
						E: _____ N: _____ W: _____ S: _____					
						E: _____ N: _____ W: _____ S: _____					
						E: _____ N: _____ W: _____ S: _____					

Origin of plots: 1. Husband/Husband's family, 2. Wife's family, 3. Government, 4. Tabia, 5. Others, specify....

Who decide on plots (make production and investment decisions): 1.Husband/male head, 2.Wife, 3.Joint husband/wife, 4.Female head, 5.Son, 6.Other, specify:

Who work on plots: 1.Husband/male head, 2. Whole family, 3.Joint husband/wife, 4.Female head, 5.Wife, 6.Son, 7. Others, specify:

Does the household have plots that are not listed on the certificate? Yes = 1 No = 0

If yes, list the plots

Plot No.	The name of the place where the plot is located	Distance (minutes)	Soil depth of the plot (Deep=1, medium=2, or shallow=3)	Plot size in Tsimdi	Measured plot size in Tsimdi	GPS Coordinates	Altitude (Elevation)	Origin of plots	Who decide on plots	Who work on plots

Origin of plots: 1. Husband/Husband's family, 2. Wife's family, 3. Government., 4. Tabia, 5. Other, specify....

Who decide on plots (make production and investment decisions): 1.Husband/male head, 2.Wife, 3.Joint husband/wife, 4.Female head, 5.Son, 6.Other, specify:

Who work on plots: 1.Husband/male head, 2. Whole family, 3.Joint husband/wife, 4.Female head, 5.Wife, 6.Son, 7.

Other, specify:

Cross/check information with plot level data from our earlier survey rounds:

NB! Fill plot number continuing from plot numbers on previous page and use carefully the same plot numbers and order of plots in the following pages.

Household Name:	Household Id. No.:	Interviewer:
-----------------	--------------------	--------------

Land rental and partners in rental market

Have you rented in or out land during the last year? Yes=1 No=0 If no, skip this page.

NB! Keep plot number the same as in land certificate and the following list of plots

Plot No.	Plot Name	Tenure status	Rented-in plot		Rented-out plot		Reasons for renting out	If the plot is transacted, details about rental partners				
			2000 1=yes 0=no	2001 1=yes 0=no	2000 1=yes 0=no	2001 1=yes 0=no		Name	Relationship	Kushet	How long has the contract partnership lasted?	Where rental partner lives

Tenure status: 1.Own land with certificate, 2.Own land without certificate, 3.Rented in, 4.Transferred, 5.Inherited, 6.

Other,specify:

Reasons for renting out: 1= lack of labour, 2= lack of oxen, 3= unable to rent oxen, 4=lack of cash, 5= credit obligation, 6=other, specify...

Relationship: 1=husband's close relative, 2=wife's close relative, 3=distant relative, 4=ex-husband/ex-wife, , 5= non-relative, 6=Son/Daughter, 7=other, specify,

Where rental partner lives: 1= within the kushet, 2= within the tabia, 3= A closer tabia, 3= distant tabia, 4= other, specify.

How long: How many years has the contract partnership lasted

Household Name:	Household Id. No.:	Interviewer:
-----------------	--------------------	--------------

Land characteristics

! Keep plot number the same as in land certificate and the following list of plots

Plot No.	Plot Name	Irrigated? 1=yes, 0=no	Soil Type	Soil Depth	Slope	Land quality	Weed infestation	Susceptibility to erosion	Degree of soil erosion /degradation
Codes: a) Soil type: 1. Baekel, 2. Walka, 3. Hutsa, 4. Mekeyih, Soil depth: 1. Shallow, 2. Medium, 3. Deep									
Slope: 1. Meda, 2. Tedafat (foothill), 3. Daget (midhill), 4. Gedel (steep hill)									
Land quality: 1. Poor, 2. Medium, 3. Good, Weed infestation: 1. High, 2. Medium, 3. Low									
Susceptibility to erosion: 1. High, 2. Medium, 3. Low, 4. None									
Degree of degradation: 1. Highly degraded, 2. Degraded, 3. Moderately degraded, 4. No degradation									

Number of Visits to Plot (May 2001 – May 2002)

Plot No.	Plot Name	Land preparation		Planting		Manuring /Fertilization		Weeding		Inspecting/ (scaring birds)		Harvesting		Threshing		If landlord, monitoring visit		Total No. of visits	No. of Sole visits
		No.	Who	No.	Who	No.	Who	No.	Who	No.	Who	No.	Who	No.	Who	No.	Who		

No: Number of Visits

Who: Persons visited the plot: 1= Husband, 2= Wife/female head, 3= Husband and wife, 4= Husband and Son, 5= Others, specify __

Land market participation

Fill in if household has participated in the land rental market (including sharecropping in or out) during the last year.

! Keep plot number the same as in land certificate and the following list of plots

Household No.:										Interviewer:								
HH name										Data of Interview:								
Kushet:										Woreda:								
Tabia:										Zone:						Who decides		
2006 plot no	Plot Name	Land rental markets								Byproducts, who get them?			Responsibilities			Contract type	Crop choice	Share rate/Rent
		Contract	Type	Duration	If duration > 3 yrs, specify	Payment	Advance payment	Paid when	Cost-sharing arrangement	Crop residues	Manure	Grain	New SWC	Maintain SWC	Pay land tax			
<p>Contract: 1. Fixed rent (cash), 2. Fixed rent (Kind), 3. Sharecropping (output only), 4. Cost sharing, 5. Output sharing after deduction of (cash) input costs, 6. Other, specify: _____ Type: 1. Oral without witness, 2. Oral with witness, 3. Written and unreported. 4. Written and reported to tabia.</p> <p>Duration: 1. 1 year, 2- 2 years, 3. 3 years, 4. >3 years, specify....., 5. Open ended.</p> <p>Payment: Fixed rent: cash amount, Sharecropping: Share of output to the landlord (Code: 1. 50%, 2. 33%, 3. 25%, other, specify:.....)</p> <p>Advance payment: Cash amount in sharecropping contracts.</p> <p>Paid when: 1. Before cultivation, 2. After harvest, 3. Other, specify:.....</p> <p>Costsharing arrangement: 1. Landlord pays fertilizer and seed, 2. Landlord and tenant share cash input costs, 3. Other, specify:.....</p> <p>Byproducts, who gets them/Responsibilities/Who decides: 1.Landlord, 2.Tenant, 3.Shared, 4. Open</p> <p>Crop choice: 1. Landlord, 2. Tenant, 3. Follow following crop rotation system (specify):</p>																		

Crop production and input use

Plot no.	Sub-plot	Season	Plot Name	Crop grown	Area planted	crop output Kg	Seeds		Manure in Kg	Urea in Kg	Dap in Kg	Herb and pesticide Birr	Number of labor man days					Oxen
							Type	Kg					Plowing	Weeding	Harvesting	Threshing	hired labor	

Season: 1=Meher (rainy season, 2=Dry season 1 (irrigated land), 3=Dry season 2 (irrigated land)
 Crops grown: C1. Barley, C2. Wheat, C3. Teff, C4. Maize, C5. Millet, C6. Sorghum, C7. Field pea, C8. Bean, C9. Linseed, C10. Lentil, C11. Hanfets
 Vegetables: V1. Onion, V2. Potato, V3. Tomato, V4. Letus, V5. Cabbage, V6. Carrot, V7. Pepper, V8. Others
 Perennials: P1. Orange, P2. Banana, P3. Eucalyptus, P4. Guava, P5. Papaya, P6. Coffee, P7. Others, Specify.....
 Seed type: 1. Improved, 2. Local, 3. Others, specify
 Oxen: 1. Own oxen, 2. Shared oxen, 3. Oxen exchange with labour, 4. Borrowed oxen, 5. Rented oxen for cash, 6. Other, specify:

Appendix VI. Health Questionnaire

Household Name:	Interviewer:
Household Id. No.:	Date of Interview:
Kushet:	Woreda:
Tabia:	Zone:

hh	Checklist (1998) ¹ (1)yes (2) no	Type of disease	Total time sick, in terms of days	Unable To work (Total time) in terms of days	Measures taken	Successes	Did you make prevention before you get sick				Treatment			How did you pay for the		
							(1)Yes		(2) no		Medical Cost (price of the medicine)	Transportation		Total treatment Cost	Prevention	Treatment
							(1) yes	how much did you pay?	(2) no	why ?		Distance To nearest health centre (in terms of minutes)	Transportation cost			

House hold: house hold head, then the wife if the household is not female headed, then the continue by age, finally relatives

Type of diseases. (1) Malaria, (2) Tuberculosis, including Respiratory problems, (3) HIV/AIDS (4) Diarrhea, (6) Malnutrition, (7) Cancer, (8) Meningitis, (9)eye problem, (10)ear problem (11)goitre (12)Other (please specify) _____, (-98) Don't know/Not Sure

Measures taken (1)use traditional treatment, (2)go to nearest health centre, (3) prevention (4)nothing, (5)others, please specify _____, (98) don't know **Success**, (1) successful (2) not successful

why? (1) too poor, (2) less expectation of illness (3)less malnutrition (4)never been seriously ill before (5)others, please specify _____ (98) don't know

How did you pay? (1)from own pocket (2)selling assets (3)credit from institutions (4)credit from money lenders (5)credit from relatives (7)others, please specify _____.

¹ have you been ill this year

Household Name:	Interviewer:
Household Id. No.:	Date of Interview:
Kushet:	Woreda:
Tabia:	Zone:

hh	Type of disease	If credit			If sale of asset				If less serious		If most serious		Who took over the duty	If hired in labor (<i>Strictly for adults, 16 and above</i>)				Taking care of the sick		
		From whom	How much	Interest rate	kind	Quantity	Unit price	Total price	Where To Be treated	why	Where To Be treated	Why		Quantity	For How long	Price per unit	Total cost	who	For how long	Expected loss of income

Credit from whom: (1) Family/friends, (2) moneylender, (3) bank or credit institution, (4) others, please specify _____ (98)don't know

Source where to be treated : (1)self-treatment, (2) pharmacy, (3) commune health center (4) polyclinic, (5)private physician, (6) hospital, (7) traditional physician, (8) health insurance clinic, (9)other, Specify _____, (98)don't know/not sure,

Why: (1) cheap price (2) free of charge for the poor (3) health insurance (4) drug availability (5) reputation (6) near the house (7) short waiting time (8) good quality of consultation (9) good attitude of staff (10) operating hours (11) home visitations (12)treatment options (13)others, please specify _____

Who took the duty of the sick? (o) no one (1)hired labour (3) adult family member (4) teenage family member² (5)relatives, (6) others, please specify _____

Who take care of the sick (1)adult relative, (2)teenage relative (3)adult family member (4)teenage family member (5)no one (6) others, please specify _____ (98)don't know

² Teenager is from 11-17

Household Name:	Interviewer:
Household Id. No.:	Date of Interview:
Kushet:	Woreda:
Tabia:	Zone:

General health status of the area

1. I am going to read a list of projects that the government could implement if it received more foreign aid. Which one would you most prefer the government to spend money on? ³	Rank		
2. When was the most recent time you or a household member went to a health care facility for health care? (Read all responses before taking answer, 1 response permitted)			
3. In the past 6 months, how often have you and other household members visited a health care facility for health care? (Spontaneous responses; 1 response permitted)			
4. How would you describe the health status of your household compared to the health status of other households in your village?			
5. What do you think is the most important disease in your village? ⁴	Rank		

1. (1) Increase supply of drugs for health clinic, (2) Increase the supply of supplies, books and equipment for the schools, (3) Ensure an adequate, safe drinking water supply for each household in Tigray, (4) Increase malaria control programs, (5) Improve credit programs, (6) Provide irrigation systems to water crops, (7) hydro electric power, (-98) Don't know/Not sure, (-95): Other (please specify) _____⁵,
2. (1) Within the past week, (2) Between 1 and 4 weeks ago, (3) Between 1 and 2 months ago, (4) between 3 and 6 months ago, (5) more than 6 months, (-98) don't know/not sure,
3. Times (enter number of times respondent gives), (1) few times (2-3 times), (2) Several times (4 and above), (-98) don't know/not sure,
4. (2) Much better, (1) Better, (0) About the same, (-1) Worse, (-2) Much worse, (-98) Don't know/Not sure
5. **Type of diseases** . (1) Malaria, (2) Tuberculosis including Respiratory problems, (3) HIV/AIDS (4) Diarrhea, (6) Malnutrition, (7) Cancer, (8) Meningitis, (9) eye problem, (10) ear problem (11) goitre (12) Other (please specify) _____, (-98) Don't know/Not Sure

³ Enumerator: Mark according to their response, rank them

⁴ Enumerator: Do not read list of responses. Record responses only, Mark according to the rank

⁵ diseases from low water quality

Household Name:	Interviewer:
Household Id. No.:	Date of Interview:
Kushet:	Woreda:
Tabia:	Zone:

Child health under 15 years of age

Household under 15	Name	Age	Sex	Malnutrition	
				Height in Cm	Weight in Kg