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ESSAYS ON MICROFINANCE, COOPERATIVES AND THEIR IMPACT ON SMALLHOLDERS' AGRICULTURAL TECHNOLOGY USE AND EFFICIENCY IN ETHIOPIA

A dissertation submitted to the doctoral school of local development and global dynamics in partial fulfillment of the requirements for the Doctoral degree (Ph.D.) in Local Development and Global Dynamics

GASHAW TADESSE ABATE

December, 2014

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To my mother **Dehnaye Bayabil**

and

my father **Tadesse Abate**

ABSTRACT

Financial constraints and limited access to markets are the most important obstacles for economic development in developing economies that are largely dependent on agriculture. Lack of access to credit and output markets, in particular, is frequently identified as a key barrier to transformation of subsistence agriculture. The fundamental problems are related to information asymmetry, lack of collateral and limited economies of scale. Innovative institutional mechanisms, in the form of microfinance and producer organizations, offer ways to address information asymmetry and increase scale economies. This dissertation examines the outreach, financial performance and impact of microfinance institutions as well as the key drivers of agricultural cooperatives and its impact on smallholder farmers efficiency in Ethiopia. To meet these objectives four data sets from Ethiopia, one institutional and three household survey data, are used.

The analysis of microfinance generally focuses on examining the trade-offs between outreach to the poor and financial sustainability by ownership forms (shareholder-owned vs. member-owned). The outreach-financial sustainability trade-offs analyzed first using the institutional survey data. The empirical results show that serving the poor and financial sustainability are challenging objectives to achieve together. There is also evidence that suggests the presence of mission drift. Second, the role of ownership form on outreach, financial performance and cost-efficiency is analyzed within the framework of efficient ownership assignment theories using regression and stochastic cost frontier approaches. This analysis aims at testing whether the commonly held proposition of greater efficiency of shareholder firms in microfinance by policy advocates is empirically supported. The results reject the superiority of shareholder-owned microfinance over financial cooperatives. In fact, the evidence here supports the advantages of member-owned microfinance on cost-efficiency and balancing the double bottom-lines of microfinance. Third, the impact of access to microfinance credit on farmers investment on agricultural inputs is assessed using propensity score matching (PSM) and control-function-regression methods that address potential participation selection biases. Results from both approaches show that access to credit increased the use of productivity enhancing inputs among borrower farmers. Indeed, farmers that borrow from financial cooperatives tend to invest more on modern inputs.

The analysis of agricultural cooperatives tested theoretical propositions from organizational and the new institutional economics theories on the drivers of agricultural cooperatives incidence and farmers membership and patronage decisions. Discrete choice models are employed for the empirical analysis. The results indicate that the incidence of agricultural cooperatives in Ethiopia is more related to the countervailing market power argument than to the transaction cost reduction hypothesis. Despite open membership polices, the analysis on farmers

participation indicates that membership and patronage decisions are related and significantly influenced by location, asset and relational specificities. Finally, the impact analysis estimated technical efficiency gains of membership in agricultural cooperatives and employed matching and stochastic production frontier techniques. The evidence suggests that membership in agricultural cooperatives significantly enhances efficiency gains among smallholder farmers.

Keywords: Microfinance, financial cooperatives, outreach, financial sustainability, trade-offs, impact, ownership form, agricultural technologies, agricultural cooperatives, countervailing market power, economizing transaction costs, membership and patronage decisions, technical efficiency, cost efficiency, propensity score matching, stochastic cost and production frontier, double discrete choice model, Ethiopia.

RIASSUNTO

I vincoli finanziari e l'accesso limitato al mercato sono gli ostacoli maggiori per lo sviluppo economico dei paesi in via di sviluppo, che dipendono in larga misura dall'agricoltura. La mancanza di accesso ai mercati del credito e dei prodotti, in particolare, è spesso identificato come uno degli ostacoli principali per la transizione da un'agricoltura di sussistenza. I problemi fondamentali sono l'asimmetria informativa, la mancanza di garanzie e le limitate economie di scala. Meccanismi istituzionali innovativi, come le organizzazioni di microfinanza e di produttori, offrono delle soluzioni per affrontare le suddette asimmetrie informative e aumentare le economie di scala. Questa tesi esamina le istituzioni di microfinanza attraverso il loro raggio d'azione, le performance finanziarie e il loro impatto, ma anche i fattori chiave della performance delle cooperative agricole e l'impatto sull'efficienza dei piccoli agricoltori in Etiopia. Per raggiungere questi obiettivi sono stati esaminati quattro dataset sull'Etiopia, uno sulle organizzazioni e tre di questionari alle famiglie.

Lo studio della microfinanza si concentra generalmente sull'esame dei trade-off tra l'impatto sulle fasce più povere e la sostenibilità economica delle forme di proprietà (azionisti vs. soci). I trade-off tra la capacità di servire anche le fasce più deboli della popolazione e la sostenibilità economica vengono analizzati utilizzando i dati sulle organizzazioni. In primo luogo, i risultati empirici mostrano che rivolgersi ai più poveri e mantenere la sostenibilità finanziaria sono obiettivi impegnativi da raggiungere contemporaneamente, e i dati mostrano un allontanamento dalla missione originaria. In secondo luogo, il ruolo della forma di proprietà su impatto, performance finanziaria ed efficienza viene analizzato nel quadro delle teorie di assegnazione efficiente dei diritti di proprietà utilizzando gli approcci della regressione e dei costi di frontiera stocastici. Questa analisi mira a verificare se la maggiore efficienza delle imprese con azionisti anche nel settore della microfinanza propugnata dai loro sostenitori sia empiricamente supportata. I risultati negano la superiorità della microfinanza gestita da società per azioni rispetto alle

cooperative di credito. Anzi, da questo lavoro emergono i vantaggi di una microfinanza gestita da organizzazioni di proprietà dei loro soci in termini di efficienza e di capacità di bilanciare la doppia bottom- line della microfinanza. In terzo luogo, l'impatto dell'accesso al microcredito sugli investimenti degli agricoltori in risorse agricole viene valutata utilizzando la propensity score matching (PSM), e i metodi control-function-regression che affrontano i potenziali errori di selezione dei partecipanti. I risultati di entrambi gli approcci mostrano come l'accesso al credito abbia aumentato lacquisto di input più produttivi. Infatti, gli agricoltori che prendono prestiti da cooperative di credito tendono a investire di più in metodi di produzione più avanzati.

L'analisi delle cooperative agricole ha testato le affermazioni teoriche delleconomia organizzativa e neo-istituzionalista riguardo ai driver dell'incidenza delle cooperative agricole e sulle decisioni degli agricoltori in merito a quali istituti di credito rapportarsi come soci o come clienti. I modelli di scelta discreta sono impiegati per l'analisi empirica. I risultati indicano che l'incidenza di cooperative agricole in Etiopia è più legata alla questione del 'potere di bilanciamento del mercato' che all'ipotesi della 'riduzione dei costi di transazione'. Nonostante le politiche di adesione libera, l'analisi della partecipazione degli agricoltori indica che la scelta di usufruire dei servizi o diventare soci è legata e significativamente influenzata da posizione geografica, asset e specificità relazionali. Infine, l'analisi dell'impatto ha stimato guadagni di efficienza tecnica grazie all'appartenenza a cooperative agricole e ha utilizzato tecniche di stochastic production frontier. I risultati indicano che l'appartenenza a cooperative agricole migliora in modo significativo i guadagni in termini di efficienza per i piccoli agricoltori.

Parole chiave: Microfinanza, cooperative di credito, outreach, sostenibilità economica, trade-off, impatto, forma proprietaria, tecnologie agricole, cooperative agricole, contropotere di mercato, economizzare i costi di transazione, l'appartenenza e le decisioni clientelari, efficienza tecnica, efficienza dei costi, , propensity score matching, stochastic cost and production frontier, double discrete choice model, Etiopia.

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Gashaw Tadesse Abate

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1 INTRODUCTION

1.1 BACKGROUND

The role of access to finance and markets in smallholder agriculture development has received considerable attention among policy makers and academicians over the last three to four decades. Following the contributions of Hansmann (1996), Staatz (1987), Bonus (1986), Stiglitz and Weiss (1981), and Akerlof (1970), among others, significant advances were made in designing policies to better link smallholder farmers and farmer organizations to institutional finance providers. Strides were made in reducing transaction costs for farmers in developing countries seeking finance or participating in agricultural input and output markets, in filling missing markets, and in overcoming problems related to information asymmetry within agricultural and financial markets. The most notable developments were the revolution of microfinance institutions[1] in rural financial markets and the revival of agricultural cooperatives as a key factor in fostering improved input supply and in undertaking product aggregation and marketing functions.

Before the blossoming of rural microfinance institutions, the principal way in which smallholder farmers were offered financial support was through subsidized credit packages offered through specialized state-owned development banks. While subsidized credit has played a crucial role to kick-start rural financial markets in some developing economies (Dorward et al., 2004), direct subsidies have been criticized for generating allocative inefficiencies and failing to achieve their primary goal of overcoming the credit constraints facing small-scale farmers, mainly due to elite capture and poor repayment rate (Binswanger et al., 1993; Adams et al., 1984; von Pischke and Adams, 1983; Adams and Graham, 1981). The dissatisfaction with subsidized credit schemes, coupled with the economic structural reforms, made in most developing countries during 1980s, led to a significant reduction in state involvement in rural financial markets and the dissolution of many state-owned development banks. This, in turn, resulted in a paradigm shift in how rural financial services were provided to farmers; from credit subsides to a more market-oriented approach that priced financial products and services to cover costs and associated risks (Meyer, 2011; Conning and Udry, 2005).

1 Note that the phrase microfinance institutions in this dissertation is used in its broader meaning and includes non-bank financial institutions (NBFIs), financial cooperatives, saving groups, and village banks that provide micro-credit, savings, and insurance services for members.

The new paradigm guided a revival of formal rural financial services across many developing countries. Financial cooperatives and non-bank financial institutions (NBFIs) made inroads in rural financial markets with loans tailored and customized to the seasonal needs of smallholder farmers. These new institutions disproved the earlier conventional belief that the poor are neither creditworthy nor are they able to save. Through their innovative loan terms the new rural financial institutions demonstrated that the rural poor can borrow, pay substantial interest rates, and save continuously (Morduch, 1999). Innovations such as providing loans to a group in which all members are jointly liable for servicing the loan and structuring a dual role for members of financial cooperatives both as providers of the demand for loans and suppliers of loanable funds. These innovations created suitable screening and monitoring mechanisms for individual borrowers, which enabled the lending institutions to inexpensively address many common information and enforcement challenges associated with microlending. The success of microfinance institutions in overcoming these information and enforcement costs also rests on their use of progressive lending and the promise of future loans to the borrower (i.e., dynamic incentive) as a tool to discourage strategic defaults. Starting with very small loans and gradually increasing loan sizes as borrowers demonstrate reliability enable the lending institutions to systematically increase the opportunity costs for the borrower of non-repayment (Galariotis et al., 2011; Tedeschi, 2005; Besley, 1995).

In general, the use of social collateral by microfinance providers to mitigate the information and enforcement costs they face in serving resource poor borrowers is largely considered a breakthrough for micro-banking and resulted in greater optimism for improving rural financial markets in developing countries. However, translating the gains from innovative loan conditions that result in high repayment rates into profits or surplus earnings to enable the microfinance institutions to sustain themselves as viable businesses is a challenge that is not yet mastered (Morduch, 1999). Moreover, there is still debate on whether microfinance providers can be financially self-sufficient while serving the poor. Some researchers see an inevitable trade-off between financial sustainability and outreach to the poor (see Herms et al., 2011; Armendáriz de Aghion and Szafarz, 2009; Cull et al., 2007). Conversely, others claim to have found self-sufficient microfinance institutions in serving the poor (Quayes, 2012). Nonetheless, most such studies focus largely on the effect of loan terms (e.g., individual vs., group) on market contract costs. They pay little attention to how the ownership of a micro-finance institution is organized and practiced and how it affects the costs of microfinance delivery (i.e., ownership costs).

One of the particular interests of this dissertation is, therefore, understanding the trade-offs between microfinance outreach and the commercial sustainability of the microfinance institution across different form of ownership. Particular emphasis is given to financial cooperatives and specialized non-bank financial institutions (NBFIs) as member-owned and shareholder-owned microfinance providers, respectively. Ac-

cording to agency theory, organizations that are owned by agents with pecuniary incentives are better able to reduce agency costs (Jensen and Meckling, 1976). Moreover, when it comes to the provision of microfinance, organizations that are owned by their customers are better able to reduce costs of market contracts (Hansmannn, 1996). While pecuniary incentives can be at a play for both shareholder-owned and member-owned microfinance institutions, the effect of ownership form on the relative costs of market contracts merits empirical investigation. Whether microfinance institutions providing micro-credit, savings services, or insurance services have any impact on the livelihoods of their clients is also a fundamental policy question which remains unsettled.

In addition to finance provision, improving smallholder farmers access to input and output markets is an important topic of discussion in development policy circles following the increasing recognition of the links between productivity gains, smallholder commercialization, and income growth (Fafchamps, 2005; Timmer, 1997; Pingali, 1997). However, pervasive market imperfection and high transaction costs in developing countries often make it difficult for small-scale farmers to fully exploit the potential gains from market participation (Poulton et al., 2005; Key et al., 2000; de Janvry et al., 1991). Although they have proved insufficient, price-based policy interventions for agricultural development have been in place since the 1970s - price stabilization policies until 1980s and policies on getting prices right during 1980s and 1990s - to address market imperfections and to stimulate smallholder market participation (Barrett, 2008; Reardon et al., 1999).

One response to imperfect markets and high transaction costs is organizing marketing groups of farmers to enable the farmers to gain bargaining power in their market transactions (Barrett, 2008; de Janvry et al., 1991; Staatz, 1987). Agricultural cooperatives have been revived over the past decade across developing countries with expectations of increasing smallholder market participation, improving access to productive technologies, better aggregating surplus output, and reducing or sharing transaction costs (Valentinov, 2007; Stockbridge et al., 2003; Rondot and Collion, 1999; Sexton, 1990). Despite their earlier turbulent history of being closely associated with and dominated by state-centered governance regimes, agricultural cooperatives are now being rebuilt in many developing countries. Substantial public development programs and private initiatives are channeled through agricultural cooperatives (Pingali et al., 2005). However, it is still contested as to whether these collective farmer organizations can kindle significant increases in smallholder technology use and market participation.

While there is evidence of reasonable success by agricultural cooperatives in improving smallholders access to productive technologies and generating better terms of trade (Abebaw and Haile, 2013; Bernard et al., 2008; Nyoro and Ngigi, 2007, Hellin et al., 2007; Poulton et al., 2004; among other), their impact on smallholder productivity and output marketing remain unclear. Moreover, empirical studies on what explains

the presence of an agricultural cooperative in a particular location and not in others and drivers of farmers membership and patronage decisions are scarce. Whether agricultural cooperatives are formed mainly to economize transaction costs or to improve bargaining power remains an open question. Therefore, of particular interest in the second part of this dissertation is seeking to explain the incidence of agricultural cooperatives, farmers decisions on membership and use of agricultural cooperatives services and their impact on smallholders technical efficiency.

1.2 PROBLEM STATEMENT

Microfinance institutions have two objectives, viz. outreach to the poor, more specifically, to poor women borrowers; and financial sustainability. During the early stages of the revival in rural microfinance, the potential conflict between achieving financial self-sufficiency while serving the poor was not subject to methodical scrutiny, despite the costs and risks involved in lending to collateral-poor clients. Especially among NBFIs/NGOs, much focus was paid to expanding outreach to the poor using reallocated resources from traditional poverty alleviation programs, with little attention to financial sustainability (Morduch, 1999). As a result, a reliance on subsides to cover start-up costs and to perpetuate financial services by the microfinance institutions was not uncommon, as, in spite of the high repayment rates that resulted from their innovative loan terms, the institutions were seldom able to generate profits.

Recently, however, increased commercialization and competition among microfinance providers coupled with a withdrawal of subsides has drawn attention to the need for financial sustainability in the industry. These developments resulted in a shift in focus from outreach *per se* to outreach and financial sustainability though some observers argue that pursuing financial sustainability alone is the surest way to deliver social impact by microfinance institutions (Christen et al., 1995). Theoretically, pursuing financial sustainability together with serving the poor can be either conflicting or complementary. On the one hand, the two objectives can be in harmony if the financial self-sufficiency requirement induces an improvement in how a microfinance institution allocates its resources and prompts the institution to better attract commercial funds that can be used to expand outreach (Frank, 2008; Ronsengard, 2004). On the other hand, striving for financial sustainability may undermine the social mission of such institutions by crowding-out smaller loans and poor borrowers, as they are more costly to service per unit of funds lent (Weiss and Montgomery, 2005; Hulme and Mosley, 1996).

Empirical understanding on whether the principal objectives of microfinance are inherently in conflict is imperative for guiding policy interventions, as microfinance in most developing countries is promoted to meet the financial needs of the unbanked poor. Failure to achieve wider breadth and deeper outreach in the pursuit of prof-

itability is an issue of policy concern. However, several years after the resurgence of microfinance, empirical evidence on the trade-off between outreach and sustainability is still scarce, and that which exists yields mixed results. Moreover, only few of the empirical studies take into account the form of ownership of the microfinance institution and the effect of this on costs of service delivery. On top of that, most of such studies have overlooked or omitted financial cooperatives in their coverage, even though that in many developing countries cooperatives are the dominant rural microfinance model[2].

While the early commitment to experimentation and innovation can be useful in finding mechanisms for reconciling the two objectives of outreach and sustainability (Morduch, 1999), the underlying question is whether access to microfinance services helps to improve the lives of clients. Like studies of the trade-off between outreach and sustainability, there are only few evaluations on the impact of microfinance services on client welfare that have used systematically chosen treatment and comparison groups within a rigorous methodological framework for evaluation. Those that do exist show a mixed picture of impact. In Ethiopia, which is the focus of this dissertation, there has been no careful evaluation on the impact of microfinance credit on modern input use by small farmers, despite that most of the loans of financial cooperatives and two-third of the loan portfolio of NBFIs are geared to investments related to primary production activities by smallholder farmers (Amha and Peck, 2010). Disaggregated impact evaluations by credit source and lending terms are equally scarce, so there is little understanding of how the impact on clients welfare varies by the type of ownership of the microfinance institution and the loan terms employed.

The gap between theoretical guidance and the empirical evidence on the incidence and impact of agricultural cooperatives is also considerable. Significant progress has been made in theoretically understanding the economic rationale behind the formation of agricultural cooperatives - the existence of agricultural cooperatives is associated with market failure-related grounds. That is, they exist to countervail market power, economize transaction costs, balance costs of market contracts and ownership, achieve gains from economies of scale, and fill missing markets (see Valentinov and Iliopoulos, 2012; Hansmann, 1996; Cook, 1993; Staatz, 1987; Bonus, 1986; Sexton and Iskow, 1988). However, given pervasive market imperfections in agricultural input and output markets across developing countries, the participation in and use of cooperative services in such countries are not anywhere close to what one would expect on a theoretical basis. Empirical evidence on what explains the presence of agricultural cooperatives in a particular community and not in the others and the use of cooperative services by a particular group of farmers and not by others are lagging far behind our theoretical understanding.

2 For instance, in Africa credit unions/cooperatives are the major provider of microfinance services and exceed other providers on number of clients and number of deposit accounts (Gaul, 2011).

Although establishing cooperatives on the basis of theoretically credible economic or social rationales is the gateway towards increasing membership and patronage, assessment of the success of such cooperatives is fundamentally based on a clear understanding of whether the organization helped to achieve its intended goals of stimulating market participation and technology use and improving productivity and efficiency among its farmer-members. Nonetheless, evaluating the impact of agricultural cooperatives is more demanding than most other program evaluations. First, finding a creditable comparison group that represents the scenario that would be in place in the absence of the agricultural cooperative is challenging due to indiscriminate service provision by most such cooperatives. Second, despite similarities in organizational structure and target membership groups, services provided by agricultural cooperatives vary considerably from one cooperative to the other, as they are often established to respond to a particular need or problem. As a result, several decades after the revival of agricultural cooperatives, empirical evidence on their impact on the welfare of their members is very limited.

1.3 RESEARCH QUESTIONS

The main focus of this dissertation is to improve our understanding of microfinance institutions and agricultural cooperatives and their impact on smallholder agriculture development in Ethiopia. To do so, it addresses the following six major research questions.

Is there a trade off between outreach to the poor and institutional sustainability in microfinance? Is it possible for microfinance providers in Ethiopia to serve the poor on a sustainable cost covering basis?

Microfinance institutions in Ethiopia operate in an environment where there are many risks to the livelihoods of their target clients - weather risk, price risk, etc. Moreover, the nature of the clients they serve means that the microfinance institutions entail higher business costs due to the scattered locations and limited financial literacy of the clients. Yet, microfinance institutions are expected to serve such target groups on a cost-covering basis. The assumption is that microfinance providers can transfer the higher costs and associated risks of lending to such clients onto the clients themselves. However, this assertion may not be always true, as charging high interest rates will depress credit demand and adversely affect the financial sustainability of the lending institution. The dissertation examines such claims and seeks to provide answers to such specific questions as: Does raising interest rates exacerbate agency problems that can be detected by lower profitability for the lender? Does serving small loan sizes and focusing on poor borrowers undermine the financial self-sufficiency of microfinance providers?

Are microfinance institutions in Ethiopia reasonably cost efficient, or do their costs include significant avoidable expenses?

One of the greatest challenges facing the microfinance industry is lowering the cost of services. Even several years after the introduction of microfinance, the costs of microfinance lending often are reportedly high, and this often is used as a rationale for charging borrowers higher interest rates. While lowering costs are beneficial for clients and for microfinance institutions through making loans affordable to borrowers, stimulating demand for the services microfinance institutions offer, and consequently improving the financial performance of lenders, microfinance providers often are unable to contain their operating costs. Recent studies on microfinance cost structure documented that of the interest charges borrowers incur, about 62 percent goes into covering the operating expenses of the lending institution (Gonzale, 2007). This dissertation analyzes this issue in the Ethiopian context. It specifically examines whether microfinance providers in Ethiopia are reasonably cost efficient, with little scope for reducing wasteful operating expenses.

What type of form of ownership for a microfinance institution (financial cooperative vs. shareholder or investor owned NBFIs) better balances the two objectives of microfinance - outreach and financial sustainability? How do shareholder owned microfinance institutions in Ethiopia contrast with financial cooperatives on the basis of their cost efficiency?

The institutional modalities in addressing problems of rural financial markets in developing countries through microfinance encompasses a diverse range of organizational designs and ownership forms that are spawned by the common idea of lending to the unbanked poor. These include public owned banks for small and medium enterprises, social venture capital funds, private credit unions, financial cooperatives, shareholder or investor owned microfinance institutions, saving groups, and village banks (Gaul, 2011; Zeller and Johannsen, 2006). These varying forms of microfinance providers have contrasting degrees of ability to reduce and balance costs of establishing and enforcing market contracts and ownership. For instance, theoretically, institutions owned by their customers are better able to reduce costs of establishing market contracts, but may face higher ownership costs. In this dissertation the two main providers of microfinance in Ethiopia, financial cooperatives and shareholder owned NBFIs are compared and contrasted on their cost-efficiency and ability of achieving financial self-sufficiency together and on their ability to serve poor borrowers.

Does access to institutional finance (microfinance credit) improve small farmers agricultural technology adoption and intensity of use in Ethiopia?

Given the crucial roles of agricultural technology use on farm households well-being and poverty alleviation, improved technology adoption rates are very low in sub-Saharan Africa (de Janvry and Sadoulet, 2010). Theoretical and empirical evidence on agricultural technology adoption overwhelmingly report limited credit access as a binding constraint that deters adoption. In Ethiopia, in recent years, most of the loans

of financial cooperatives and two-thirds of the shareholder-owned NBFIs loan portfolio goes to agriculture to encourage smallholders to invest in productivity-enhancing agricultural technologies (Amha and Peck, 2010). This dissertation seeks to estimate the direct impact of microfinance credit access on modern input uptake and use by smallholders in Ethiopia. It also examines the potential impact of heterogeneity in credit provision by explicitly considering the source of the credit and the size of the farm of the borrower.

What explains the incidence of agricultural cooperative in some villages and not in others? What determines smallholders participation and use of cooperative services?

In Ethiopia, like in many other developing countries, establishment of farmers cooperatives as an institutional remedy for agricultural market failure is an accepted policy alternative. Over the last two decades, agricultural cooperatives have been revitalized with rising expectations of playing crucial roles in improving smallholders access to modern inputs, achieving economies of scale through aggregating surplus outputs, and in bargaining better terms of trades for their members. However, despite continuous promotional efforts, their prevalence and farmers participation in them are limited - only about 35 percent of the *kebeles* in the country have agricultural cooperatives and only 17 percent of farmers residing in these *kebeles* are members (Bernard et al., 2008). Nonetheless, our empirical understanding of the rationale for cooperative incidence and the determinants of farmers membership and patronage decisions are limited. To fill this research gap, the dissertation addresses questions such as: What drives the actual existence of agricultural cooperatives in particular places and not in others? Which types of farmers become members and/or users of agricultural cooperatives and why? Is there a link between farm households membership and patronage decisions in relation to agricultural cooperatives?

Does participation in agricultural cooperatives have an impact on smallholders technical efficiency?

Besides modern input supply and commercialization, agricultural cooperatives in Ethiopia are expected to play a role in linking members to agricultural extension services. Most of the agricultural cooperatives are anticipated also to provide information and training to farmers on better agronomic practices. The last chapter of the dissertation evaluates the impact on members technical efficiency of such services by agricultural cooperatives.

1.4 ANALYTICAL APPROACHES AND DATA

Different data sets and empirical methodologies are used to address these research questions. The dissertation uses four data sets that resulted from surveys conducted by the author and by the International Food Policy Research Institute (IFPRI) between

2008 and 2012. The data sets include household, institutional, and community surveys. The methods and data used to address each research question are described in this section.

The first two research questions are about the tension for rural microfinance institutions between lending to the poor and maintaining financial sustainability and about the role of ownership form in realizing these two objectives. An Ordinary Least Square (OLS) regression method is used to describe the correlates of financial self-sufficiency and microfinance outreach. After examining the trade-off between outreach to the poor and institutional sustainability, the analysis uses OLS regression forms that allow factors of interest to vary by microfinance ownership form in order to investigate which type of ownership better balances outreach and financial sustainability in microfinance. Moreover, the study uses a Stochastic Frontier Approach (SFA) to predict cost-efficiency at the microfinance institution level. The one-step stochastic cost frontier suggested by Battese and Coelli (1995) is followed to estimate the cost frontier and inefficiency correlates simultaneously. Institutional data from 107 microfinance providers in Ethiopia (30 shareholder-owned microfinance institutions and 77 financial cooperatives) is used for the empirical analysis.

The third and fifth research questions aim at evaluating the impact of access to institutional finance and participation in agricultural cooperatives on farmers adoption of modern inputs and on farmers technical efficiency, respectively. The investigation of both questions demands a systematic observation of adoption patterns and efficiency levels in the absence of access to finance and cooperative services. Ideally, a randomized experiment would provide such data. Identifying causal impact in the absence of observations on the counterfactual case of no access to institutional finance and no participation in agricultural cooperatives (the set-up on both cases) requires a method that can restore the missing data. The non-parametric Propensity Score Matching (PSM) approach is used to construct the counterfactual based on pre-exposure observable covariates to estimate average effects. The results from PSM are also compared with estimates of control-function-regression models to check the robustness of the results and to obtain insights on the bias reductions obtained from using PSM. Data from a farm household survey conducted by the author (i.e., 820 households) in 2012 is used to address the fourth research question, while data from an agricultural marketing household survey conducted by IFPRI (i.e., 1707 households) in 2008 is used to address the sixth research question.

To address the fifth research question, the analysis used a data set from the 2012 Ethiopian Agricultural Transformation Agency (ATA) baseline survey conducted by IFPRI. The data set includes a survey of 102 agricultural cooperatives, 200 communities or peasant associations, and 3,000 farm households. A flexible probit and seemingly unrelated bivariate probit models are used to analyze the determinants of agri-

cultural cooperative presence in a *kebele* and the participation and use of cooperative services by smallholder farmers.

1.5 OUTLINE OF THE DISSERTATION

Together with the introductory and summary chapters, the dissertation contains seven chapters in two parts. The first part, chapters two to four, focuses on shareholder owned NBFIs, financial cooperatives, and their impact on agriculture technology use by smallholder farmers in Ethiopia. The second part contains the remaining two chapters and focuses on agricultural cooperatives and their role in improving farmers technical efficiency.

The background section provides a description of the landscape of agricultural finance in Ethiopia and the share of agricultural lending in the country accounted for by each type of agricultural finance institution. Chapters two and three give a picture of the outreach, financial performance, and cost-efficiency of microfinance providers in Ethiopia. These include analysis of the trade-offs between outreach to the poor, financial self-sufficiency, and cost-efficiency in microfinance service provisions. The link between interest rates and profitability and the effect on costs of microfinance services delivery of the way ownership is organized and practiced are also explored in these two related chapters. Chapter four evaluates the effects of access to institutional finance (e.g., credit from NBFIs and financial cooperatives) on adoption and uptake of productivity-enhancing agricultural technologies by smallholder farmers in Ethiopia. The impact of access to institutional finance disaggregated by farm size and credit source are also presented in this chapter.

Chapter five presents the results of tests on some of the theoretical economic rationale behind the incidence of agricultural cooperatives. It explores the prevalence of agricultural cooperatives, discusses the locations where agricultural cooperatives primarily are found in Ethiopia, and considers why they are located where they are. It explicitly considers whether agricultural cooperatives are located primarily in remote locations to reduce or share transactions costs where such costs are high or are they located in locations where markets are better developed with good access for bargaining better terms of trades for their members. It also discusses the determinants of household membership and patronage decisions. Chapter six evaluates whether the embedded support services provided by agricultural cooperatives improve the technical efficiency of members. It also depicts the sources of technical inefficiencies for smallholder farmers in Ethiopia, in general. The last chapter summarizes the key findings and conclusions of this dissertation and sets out the implications of these findings for rural microfinance service development and for the promotion of agricultural cooperatives in Ethiopia. Potential future areas of researches on these two thematic topics are also suggested in the last chapter.

Part I

MICROFINANCE SERVICE PROVIDERS IN ETHIOPIA: OUTREACH, FINANCIAL PERFORMANCE AND IMPACT - BACKGROUND

The first part of this dissertation focuses on microfinance services providers in Ethiopia. It examines their depth of outreach, financial performance and impact on smallholders agricultural investment in the country. It also investigate the roles of microfinance ownership and organizational form on cost-efficiency in serving the poor using data from financial cooperatives and shareholder owned Non-Bank-Financial Institutions (NBFIs), the most widespread microfinance services providers in Ethiopia. To give readers a background for the following three chapters that belongs to the first part of the dissertation, this section discuss a brief account on the status of financial inclusion and the roles played by microfinance institutions towards the process of building inclusive financial sector in Ethiopia.

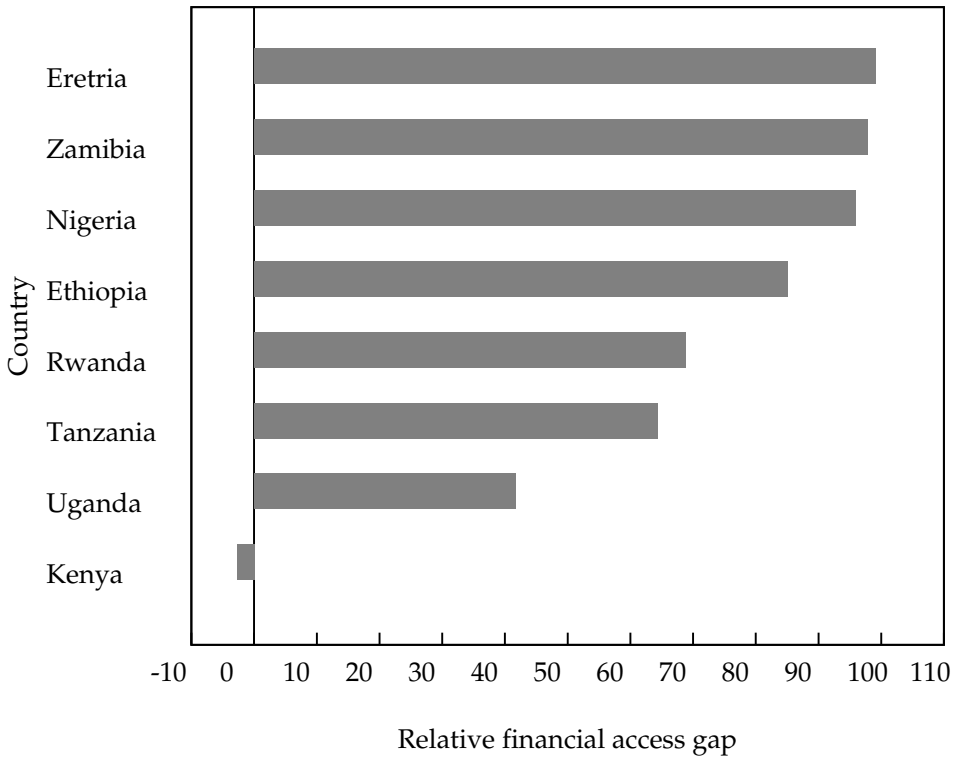
ACCESS TO FINANCIAL SERVICES IN ETHIOPIA

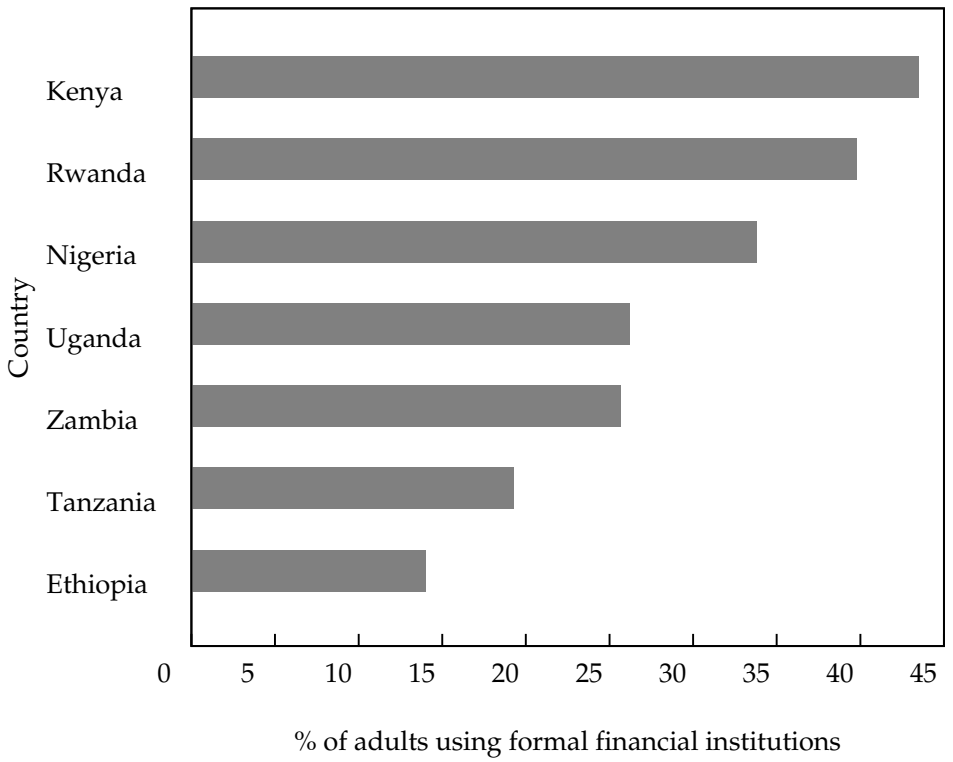
It is widely recognized that a well-developed financial system is vital to stimulate economic growth through facilitating allocation of resources to its most productive use. Availability of financial services like credit, saving, payment and insurance products trigger investments, spread risks and facilitate ease of exchanges. Broader and inclusive financial system that overcomes price and non-price barriers in particular benefits the poor segment of the population who are often systematically excluded from accessing financial services (Demirgyc-Kunt and Klapper, 2012).

In recent decade, like other developing countries, Ethiopia experienced a positive development in dealing with financial access obstacles and expanding financial services to the poor compared to the pre-reform periods. Before the economic reform in 1991 the financial sector in Ethiopia was under state control, with no or little institutional independence. The lack of institutional autonomy during those periods has been a barrier to inclusive financial provisions. In particular during the socialist regime, nationalization of financial institutions and direct state control over credit allocations seriously undermine individuals access to financial services in the country. For instance, over the ten year period before the economic reform the share of private credit (which includes private business and individuals) was only 8.3 percent, while the government and state enterprise loans accounts for the difference (see Geda, 2006; Admassie, 1987). It is only later after the economic reform important policy changes have taken place in the financial sector that allow the establishment of private owned domestic banks and liberalized interest rates with a floor for deposit and ceiling lending rates. In recent decades, the entry of domestic private banks in the financial sector coupled with the expansion and downsizing of commercial banks in rural areas, the revolution of microfinance institutions, and the revival of financial cooperatives fairly expand access to financial services in the country.

Nonetheless, the financial sector in Ethiopia still remains under-developed as compared to other developing countries. Financial depth and size indicators show a significance access gap that entails considerable efforts towards building an inclusive financial sector in the country. For example, liquid liabilities to GDP, a common measure of financial depth and overall size of the financial sector, are reported 35.9 and 44.6 percent in 2000 and 2007, respectively. Despite relatively low GDP, the ratio of private credit to GDP is only 19.1 percent compared with 24 percent for Sub-Saharan Africa and 77 percent for all developing economies (Trading Economics, accessed on October 29, 2013; Demirgyc-Kunt and Klapper, 2012; Kiyota et al., 2007). Moreover, Ethiopias gross domestic saving rate is estimated only 3.6 percent, the lowest in East African region (Kiyota et al., 2007) and recent diagnostic study on Ethiopian financial sector indicated a USD 3 billion unmet credit demand in the country (Amha and Peck, 2010).

Access and use of financial products and services by individual adults also indicates lower rates of financial penetrations in Ethiopia. Recent financial inclusion data from the World Bank plotted in Figure 1.1 shows that only 14 percents of adults in the country use formal financial institutions, the lowest compared to neighboring benchmark countries. The relative financial access gap measure that take into account individuals poverty status by Gaul (2011) also shows that in Ethiopia the size of population living below the national poverty line exceed total accounts in the country by about 85 percent (Figure 1.1), implying limited access and use of formal financial institutions. Access to financial services by rural population is even more limited, as most of the banks are clustered in the urban areas. Recent estimates show that only one percent of the rural households have accounts in formal financial institutions and number of bank branches per 100,000 rural adult population is 0.8 (i.e., one branch for about 125,000 rural adults) compared with 45,000 adult population per branch for urban areas (World Bank, 2012).

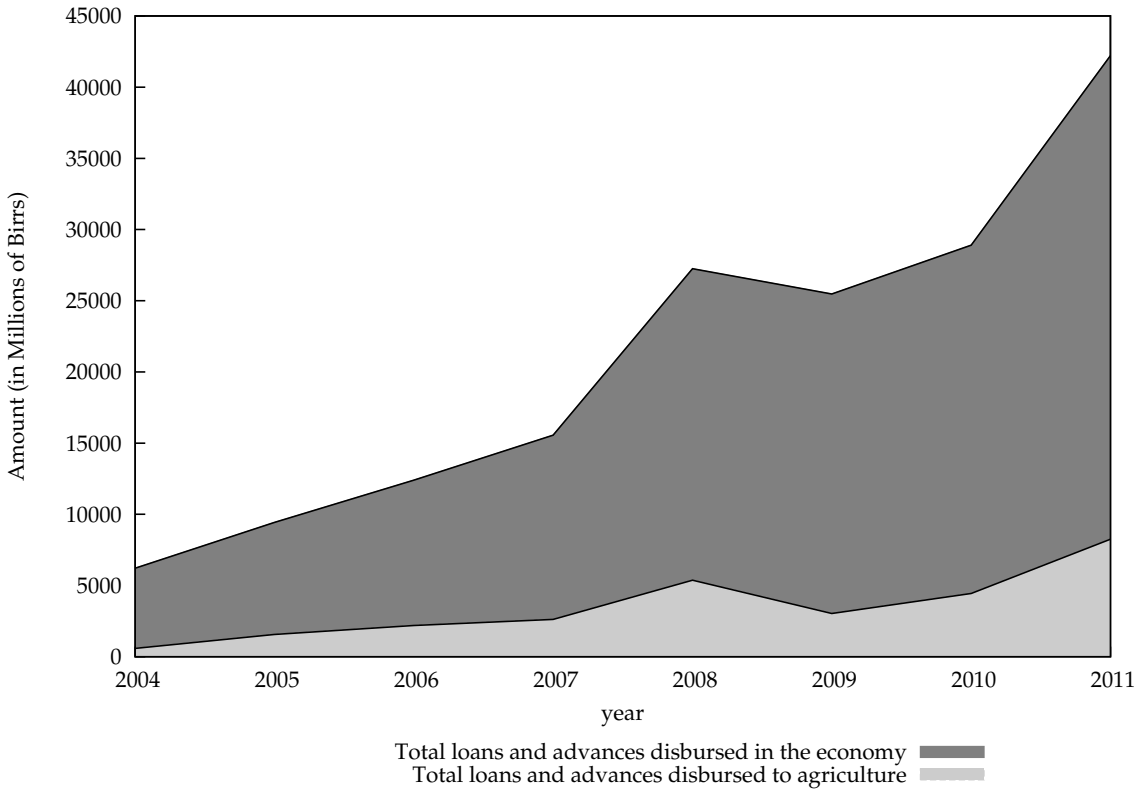




Source: World Bank Global Findex data (2012); World Bank Agribusiness Indicators: Ethiopia (2012); and Gaul (2011).

Figure 1.1: Percentage of adults using formal financial institutions and relative financial access gap, 2011.

Data on domestic loans and advances by sector of the economy further indicates that the rural agricultural sector is the most affected by the aforementioned credit crunch and limited access to financial services compared to other sectors in the economy. The proportion of domestic credit channeled to the agricultural sector is very limited despite the fact that the sector account for about 41 percent of the countys GDP. Figure 1.2 shows the total domestic credit and share of agricultural credit during the last eight years. Over these years the share of agricultural credit averaged only 9 percent. Even though lending volume has been increasing in nominal terms (albeit marginally), its share didn't exceed a maximum of 14 percent. Moreover, studies indicated that significant proportion of the agricultural loans is allocated to agricultural investments related to internationally traded commodities. Only small fraction of the commercial lending to agriculture goes to individual farmers for primary production activities (World Bank, 2012). Individual farmers looking for financial services heavily relay either on microfinance institutions (i.e., financial cooperatives, shareholder NBFIs, village banks, etc.) or on the informal financial sector.



Source: National Bank of Ethiopia, annual reports-various issues (2004-2011).

Figure 1.2: Total and agricultural loans and advances disbursed, 2004-2011.

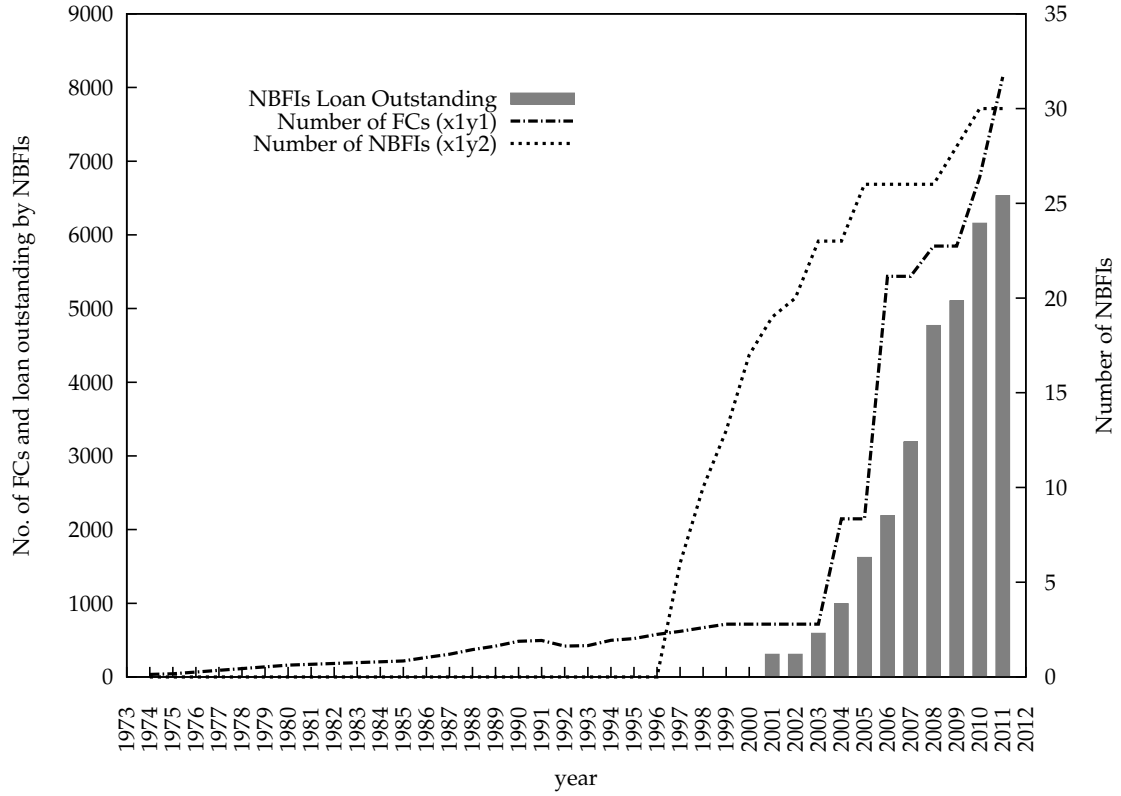
THE MICROFINANCE LANDSCAPE IN ETHIOPIA

In Ethiopia, as noted above, mainstream commercial financial institutions are not only unwilling, but they also lack the capacity to serve the needs of the poor (Amha, 2007). Financial services to the poor are largely delivered by the microfinance industry, which is mainly made up of services rendered by financial cooperatives, non-governmental organizations (NGOs) and shareholder owned NBFIs. Financial cooperatives are the forerunners in delivering financial services for the poor excluded by conventional financial institutions. Financial cooperatives in Ethiopia are notable both in lending small uncollateralized loans, saving mobilization, and in inculcating the importance of financial services in the society at large (Degefe and Nega, 2000). Despite a weakening of cooperative activities in the country during the economic reforms in the early1990s, financial cooperatives were among the most resilient cooperative institutions and generally survived the reform and have grown steadily subsequently.

As shown in Figure 1.3, the spread of financial cooperatives has grown over the period since 1974. It grows sharply from 2003 onwards, right after the establishment of the Federal Cooperative Commission, a public body organized with the aim of revitalizing cooperative businesses in the country. Currently, about 42 saving and credit unions and over 7,000 primary saving and credit cooperatives reportedly are providing microfinance services (i.e., saving, loan and insurance) for about one million members in the country (Federal Cooperatives Agency, 2012). Similar to most credit cooperatives elsewhere, financial cooperatives in Ethiopia are organized by individuals (i.e., farmers, laborers, employees, etc.) working or living in the same localities. They mainly use standard bilateral lending contracts between the cooperative and a member borrower. Liability for repaying the loan rests with the individual borrower and the co-signer, who is also a member of the same cooperative. In most cases, the savings of the borrower and the co-signer serve as a guarantee for loan - they are savings-led in their approach. In terms of market share, however, financial cooperatives in Ethiopia account for only less than one percent of the total credit in the economy, very low compared to NBFIs, on the contrary to the global scenario where credit union/cooperatives surpass other providers of microfinance both in number of clients, loans and deposit accounts (Gaul, 2011; Amha and Peck, 2010).

Besides the role played by financial cooperatives, the development of microfinance in Ethiopia also counts on efforts made by international NGOs, local NGOs, and government credit programs that integrate credit services in their development and relief schemes to bring sustainable improvement to the welfare of their beneficiaries. History teaches us that the involvements of the government and NGOs in credit delivery have been encouraging in terms of poverty reduction. Nevertheless, poor financial discipline and distorted resource allocation by NGOs and government credit programs have been equally substantial. Interest rate subsidies, debt write-off, and equating

loans with humanitarian assistance by the NGOs were among the distortions which have indoctrinated a bad credit culture - a culture of entitlement - that undermines the development micro-credit markets in Ethiopia today (Amha, 2007; Degefe and Nega, 2000).



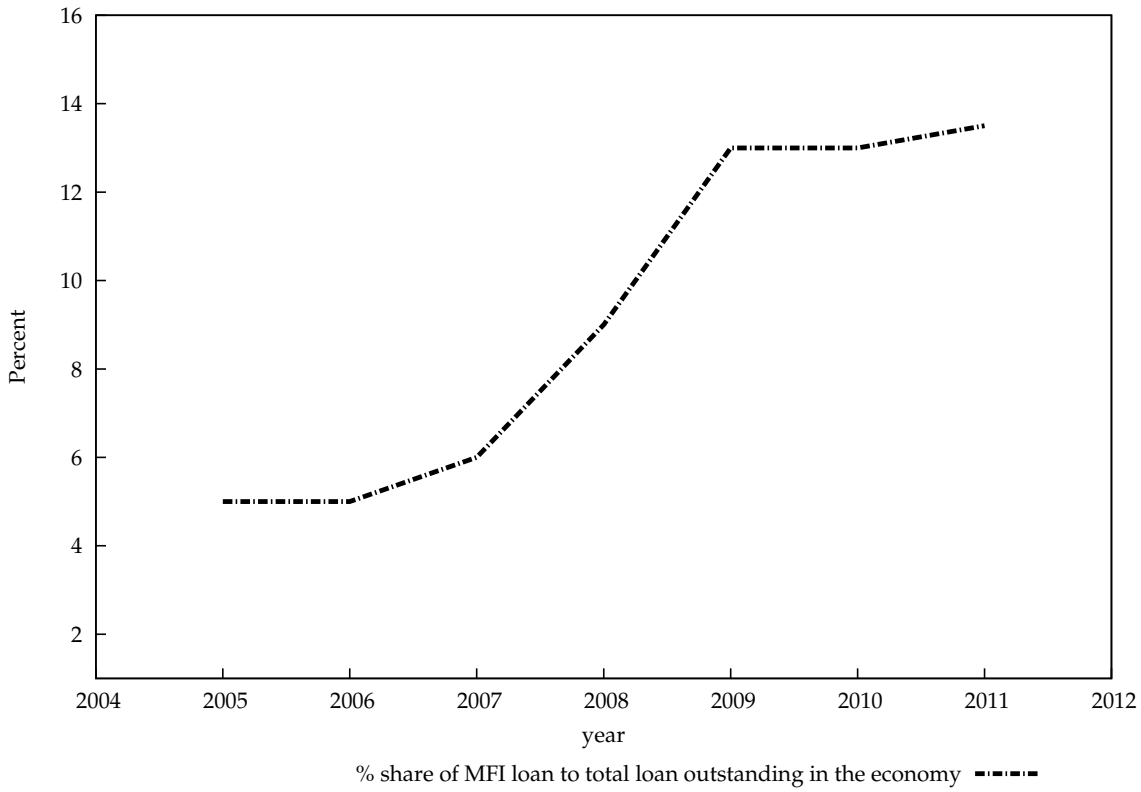
Note: the left hand axes represent number of financial cooperatives and volume of loan outstanding by NBFIs. The right hand axes stands for number of financial cooperatives.

Source: Federal Cooperative Agency (2012); Association of Ethiopian Microfinance Institutions (2012); Ethiopian Economic Association (2000).

Figure 1.3: Number of microfinance institutions in Ethiopia and volume of loans outstanding, by organizational form.

Following the economic reform in 1991, some of the NGO and government pilot credit programs engaged in financial intermediation transformed into formal (specialized or non-bank) microfinance institutions. The transformation was made mainly to reverse the bad credit culture instituted by NGOs and state credit programs. This was done through establishing efficient microfinance institutions that adhere to the market mechanism while serving the poor. Nonetheless, the involvement of regional governments and mother NGOs as contributors of ownership equity that impacts

decision-making powers is still prevalent. In addition to the NBFIs evolved from prior NGOs and government credit programs, the industry also witnessed new start-ups of investor-owned microfinance providers. As of 2011, a total of 30 NBFIs in Ethiopia reported reaching over 2.3 million clients, with total loans outstanding of 6.5 billion *birr* - about $365 million (Figure 1.3). Altogether they account about 13 percent of the total loan outstanding in the economy (Figure 1.4) and two-third of their loan portfolio geared to smallholder agriculture, with government-owned microfinance institutions representing the lion share (Amha and Peck, 2010).



Source: National Bank of Ethiopia, annual reports-various issues (2004-2011).

Figure 1.4: MFIs loans as percentage of total loan disbursements and outstanding in the economy.

NBFIs in Ethiopia are share companies that are registered and regulated by the National Bank of Ethiopia (NBE). They are owned by individuals, public bodies, or mother NGOs or by a combination of the three. Most of them are commercial lenders that aim at achieving financial self-sufficiency while serving the poor. Unlike credit unions or financial cooperatives, which are confined to specific locations, NBFIs cover wider areas of operation, such as entire region. NBFIs use both bilateral individual

lending contracts and contracts based on joint liability. In the case of group lending, which is the main lending contract of NBFIs in Ethiopia, loans are made to individuals, but the group that is formed by the borrowers shoulder responsibility for a loan if one among the group members defaults.

In spite of the prominence and wider prevalence of both types of microfinance institutions in the country in general and in the agricultural sector in particular, empirical work on their outreach, financial performance, and impact are scarce. Except the works by Berhane and Gardebroek (2011) and Liverpool and Winter-Nelson (2010), the existing research is based either on anecdotes or on very small samples. While the samples used in these two studies still overlooked financial cooperatives, they systematically documented a positive impact of specialized microfinance on borrowers income, consumption, and housing. With the purpose of bridging the knowledge gap on the institutional performance of microfinance, the following three chapters of this dissertation aims at estimating impact and understanding the extents of outreach, financial performance, and outreach financial sustainability trade-offs from an organizational point of view using disaggregated data that encompass both shareholder owned NBFIs and financial cooperatives.

2

FINANCIAL SUSTAINABILITY AND OUTREACH OF MICROFINANCE INSTITUTIONS IN ETHIOPIA: DOES ORGANIZATIONAL FORM MATTER?

Abstract

Growing commercialization and competition in microfinance drives the focus of micro lenders from outreach per se to achieving financial sustainability in serving the poor. Such a goal can conflict with the traditional social mission of microfinance - outreach to the poor. In places where credit markets are inefficient, attaining financial sustainability while serving the poor depends largely on the ability of lenders to reduce the costs of market contracts. Such ability of cost containment often varies by lending terms and organizational forms. Using disaggregated data of microfinance providers in Ethiopia, we compared financial cooperatives and specialized or non-bank microfinance institutions on their outreach, financial performance and ability to achieve financial self-sufficiency together with outreach to the poor. The results show that non-bank microfinance providers perform relatively well in terms of breadth and depth of outreach, but face higher cost, which creates tension between outreach and financial sustainability. In contrast, there exists a positive complementarity between outreach and financial viability for financial cooperatives. On average, financially self-sufficient cooperatives lend small size loans and serve larger proportions of women borrowers, implying a greater depth of outreach together with achieving financial sustainability. While non-bank microfinance providers do better in expanding outreach, based on the findings, financial cooperatives should better contain their costs, balance social and economic goals and enable the microfinance industry to fulfill its full promise - serving the poor on a cost-covering basis.

KEYWORDS: Financial cooperatives; Non-bank microfinance institutions; Financial sustainability; Outreach; Trade-off; Ethiopia.

2.1 INTRODUCTION

Making finance accessible to the poor is a crucial mechanism for poverty reduction and wealth creation in developing economies where there exists a huge unmet demand for financial services. So far, access to financial services by the poor from financial mainstream institutions is very limited[1] , mainly due to high costs of market contracts

1 For instance, in most of Sub-Saharan African countries about 80 percent of the population lack a bank account (Demirgüç-Kunt and Klapper 2012; World Bank, 2008).

and constraints (Demirgüç-Kunt and Klapper 2012; World Bank, 2008). Microfinance has emerged as a dedicated pro-poor financial institution to lend uncollateralized and tailored loan terms to the unbanked poor in low-income communities. Through institutional innovations and innovative loan terms, microfinance institutions become able to dispense with information and enforcement costs and generate high repayment rates (Morduch, 1999; Banerjee et al., 1994). Microfinance institutions demonstrate that the poor can borrow, pay substantial interest rates and save continuously, which in turn results greater optimism for improving credit markets in developing economies[2].

However, the efforts of microfinance institutions to expand and perpetuate financial services to the poor are often backed by a steady flow of subsides (Morduch, 1999). Providing financial services on a cost-covering basis and translating high repayment rates into profits remains a challenge not mastered yet. Besides the inherent costs of market contracts in micro lending, focus on outreach *per se* and dependence on non-commercial sources of funds, such as subsidies[3], undermines the need for financial self-sufficiency in microfinance practices (Armendáriz de Aghion and Morduch, 2010). Recently, however, increasing regulations, commercialization and competition in microfinance has driven micro lenders to shift their focus from outreach and a reliance on donated funds to achieving financial sustainability - a demanding goal that requires the ability to cover costs out of the income generated.

A natural concern is, thus, the implications of shifting the focus towards financial viability on the traditional social mission of microfinance - outreach to the poor. Such a concern can be even greater in countries like Ethiopia where the financial market is less developed and microfinance institutions are promoted as a poverty reduction instrument (Amha, 2007). As they are mainly promoted to extend financial services to the unbanked poor, failure to achieve wider breadth (scale) and deeper outreach in the pursuit of financial sustainability can be indeed a policy concern.

In theory, outreach to the poor and financial sustainability can be potentially either complementary or conflicting[4]. On the one hand, a focus on financial performance and efficiency can reduce excess costs and attract commercial funds (including voluntary savings), which may, at the same time, contribute to expand outreach. Once the institution becomes financially sustainable, it can mean wider outreach today, tomorrow and in the future (Frank, 2008; Rhyne and Otero, 2006; Christen, 2001). On

2 Credit cooperatives have been operating since about century ago in Germany. At present, Grameen Bank in Bangladesh, VBSP in Vietnam, Spandana in India and Caja Popular of Mexico are some of the very well known cases in point. Their innovative contracts and lending arrangements have partly managed to reduce the costs of information asymmetries that hinder micro-lending.

3 Empirical evidences suggest that subsidies can hamper efficiency, especially if continuous and beyond a threshold (Hudon and Traca, 2011).

4 See Robinson (2001) for a full account of the debates between the poverty lending approach (i.e., welfarist view) and the financial systems approach (i.e., institutionalists view) on the outreach - financial sustainability trade-off.

the other hand, striving for financial sustainability and efficiency can result in a shift in the composition of new clients at the cost of lending to the poor, as lending small and customized loan terms are very costly to maintain[5]. In other words, seeking financial sustainability can push microfinance institutions to crowd-out of their portfolio of lending the small size loans that are demanded by the poor (Hashemi and Rosenberg, 2006; Weiss and Montgomery, 2005; Woller and Schreiner, 2002). Moreover, priority to achieve profitability can lead to higher interest rates and anti-social contract enforcement methods (Roberts, 2013; Galariotis et al., 2011).

Despite its policy salience, there are very few systematic empirical works that analyze the potential trade-offs between outreach and financial sustainability in microfinance. The evidence presented by these studies is mixed. Studies by Hermes et al. (2011) and Cull et al. (2007) found tensions between outreach to the poor and financial sustainability and efficiency. In their global analysis of microfinance providers, they found that institutions with lower average loan balance and more women borrowers are less financially sustainable. In particular, Cull et al. (2007) found that, for larger individual lenders, the pursuit of improved financial performance considerably reduces their focus on the poor. On the other hand, a recent study using data from 702 microfinance providers operating in 83 countries by Quayes (2012) documented a positive complementary relationship between depth of outreach and financial performance.

With the aims of expanding the body of existing empirical works, this study provides an in-depth analysis on how organizational form (i.e., the way ownership is organized and practiced) affects the potential compatibility or trade-offs between financial performance and outreach for microfinance providers in Ethiopia. It also examine patterns of profitability and variations in cost containment by organizational form (i.e., financial cooperatives vs. non-bank financial institutions (NBFIs)), as it is equally important to know whether one type of organizational form is more cost effective than another in explaining differences in financial performance of lending institutions (Berger and Mester, 1997).

To this end, the study used disaggregated data of 107 microfinance providers to compare financial cooperatives and specialized NBFIs - the two prevailing microfinance providers in Ethiopia - on their outreach, financial performance, and ability to balance social and financial/economic goals. Considering both specialized microfinance and financial cooperatives enables the analysis to reduce potential biases towards large and commercial firms and selection biases seen in prior studies[6]. Furthermore, the study aims at going beyond existing empirical works in measuring the outreach of the

5 The cost differential between serving small uncollateralized loans and large collateralized loans is mainly emanated from varying level of screening and monitoring efforts (Armendáriz and Szafarz, 2009).

6 The analysis in works by Cull et al. (2007), Hermes et al. (2011) and Quayes (2012) are largely based on microfinance institutions that are united by their strong commitments to achieving financial self-sufficiency. Whereas, our work encompasses microfinance institutions that are committed to achieving economic viability, social visibility, or both.

microfinance providers. In addition to average loan size and percentage of women borrowers that measures depth of outreach; it used average length of client relationships and time between installment payments as measures of length and scope of outreach, respectively.

The rest of the chapter is organized as follows: Section 2 reviews organizational varieties of microfinance providers and their innovations to overcome costs of market contracts and constraints in micro-lending. Section 3 describes the data source and summary statistics. Section 4 explains the methodology used to understand the potential compatibility or trade-offs between outreach and financial performance. The analysis and results are presented in section 5. Section 6 concludes by summarizing the main findings and sets a recommendation.

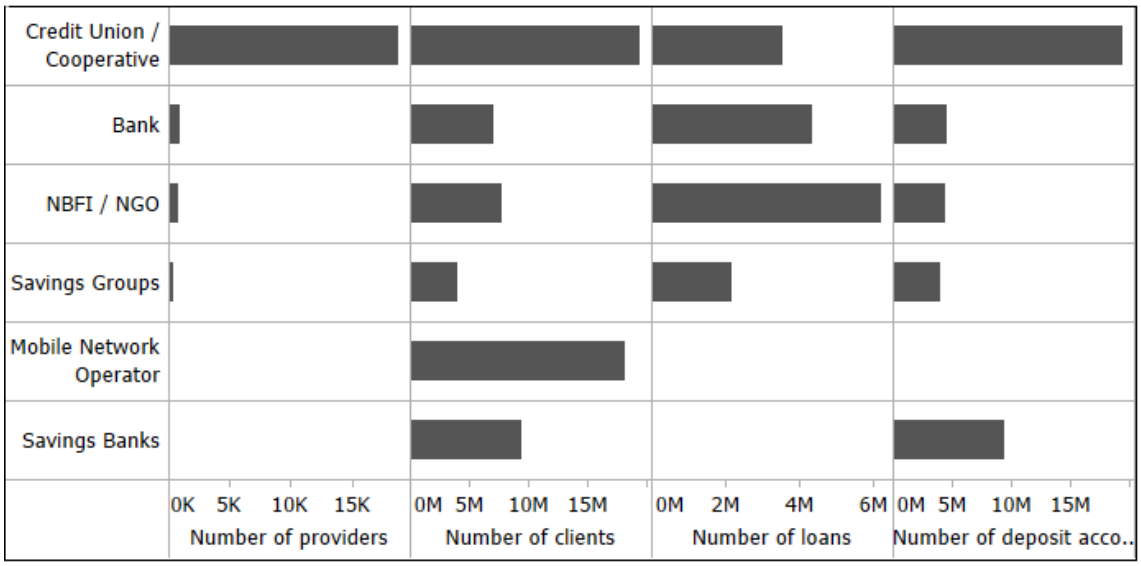
2.2 ORGANIZATIONAL FORMS IN MICROFINANCE

The modalities of interventions towards addressing problems of credit/financial markets in low-income communities in the name of microfinance encompass a diverse range of organizational designs spawned by the common idea of lending to the unbanked poor. These range from public state-owned banks for SMEs (Small and Medium Size Enterprises) and social venture capital to private credit unions, financial cooperatives, specialized or non-bank microfinance institutions/NGOs, saving groups, mobile network operators and village banks (Gaul, 2011; Zeller and Johannsen, 2006). All of these forms have varying degrees of ability to overcome costs of market contracts and constraints, which are partly intrinsic to their organizational design. In our comparisons hereunder, this review examine the comparative advantage of the two most popular organizational forms, financial/credit cooperatives and specialized or non-bank microfinance institutions, in terms of their inherent ability in reaching the poor and containing information and enforcement costs.

The microfinance practices of lending to individuals whom banks would spurn and tailoring the loan terms more closely to the needs of poor borrowers (e.g., farmers and laborers) were pioneered by the 19th century German financial cooperatives[7] in credit markets that are similar to those found in many developing countries today (World Bank, 2007; Helms, 2006; Guinnane, 2002; Guinnane, 2001a). The German financial cooperatives therefore were an early antecedent for the current microfinance revolution. They paved the way for lending policies and loan terms that catered for the needy and differed from conventional banks - they can be considered as institutional innovations in the financial sector[8]. In principle, financial cooperatives are local, autonomous or

7 Credit cooperatives were first established in Germany during the 1840s by Schulze-Delitzsch and Raiffeisen. See Guinnane (2001a) for a detailed economic history of German credit cooperatives.

8 Enforcement of unlimited liability as an instrument to overcome any form of empathy and moral hazard was part of the innovation, which were strictly followed by the Raiffeisen model of credit cooperatives.



Source: Mixmarket - Gaul (2011).

Figure 2.1: Outreach of microfinance providers in Africa by product type.

freestanding organizations owned and controlled by their members. They are self-help institutions established to made loans to members who cannot otherwise obtain credit from conventional banks.

Financial cooperatives remain major players in the microfinance industry today and it is a dominant model in Western Europe and French-speaking Africa (Helms, 2006; Zeller and Johannsen, 2006). Currently financial cooperatives are serving over 857 million people worldwide, 13 percent of the world population (ILO, 2012). As shown in Figure 2.1, in Africa alone, financial cooperatives are numerous and surpass other providers of microfinance services by number of active clients, loans and deposit accounts - it serve about 20 million active clients in the continent. From Figure 2.1 that shows outreach of microfinance providers by product type in Africa, one can clearly see that financial cooperatives are competitive in credit provision and excel other providers in number and saving mobilization.

Compared to conventional banks, the efficiency and success of financial cooperatives in lending uncollateralized loans rests on a combination of better information about borrowers, repeated interactions, and their ability to use sanctions against default that are not available to banks (Banerjee et al., 1994). In most cases, they are established by people who live in the same communities, so that members know each others

Besides being an incentive to choose recipients of credit with care and to vigilantly monitor its use, pursuing unlimited liability also was used as a tool to continuously engage members in their cooperative (Emmons and Mueller, 1997; Guinnane, 2001a).

habits, characters, abilities and creditworthiness. Having this information about fellow members, people could impose a wide variety of economic and social sanctions on one another. Unlike bank clients, members in cooperatives act both as borrowers and lenders, providing both the demand for and supply of loanable funds. Such dual roles are the sources of credible incentives for members to monitor each other (Smith et al., 1981). In other words, the need for continuous access for loans push borrowers to exert maximum efforts and the fear of losing their saving encourage depositors to be actively involved in screening potential borrowers and in monitoring those who had received loans. Equally important is that social sanctions within the community available for cooperatives in case of defaults by their members (Guinnane, 2001a; Banerjee et al., 1994).

Despite their ability to overcome information and enforcement problems through capitalizing on local information and imposing inexpensive but effective sanctions, financial cooperatives can be challenging to run. They may entail considerable costs of ownership, as members should continuously save and commit to helping the institution operate. As they do not pursue the traditional bank-client relationship, in order to borrow, members should continuously save. Experience tells us that members often disappear when they are unable to perpetuate their savings in the cooperative due to economic reversals. Hence, financial cooperatives can be fragile due to their thin capital base (i.e., being highly dependent on local resources) and limited options for risk diversification (Armendáriz de Aghion and Morduch, 2010; Adams, 1995). Nonetheless, financial cooperatives that strictly follow rules requiring them to keep aside a fraction of profits as indivisible assets can be resilient to members economic reversals.

The second and most popular institutional form for lending small, uncollateralized and tailored loans are the specialized or non-bank microfinance institutions[9], which we call non-bank financial institutions (NBFIs) throughout this dissertation. Their roots can be found in many places, but a typical example is the Grameen Bank in Bangladesh and its replicas, which have received considerable attentions over the last three decades. They emerged during 1980s and spread all over the world with the premise that the existing lending mechanisms of conventional banks are not propoor or highly constrained by local resources (e.g., financial cooperatives and informal credit market). They are the dominant models in Asia, Latin America, Eastern Europe and Middle East and Northern Africa (Helms, 2006). As of 2010, 3,652 specialized microfinance institutions reported reaching over 205 million clients worldwide, of which about 65 percent were among the poorest when they took their first loan (Microcredit Summit Campaign, 2012). In Africa, NBFIs along with NGOs account for above 5 million active microfinance clients and 6 million loans (Figure 2.1).

9 The ownership of the specialized microfinance institutions ranges from informal non-governmental ownership to public and private ownership. Here we focus on those microfinance institutions that are share companies in their legal status, as all microfinance institutions in Ethiopia are shareholder firms.

Building on the experiences of financial cooperatives, NBFIs opened up with the discovery of joint liability that harnesses social collateral and strengthens and expands the role of the group in microfinance (Morduch, 1999). Joint liability lending was an innovation of NBFIs, which enable borrowers to self-select[10] on their own and avoid risky borrowers in their credit group using their local knowledge. Such a mechanism helps them to overcome *ex ante* moral hazards at lower costs by inducing borrowers to monitor each others choice of project to which to apply the borrowed funds and impose sanctions upon borrowers who have chosen excessively risky projects (Stiglitz, 1990). It can also reduce *ex post* default risks in the presence of dynamic incentives (Ghatak and Guinnane, 1999). In its strict sense, joint liability lending is a transfer of default risks from lenders to borrowers.

The success of NBFIs in overcoming information and enforcement costs also rests on their ability to use progressive lending[11] both as screening mechanism and as a tool to discourage strategic defaults. Starting with very small loans and gradually increasing loan sizes as borrowers demonstrate reliability enable them to systematically increase the opportunity cost of non-repayments (Galariotis et al. 2011; Tedeschi, 2005; Besley, 1995). Equally important in the design of NBFIs is to dispense with repayment risks by using a repayment schedule that starts shortly after the disbursal of the initial short-term loan and changes the nature of the risk for lenders (Armendáriz de Aghion and Morduch, 2010).

Besides the loan terms and types of innovations noted above, the fundamental differences between the two-microfinance providers considered in this study are their ownership structure and approach. Financial cooperatives are member-based organizations and saving-led in their approach. In contrast, specialized or non-bank microfinance are not member-owned (i.e., often owned either by NGOs, investors or governments) and credit precedes saving. The other major differences between financial cooperatives and NBFIs are the source of loanable funds and its implication on their ability to overcome the costs of market contracts. Unlike financial cooperatives, which are self-supporting by their nature and serve large number of depositors (Figure 2.1), NBFIs are commonly attached to international donor agencies and rely on outside sources of capital.

Hypothetically, microfinance institutions based on extensive outside financial sources can be less effective in overcoming *ex post* moral hazards. For instance, the group can collude against the lenders by collectively deciding not to repay or to avoid imposing social sanctions on one another (Armendáriz de Aghion and Morduch, 2010). In

10 Despite its imperative in overcoming adverse selections in micro lending, the group mechanism, based on self-selection or assortative matching emphasizing the need for homogeneity, could be exclusionary of the poor and less practical in the presence of dynamic incentive mechanisms (Guttman 2008; Montgomary, 1996).

11 See Besley (1995) for a detailed analysis of dynamic incentives mechanisms in the form of progressive lending that result in high repayment rates in microfinance.

the case of credit cooperatives, however, the members fear of losing their savings deposits (and his/her deposits and the deposits of relatives) mentioned above prevents or sharply reduce the possibility of conspiring against the cooperative. Moreover, despite its limits on diversification of risks, being confined to small communities places financial cooperatives at an advantage in terms of capitalizing on borrowers local knowledge. NBFIs, however, cover wider areas and borrowers have less chance to observe each others effort level, especially in urban areas where getting to know each other is imperfect.

The possible distinctions between these two forms of microfinance institutions in terms of serving the poor while maintaining their financial viability is a topic less studied, mainly due to a dearth of data. The understanding is that both forms of microfinance institutions make financial services accessible for a considerable proportion of the poor and female populations in the world. In relative terms, the roles of NBFIs, in particular, are well recognized by international development organizations and donor agencies, as they are the big-push behind their revolution. What is less obvious for policy makers is the extent and depth of outreach of financial cooperatives. Implicit or explicit in much of the policy and academic literature on financial cooperatives is the notion that they are meant for unbanked middle-income clients and have limited outreach only to their members. However, studies by World Bank (2007) and Lapenu and Zeller (2002) shows that the scale and depth of outreach and pace of adaptability by financial cooperatives are comparable with NBFIs, and even higher in some contexts[12].

While they may be similar in terms of scale and depth of outreach, so far there is no comparison of financial cooperatives and specialized non-bank microfinance institutions in their financial viability and ability of achieving financial sustainability in serving the poor. Theoretically, financial cooperatives are assumed to be financially self-sufficient and sustainable, as they largely depend on member savings for lending. Moreover, they are at an advantage in terms of overcoming costs of market contracts and constraints (Mershland, 2008). However, this does not mean that financial cooperatives are always cost efficient, as they may bear higher ownership costs[13] than NBFIs and are constrained by local resources and limited opportunity for risk diversification (Hansmann, 1996).

With regard to non-bank microfinance institutions, conventionally, outreach to the poor is their principal focus - achieving financial viability while serving the poor was

12 Reseau de Caissese Popularies du Burkina in Burkina Faso; Sistema de Cooperativas de Crédito do Brasil (SICOOP) and SIGREEOI in Brazil; Sanasa network of financial cooperatives in Sir Lanka; and Saving and Credit Cooperatives (SACCOs) and Cooperatives Bank of Kenya in Kenya are examples of greater scale and depth of outreach by financial cooperatives (Turtiainen, 2008; World Bank; 2007).

13 Although ownership costs are intrinsic and cannot be completely neutralized by either of the two organizational forms, ownership costs related to capital efficiency can be higher for financial cooperatives due to capital lock in and the indivisibility of assets (Mershland, 2008).

considered as unattainable, and constitutes an inherent challenge to micro-lending. Despite potential trade-offs with their traditional social missions, the recent commercialization of non-bank microfinance institutions driven by the need for financial self-sufficiency results in a greater optimism for this form of microfinance. In order to reduce such knowledge gaps, this chapter aims at comparing financial cooperatives and non-bank microfinance institutions in Ethiopia based on their ability of achieving financial self-sufficiency together with serving the poor.

2.3 DATA AND SUMMARY STATISTICS

As described by Cull et al. (2007) and Morduch (1999), in the microfinance industry, uniformity of products provided by lenders (i.e., lack of variations in contracts, interest rates, loan size, etc.) and homogeneity in institutional structure and size make it difficult for researchers to systematically assess the effects of products and institutional changes on social and economic outcomes. The data here, which include both non-bank microfinance institutions and financial cooperatives, however, offer considerable variations in institutional structure, size, loan terms, contractual types, prices and costs, and risk-mitigating strategies. Such variation enables this study to describe patterns of institutional change and their effects on financial performance, cost containment, and depth of outreach.

The study used primary data collected from microfinance providers in Ethiopia between April and June 2012[14]. After dropping institutions with missing data points, the data set contain information for 107 microfinance institutions. This includes all non-bank microfinance institutions in Ethiopia, which are 30 in number, and 77 financial cooperatives that account for about nine percent of the total number of financial cooperatives in the country. In the case of financial cooperatives, the data set is not representative of all such institutions. The selection of financial cooperatives were mainly based on the auditing status of the institution, with those selected being those that were audited during 2011 and have an audit report for 2010. However, most financial cooperatives are not audited every year due to the limited capacity of the supervisory authority[15]. The availability of the audit reports for prior year enables us to get reliable historical financial data for calculating some of our variables of interest (e.g., average assets, average equity, average loan outstanding, etc.). In spite of the small proportion

14 The data was collected through structured interviews. The survey was conducted with the financial and logistical assistance of the European Research Institute on Cooperatives and Social Enterprises (EURICSE), the International Food Policy Research Institute (IFPRI), the Association of Ethiopian Microfinance Institutions (AEMFIs) and the Federal Cooperative Agency (FCA) of Ethiopia.

15 In Ethiopia, financial cooperatives are audited by the regional cooperative promotion offices, public bodies organized to promote and supervise cooperatives, or by a person assigned by this office. Without authorization, they are not allowed to independently arrange auditing services from private auditors (Federal Democratic Republic of Ethiopia: Proclamation No. 147/1998).

of financial cooperatives included in our analysis, when combined with the non-bank microfinance institutions, however, the institutions in the data set serve the majority of microfinance clients in the country.

Table 2.1 presents summary statistics by organizational form on financial performance indicators, outreach variables and other control covariates used in the analysis for the microfinance institutions in our data set. On average, the microfinance institutions considered are marginally financially self-sufficient (i.e., 1.03). However, when it is disaggregated by organizational form, it is found that NBFIs are not financially self-sufficient, on average. Financial cooperatives, on the other hand, are able to generate sufficient revenues to cover their costs, although their return to assets is significantly lower than that for NBFIs. The possible explanations behind such disparities can be loan sizes, cost of loans, and loan-loss expenses. The summary statistics at the middle of Table 2.1 indicates that, on average, financial cooperatives spend less for both personnel and capital expenditures relative to their assets. The costs of capital and labor and loan-loss expenses are higher for NBFIs, with the difference with financial cooperatives being statistically significantly. Another measure of cost efficiency, cost per unit of *birr*[16] lent, further indicates that financial cooperatives incur lower costs per unit of currency lent compared to NBFIs. Besides lower capital and labor costs, this could be in part due to differences in loan sizes or target markets.

The outreach indicators suggest that NBFIs cater more to poor borrowers relative to financial cooperatives. On average, NBFIs offer lower loan sizes with short and frequent repayment schedules (suggesting a wider scope of outreach) and serve a higher proportion of women clients. The difference in loan sizes, however, can be due to differences in breadth of outreach and length of client relationships. As shown at the bottom of Table 2.1, financial cooperatives are characterized by limited breadth, but have repeated interactions with their borrowers (i.e., longer relation with their members, as measured by average number of borrowings). Financial cooperatives in the sample serve a smaller set of members compared to NBFIs, - 247 to 70,397, respectively. This difference on breadth of outreach is expected, because financial cooperatives in Ethiopia are confined to a particular location or communities by their nature. And their breadth can be further constrained by local resources, as they have limited sources of capital compared to NBFIs - they heavily rely on members equity and deposits for lending. NBFIs, on the other hand, are at an advantage in attracting various sources of capital and cover wider areas of operations (e.g., regional states).

The summary statistics in Table 2.1 also show statistically significant differences by organizational form in the interest rates charged. The costs of loans are found to be considerably higher for NBFIs. On average, they charge 19 percent on a flat basis, compared to the 9.6 percent interest rates charged by financial cooperatives. This difference can be due to differences in the costs of loans - the higher the cost of the loans,

16 *Birr* is a currency of Ethiopia; its exchange rate to US dollar was 17.2941 on December 30, 2011.

Table 2.1: Descriptive statistics by organizational form.

Indicator	Non-Bank Financial Institutions (NBFIs) (n=30)		Financial Cooperatives (n=77)		Significant Mean Difference?
	Mean	Std. Dev.	Mean	Std. Dev.	
Financial Self-Sufficiency	0.771	0.426	1.133	0.591	*Yes*
Operational Self-Sufficiency	1.031	0.466	1.372	0.525	*Yes*
Adjusted Return on Assets	0.121	0.058	0.078	0.052	*Yes*
Average Loan Size	0.464	0.340	1.135	1.224	*Yes*
Total number of active borrowers	70,39	149,3	247	600	*Yes*
Women borrowers, proportion	0.581	0.168	0.395	0.233	*Yes*
Rural borrowers, proportion	0.493	0.343	0.395	0.479	*No*
Gross Loan Portfolio	232.8	537.4	1.56	3.27	*Yes*
Yield (in percent)	19.01	5.699	9.652	2.295	*Yes*
Loan to assets	0.733	0.181	0.798	1.018	*No*
Labor cost to asset	0.067	0.054	0.021	0.031	*Yes*
Capital cost to asset	0.076	0.076	0.021	0.048	*Yes*
Cost per unit of *birr* lent	0.263	0.157	0.099	0.074	*Yes*
Loan loss reserves over GLP	0.080	0.160	0.035	0.035	*Yes*
Donation over loan	0.214	0.361	0.077	0.265	*Yes*
Age of institution	10.8	4.3	11.5	7.4	*No*
Size of institution	2.6	0.674	1.42	0.637	*Yes*
Time between payments	1.68	2.36	3.55	4.20	*Yes*
Number of sources of capital	2.4	0.498	1.85	0.530	*Yes*
Length of client relationship	5.31	1.94	8.59	4.48	*Yes*
Individual owned, proportion	0.400	0.498	1.000	0.000	*Yes*
NGO owned, proportion	0.266	0.449	0.000	0.000	*Yes*
Amhara region	0.066	0.253	0.363	0.484	*Yes*
Oromia region	0.066	0.253	0.415	0.496	*Yes*
Other regions	0.233	0.430	0.064	0.248	*Yes*

Note: Other regions include Tigray, Benishangul-Gumuz, Dire-Dawa, Gambela, Harari, Somali and Southern Nations, Nationalities and Peoples Region (SNNP). They are categorized in a single group due to small population of microfinance providers in all the regions, with the exception of Tigray and SNNP. In Tigray and SNNP we have collected data from considerable number of microfinance providers. However, we consider only NBFIs and drop all financial cooperatives from our sample due to data quality problems, which had to do with problems in data collection. Note: Addis Ababa is a reference group for regions.

Source: Author's calculations, based on primary data collected between April and June 2012.

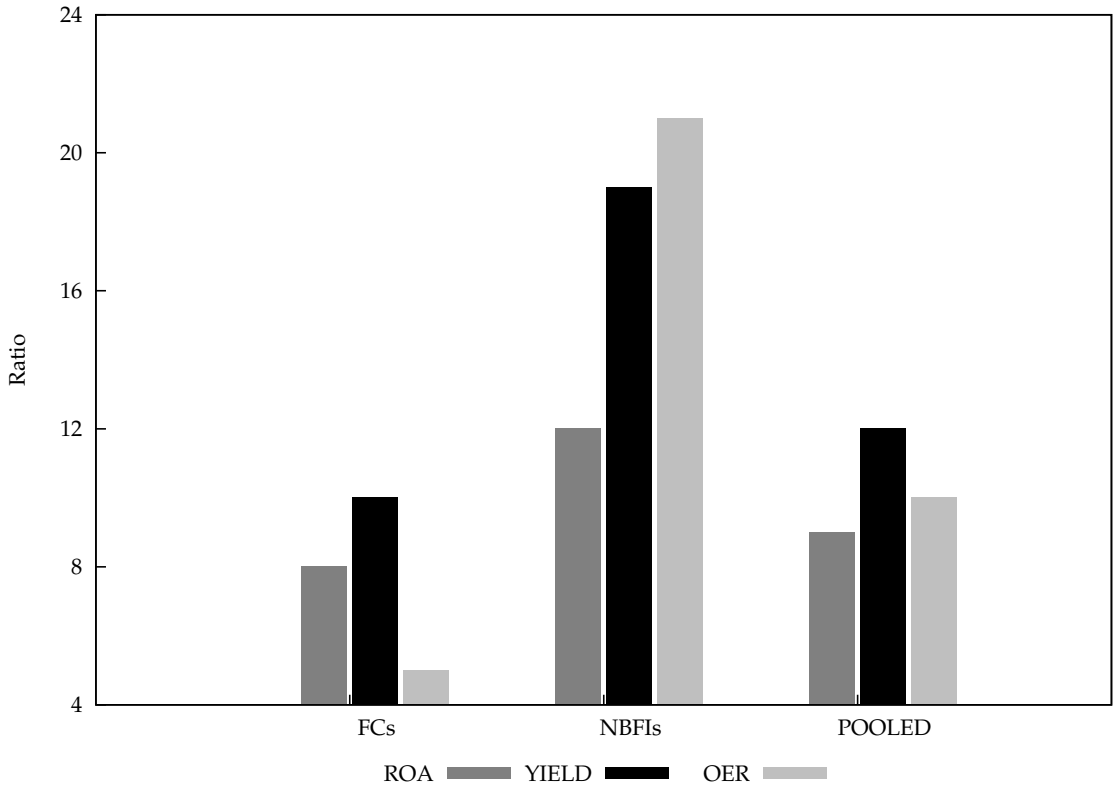
the higher the prices. Besides, the conventional measure of risk-taking (i.e., equity-to-assets ratio) show that financial cooperatives are less leveraged, indicating lower costs of capital. They use a higher proportion of their own equities to finance their assets. NBFIs, on the other hand, are found to be risk-taking in their strategies, as measured by the extent of loan-loss reserves and equity-to-assets ratio. Moreover, NBFIs rely on grants for lending - on average 21 percent of their loans come from donations.

In the sample considered, the two providers of microfinance also differ in size (i.e., measured in total assets) and equity capital ownership that renders decision-making powers more diffuse. Financial cooperatives are relatively small in sizes and individual members own equity capital. NBFIs, on the other hand, are bigger and their equity capital is owned either by individual investors, NGOs, or regional governments. There are also cases where ownership equity is contributed by a combination of the three. Based on ownership of the majority of the shares (i.e., more than 70 percent) NGOs and regional states owned 27 and 33 percent of the NBFIs surveyed, respectively. Individual investors own the remaining 40 percent of NBFIs.

Overall, the sample is reasonably balanced across regional states. 28 percent of the institutions are in Amhara region, another 32 percent in Oromia region. Institutions from regions other than Amhara, Oromia, and Addis Ababa comprise 11 percent of the sample. The remaining 39 percent are from Addis Ababa, where most of NBFIs and financial cooperatives are located. However, when we disaggregated by organizational form, the majority of NBFIs are found to be from Addis Ababa and financial cooperatives from Amhara and Oromia regions.

Figure 2.2 shows that patterns of revenues, prices, and costs vary systematically by organizational form. As already indicated, despite their access to cheaper financial capital (e.g., grants and loans on concessional rates), on average NBFIs charge the highest prices and incur the highest average costs, as measured by Operational Expense Ratio (OER), which is the ratio of total expenses over total assets. Our measure of interest rates, however, captures only direct interest charges and we presume that the price charged could be even higher if we account additional fees charged by NBFIs, for which we do not have the data. Since costs prevail slightly over the interest rates charged for NBFIs, significantly lower returns on assets relative to prices results. Financial cooperatives, conversely, charge lower interest rates and face lower operational costs, resulting in higher returns relative to the prices of loans.

These patterns points to cost containment differences between the two groups of lenders. Costs are higher for NBFIs and results in higher interest rates for their borrowers. On the other hand, costs and interest rate charged by financial cooperatives are significantly lower and the difference is statistically significant. The possible explanation for this is that, in relative terms, the NBFIs cater for poor and female borrowers, which entails higher costs than financial cooperatives. In all, the results from the sum-



Source: Authors calculations, based on a primary data collected between April and June 2012.

Figure 2.2: Return on Assets (ROA), Gross Portfolio Yield (YIELD) and Operation Expense Ratio (OER), by organizational form.

mary statistics imply differences in cost-efficiency and target markets between the NBFIs and financial cooperatives.

2.4 EMPIRICAL APPROACH

Ordinary Least Square (OLS) regression is used to describe the correlates of profitability, total costs of lending, and outreach of microfinance institutions. It is mainly used to understand why some microfinance providers are more financially sustainable than others and to examine which organizational form is able to achieve financial self-sufficiency together with serving the poor. The estimated OLS model allow factors of interest to vary by lender organization type in order to understand the extent of variation in profitability and cost containment relative to the scope and depth of outreach by organizational form, which are the primary objective of this chapter. The reduced-form of the regression model is as follows:

$$y_i = \alpha + \beta_1 x_i + \beta_2 D_i + \beta_3 (x_i D_i) + f^i(\cdot) + u_i \tag{2.1}$$

Where y_i is a dependent variable - representing profitability, total cost and outreach in this chapter - x_i is a factor which is allowed to vary by organizational form (e.g., interest rates in the profitability regression and financial self-sufficiency in the outreach-sustainability regression), D_i is organizational dummy and $f^i(\cdot)$ is a function that contains control variables about the history, orientation, ownership and location of the microfinance providers.

Different specifications are used for correlates of profitability, cost, and outreach. The first specifications on profitability and total costs are a benchmark regression that describes the question we raised above - why some microfinance institutions are more profitable than others - focusing on the role of interest rates, lending expenses, loan sizes, and organizational form. For the specification of profitability, we use a modified version of the models employed by Quayes (2012) and Cull et al. (2007), which define financial self-sufficiency mainly as a function of prices, costs, history, and orientation of lenders. The empirical profitability function estimated is specified as follows:

$$\begin{aligned} FSS_i = \alpha + \beta_1 yield_i + \beta_2 yield_i \times orgform_i + \beta_3 capitalcost_i + beta_4 laborcost_i + \\ \beta_5 orgform_i + \beta_6 history_i + \beta_7 orientation_i + \beta_8 outreach_i + \\ \beta_9 region_i + \epsilon_i \end{aligned} \tag{2.2}$$

FSS represent the financial self-sufficiency ratio of microfinance institution i. It is one among the profitability indicators used to measure the financial performance of microfinance institutions. Operational Self-Sufficiency (OSS) and Return on Assets (ROA)

are also used as additional measures of profitability. The correlation matrix in Table A.1 shows that the measures of profitability are interdependent. Their descriptions and summary statistics are presented in Table 2.1 and Table A.1. The summary statistics are within the expected ranges, although with a wider range between the maximum and minimum values. Robust regression methods is used to ensure the robustness of the results to possible outliers.

yield is a measure of interest rates or the price of loans charged by the microfinance institution. Yield in this case captures only direct interest rates charged by lenders. It neither includes additional fees charged nor is adjusted for loan losses. As shown in Table 2.1, the price of loans largely varies by organizational form. As a result, yield is allowed to vary by organizational designs. Hence, the coefficient of the interaction term, β_2, shows how the effect of yield varies by organizational type. As NBFIs are omitted for reference, the difference between β_2 and β_1 is a yield coefficient for financial cooperatives. Thus, β_1 is the effect of yields on financial self-sufficiency of NBFIs. *capitalcost* and *labourcost* measures the effects of personnel and capital expenditures relative to assets on the lenders level of financial self-sufficiency. The constructions and summary statistics of these measures appear in Table A.1 and Table 2.1. Besides its interaction with yields, the organizational form dummy, $orgform$, also enters the model independently (i.e., $orgform = 1$ if the organization is a financial cooperative, 0 otherwise). Note that there is no parallel coefficient for NBFIs, as they are the omitted category.

The matrix *history* includes two common measures of organizational backgrounds - age (measured by number of years since founding) and size (measured by total assets) of the microfinance institution. The matrix *orientation* includes variables that describe the lenders level of risk taking and extent of dependency on grants to sustain lending. The variables it contains are loan to assets and donation over loan portfolio ratios. *outreach* comprises proxy indicators of client or member poverty levels (i.e., average loan size, percentage of women borrowers) and a variable that measures the length of outreach based on average length of client relationships with the microfinance institution. *region* is a dummy variable for each major regional states and regions that come under the other regions category, with Addis Ababa as the omitted reference group.

The second benchmark regression relates total cost per unit of currency lent to average loan sizes of the microfinance institution. Understanding the effect of increasing loan sizes on cost of loans and how this effect varies across organizational form are the empirical questions. The regression model correlates the cost of loans with average loan size and other control variables. It is specified as follows:

$$\begin{aligned} TC_i = \alpha + \beta_1 loansize_i + \beta_2 loansize_i \times orgform_i + \beta_3 orgform_i + \beta_4 history_i + \\ \beta_5 donation_i + \beta_6 outreach_i + + \beta_7 region_i + \epsilon_i \end{aligned} \tag{2.3}$$

where TC is total cost of loans of microfinance institution i. It is a ratio of total operating costs during the period over total amount of loan outstanding. Capital costs and labor costs are also used as dependent variables. *loansize* is the average loan size of lenders (i.e., total loan outstanding divided by total number of active borrowers relative to regional income per capita). This variable is allowed to vary by organizational form and the interpretation of the coefficient is similar to that of *yield* discussed above. In the results table of the total cost regression that follows, the squared average loan size is also included to capture potential non-linear effects. *donation* is the amount of grants to loans over the gross loan portfolio of the institution. *history*, *outreach* and *region* matrices are as defined above in the profitability regression.

The main regression model relates outreach and profitability of microfinance institutions in our sample. It analyzes the relationship between depth of outreach and financial self-sufficiency using a variety of outreach proxy measures as dependent variables. Can microfinance institution be profitable while serving the poor and which organizational form is relatively at a better position in balancing the two bottom-lines are the issues put forward. The specification of the model is as follows:

$$\begin{gathered} LS_i = \alpha + \beta_1 FSS_i + \beta_2 FSS_i \times orgform_i + \beta_3 orgform_i + \beta_4 age_i + \beta_5 age_i \times orgform + \\ \beta_6 size_i + \beta_7 size_i \times orgform + \beta_8 donation_i + \beta_9 length_i + \\ \beta_{10} ownership_i + \beta_{11} region_i + \epsilon_i \end{gathered} \tag{2.4}$$

where LS is average loan size relative to regional income per capita for microfinance institution i. It is a widely used measure of depth of outreach in the microfinance literature. As noted above, the study also uses other proxy measures of outreach, which includes percentage of women borrowers, percentage of rural borrowers, and time between installment payments as a measure of outreach scope[17]. FSS is financial self-sufficiency that measures the ability of a microfinance institution to generate sufficient revenues to cover its costs. As is clear from the model, FSS vary by organizational form in order to understand differences by organizational form in achieving financial viability together with outreach to the poor. Thus, the coefficient of the interaction term, β_2, shows how the effect of FSS varies by organizational types. As NBFIs are

17 Scope of outreach measures the number of types of financial contracts provided by microfinance institutions. It includes both contracts between products (i.e., loan and saving) and within products (i.e., individual and group contracts), Schreiner, M. (2002). We measure scope based on loan repayment terms for two reasons. One, as all microfinance institution in our sample provide both loan and saving services and individual and group contracts and therefore no variability to systematically distinguish the effects of types of products on financial performance. Two, the frequency of repayment schedules can matter most if microfinance institutions are concerned with the welfare of their clients. While it inculcate fiscal disciplines for better repayment behavior, for borrowers engaged in seasonal activities and variable income, more frequent repayment schedules can result in over-borrowing, sale of productive assets and failure to smooth consumption (Fischer and Ghatak, 2009).

the omitted category, the difference between β_2 and β_1 is a FSS coefficient for financial cooperatives. β_1 is therefore the effect of financial self-sufficiency on outreach of NBFIs.

The interaction coefficients β_5 and β_7 shows how the effects on outreach of age and institutional size vary across organizational forms. The coefficient vectors β_4 and β_6, on the other hand, summarize the effects of age and institutional size on outreach for NBFIs. The variable *donation* and *length* measures the amount of grants received to loans and the average length of client relations with the microfinance institution, respectively. *ownership* is a matrix of dummy variables for individual- and NGO-owned microfinance institutions, with government-owned institutions as the omitted category. *region* is a matrix of regional dummies as defined in the preceding models.

2.5 ESTIMATION RESULTS AND DISCUSSIONS

2.5.1 *Financial performance*

The summary statistics in the preceding sections shows that the financial performance of the microfinance institutions in the sample considered is encouraging. It indicates that over half of the institutions are profitable and, on average, all are financially self-sufficient - that is, they generate sufficient revenues to cover costs. However, patterns of financial viability vary considerably when the sample is disaggregated by organizational form. The level of financial viability turns out to be below the cost-covering line for NBFIs, indicating that NBFIs, on average, are not financially self-sufficient. In contrast, financial cooperatives remain financially viable after disaggregation. This section further analyze the correlates of profitability with a greater emphasis on prices and costs of loans charged and incurred by microfinance lenders and their varying effects on profitability by organizational form.

Table 2.2 summarizes the results from the estimation given under equation (2.2), which examines the relationship between profitability and interest rate charged. The results show a strong association between interest rates and levels of financial performance, with varying effects across types of institutions. For NBFIs, the coefficient for gross portfolio yield is positive and statistically significant across all measures of profitability used in this study (i.e., financial self-sufficiency, operational self-sufficiency, and return on assets). It indicates that specialized microfinance institutions tend to be more profitable when their average interest rate is higher.

Conversely, the results for financial cooperatives show that raising interest rates results in reduced financial performance, which rejects the hypothesis that claims similar effects of interest rates on financial performance across microfinance institutions form of ownership. The coefficients of financial cooperatives are negative and signif-

icant across all profitability indicators, signifying that increasing interest rates does not necessarily result in improved financial performance for these institutions. This result remain the same after we sum the coefficients for yield and yield interactions, which further marked an inverse and significant relationship between interest rates and profitability for financial cooperatives, even after controlling for costs and depth of outreach. This result can be because well-functioning cooperatives[18] have less incentive to increase returns, as their motive is, in principle, not profit maximization.

As noted above, the study also looks at the effect of costs on financial performance in the same model. The results show that higher capital costs are associated with reduced financial performance in two of our profitability indicators. The capital cost coefficient is negative and significant, which suggests that containing those costs (i.e., rent, transportation, depreciation, etc.) is a key to the profitability of microfinance providers. Labor costs also tend to be inversely and strongly related with profitability in our specifications of financial and operational self-sufficiency - its coefficient is negative and statistically significant. In a similar way, this result suggests that containing labor costs is associated with improved financial performance. In particular, an unreported specification that allowed the effects of capital and labor costs to vary by organizational form exclusively showed that containing labor cost and capital costs are key to improved financial performance among financial cooperatives and NBFIs, respectively. Overall, the coefficients on the cost indicators suggest that cost efficiency or cost containment play a crucial role in determining the profitability of microfinance providers.

After permitting the effects of interest rates to vary by organizational form, the financial cooperatives dummy introduced independently also explains additional variation in financial performance. Across all measures of profitability, the coefficient for the financial cooperatives dummy is positive and statistically significant. Indicating that in terms of financial performance, microfinance providers that are member owned outperform the specialized NBFIs.

Age of the institution, the variable that controls for experience, is negatively associated with financial performance. Older microfinance providers were expected to be more profitable, as they can develop efficiency through experience. However, the alternative hypothesis that holds in this case is also plausible, as more recently established microfinance providers could also learn from the existing knowledge accumulated by their antecedents at lower costs. Moreover, costs of older microfinance institutions can also rise as they try to reach beyond their initial target clients to those that are more isolated and difficult to reach - the correlation matrix indicates that breadth increases with age (Table A.1). Size of institutions, a control for scales of operation, is significantly positively linked with financial performance. It suggests that large mi-

18 Our presumption with regard to this inverse relationship between profitability and yield is that financial cooperatives strive for higher interest rates while they are poorly performing and vies versa.

Table 2.2: Gross portfolio yield and financial performance.

Indicator	Financial self-sufficiency (FSS)	Operational self-sufficiency (OSS)	Return on Asset (ROA)
Yield	0.027	0.024	0.007
	(2.49)**	(2.00)**	(7.50)***
Yield (coops)	-0.090	-0.069	-0.008
	(3.16)***	(2.38)**	(1.83)*
Capital cost to assets ratio	-1.806	-1.857	0.105
	(1.88)*	(2.73)***	(1.20)
Labor cost to assets ratio	-4.186	-4.656	0.179
	(3.17)***	(4.09)***	(1.71)*
Financial coops dummy	0.955	0.810	0.088
	(2.65)***	(2.17)**	(2.13)**
Age of the institution	-0.027	-0.025	-0.002
	(2.11)**	(2.44)**	(1.68)*
Institution size (in total asset)	0.211	0.173	0.016
	(1.93)*	(1.91)*	(1.42)
Loan to assets ratio	0.166	0.165	0.014
	(2.86)***	(3.53)***	(3.20)***
Donation over loan	-0.076	-0.008	-0.007
	(0.49)	(0.08)	(0.58)
Average loan size	0.050	0.021	0.000
	(1.10)	(0.71)	(0.08)
% of women borrowers	0.512	0.619	0.010
	(1.84)*	(2.53)**	(0.38)
Length of client relationships	0.050	0.057	0.005
	(2.47)**	(4.06)***	(2.55)**
Amhara region	0.895	0.607	0.039
	(5.97)***	(5.08)***	(2.61)**
Oromia region	0.418	0.214	0.047
	(2.75)***	(2.00)**	(2.93)***
Other regions	0.189	0.173	0.008
	(1.10)	(1.46)	(0.40)
Constant	-0.395	-0.043	-0.101
	(1.02)	(0.12)	(2.97)***
R-squared	0.51	0.52	0.47
Number of obs.	107	107	107

Note: *** significant at 1%, ** significant at 5%, and * significant at 10%. Capital cost is the sum of rent and transportation expenses and depreciation.

Source: Author's calculations, based on primary data collected between April and June 2012.

crofinance institutions are more profitable, as they benefit from economies of scale or from the potential intensity of larger assets over a larger client base with diverse risks.

Controls for depth of outreach indicate mixed results. Average loan size is positively linked with financial performance (although not significant so), suggesting smaller loans are, on average, less profitable. Serving more women tend to be linked with improved financial performance. The coefficient of percentage of women borrowers is positive and statistically significant in the first two measures of profitability. Length of outreach, among the six aspects of outreach proposed by Schreiner (2002), is also positively associated with financial performance. Microfinance providers with longer and repeated client relationships are more profitable than those offering one time or less repetitive loans. The regional dummy variables at the bottom of Table 2.2 also explain some variation in financial performance. The results show that microfinance providers operating in Amhara and Oromia regions do better than microfinance providers operating in Addis Ababa and other regions[19] in terms of financial self-sufficiency, operational self-sufficiency, and return on assets.

The results summarized in Table 2.3 further extend the analysis of interest rates and profitability indicated above to examine the implications of high enough interest rates on financial performance. Charging exorbitant interest rates by microfinance providers to offset higher costs of information and enforcement is not uncommon. Based on agency theory, our hypothesis is that charging very high interest rates above a certain threshold could result in problems of adverse selection and moral hazard. This is because of possible low repayment rates and less demand for expensive loans. Hypothetically, high interest rates drive worthy borrowers out of the market and only risky borrowers would find it in their interest to borrow, which in turn may results in low repayment rates and profitability (Morduch, 1999). The relationship with demand is straightforward - high interest rates can reduce demand, as it crowd out safe borrowers (Armendáriz de Aghion and Morduch, 2010; Stiglitz, 1990). If these assertions are true, microfinance providers in our sample charging comparatively higher interest rates should experience lower financial performance.

The implications of relatively high interest rates on financial performance is examined by including the quadratic term of gross portfolio yield in our profitability specification given under equation (2.2). The association between the squared portfolio yield and profitability is also allowed to vary by organizational form, as was done in the previous estimation. As shown in Table 2.3, for NBFIs, the relationship between interest rates and financial performance follows the hypothetical predictions. Both the linear

19 We presume that the financial performance of some of the microfinance institution under the Other regions category might be undermined by other microfinance institutions in the group. For instance, if we consider individual microfinance specific statistics, one of the microfinance institution surveyed from Tigray Region (which is placed in the Other regions category) is among one of the best microfinance providers in Ethiopia.

yield and quadratic yield coefficients are statistically significant across the two measures of profitability, with positive and negative signs, respectively. This indicates that financial and operational self-sufficiency for NBFIs increases with portfolio yield, but only up to a certain point at which the negative quadratic yield coefficient outweigh the positive linear yield coefficient. Figure 2.3-(a) shows the pattern of this relationship between interest rates and financial self-sufficiency for NBFIs based on the estimation from Table 2.3, column 1. Consistent with theoretical predictions, levels of financial self-sufficiency increase with yield up to a point and, as interest rates exceed about 25 percent per annum, the curve start trending down[20].

For financial cooperatives, the coefficients for linear yield and quadratic yields are the opposite sign of those for NBFIs. Similar to the results of the base regression, the linear portfolio yield coefficient is negative and significant before and after summing the yield and yield interaction coefficient, signifying an inverse relationship between interest rates and financial performance. However, the hypothesis that associates relatively high interest rates with lower financial performance for financial cooperatives cannot be rejected, since the quadratic yield coefficient is not statistically significant (although it is positive). In all, as far as financial cooperatives are concerned, any relative increase of interest rates have a decreasing effect on financial performance. Figure 2.3-(b) shows the pattern of this relationship between interest rates and financial self-sufficiency for financial cooperatives based on the estimation from Table 2.3, column 1.

In summary, the results from the specification that permits for non-linear effects of interest rates on financial performance (Table 2.3) suggest a negative association between financial performance and relatively higher interest rates. NBFIs that charge higher interest rates above the threshold are less profitable than those who charge relatively lower rates. For financial cooperatives, on the other hand, charging lower interest rates tends to be strongly linked with improved financial performance. The signs and levels of significance of other cost and outreach control variables remain similar to the base profitability regression.

The profitability analysis in this section is further extended to examine the implications of cost of loans on financial performance. As indicated above, the higher interest rates charged by microfinance providers often are ascribed to the high lending costs associated with small loans. Based on the results of the base profitability regression and theoretical predictions, here the study put forward cost reduction as an alternative solution to achieve improved profitability in microfinance service provision. Microfinance institutions that are able to dispense with information and enforcement costs through cost reduction mechanisms can at the same time overcome loss of demand and repayment problems that might arise from the prescription of higher interest

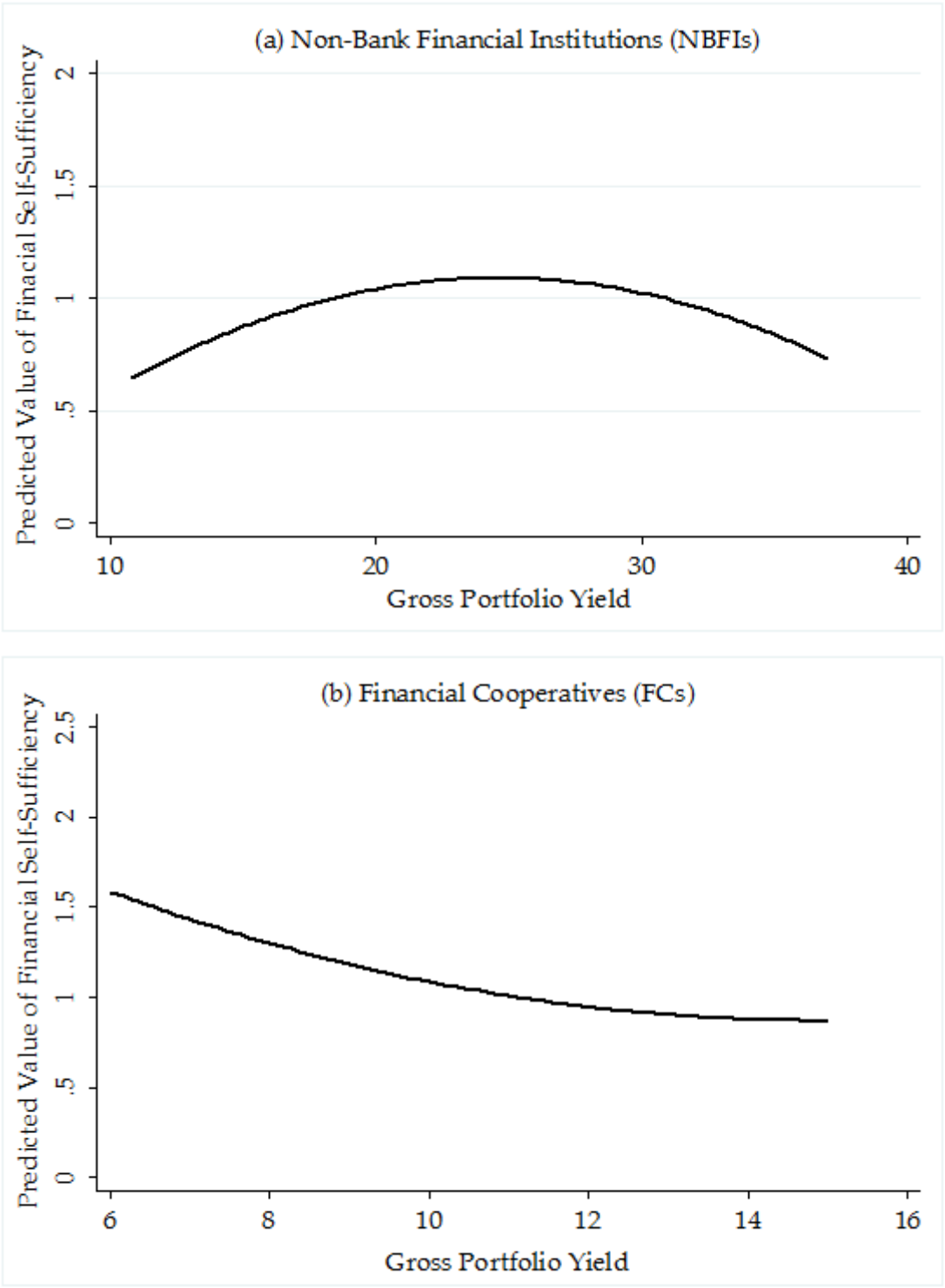
20 This can be due to higher costs correspond with charging higher interest rates, as recently found by Roberts (2013) among for-profit microfinance institutions.

Table 2.3: Gross portfolio yield and financial performance: *allowing non-linear effect of interest rates*.

Indicator	FSS	OSS	ROA
Yield	0.109	0.143	0.013
	(2.27)**	(2.98)***	(2.37)**
Yield squared	-0.002	-0.003	-0.001
	(1.93)*	(2.81)***	(1.18)
Yield (coops)	-0.299	-0.342	-0.028
	(1.71)*	(2.00)**	(1.11)
Yield (coops) squared	0.008	0.010	0.001
	(1.01)	(1.33)	(0.78)
Capital cost to assets ratio	-1.716	-1.730	0.113
	(1.73)*	(2.54)**	(1.27)
Labor cost to assets ratio	-4.175	-4.665	0.186
	(3.05)***	(3.92)***	(1.71)*
Financial coops dummy	2.412	2.771	0.222
	(2.35)**	(2.70)***	(1.48)
Age of the institution	-0.030	-0.028	-0.003
	(2.24)**	(2.80)***	(1.72)*
Institution size (in total asset)	0.213	0.174	0.017
	(1.93)*	(1.88)*	(1.49)
Loan to assets ratio	0.147	0.142	0.012
	(2.43)**	(2.93)***	(2.19)**
Donation over loan	-0.081	-0.017	0.001
	(0.53)	(0.16)	(0.29)
Average loan size	0.060	0.034	0.012
	(1.29)	(1.06)	(0.49)
% of women borrowers	0.544	0.663	-0.006
	(1.90)*	(2.60)**	(0.56)
Length of client relationships	0.050	0.058	0.005
	(2.42)**	(4.07)***	(2.50)**
Amhara region	0.903	0.616	0.040
	(5.78)***	(5.14)***	(2.67)***
Oromia region	0.434	0.233	0.049
	(2.70)***	(2.11)**	(2.98)***
Other regions	0.218	0.218	0.010
	(1.25)	(1.87)*	(0.47)
Constant	-1.238	-1.260	-0.160
	(1.88)*	(2.08)**	(2.59)**
R-squared	0.52	0.54	0.48
Number of obs.	107	107	107

Note: *** significant at 1%, ** significant at 5%, and * significant at 10%. Capital cost is the sum of rent and transportation expenses and depreciation.

Source: Author's calculations, based on primary data collected between April and June 2012.



Note: Both of the graphs are from specification 1 of Table 2.3.
Source: Author's calculations, based on primary data collected between April and June 2012.

Figure 2.3: Predicted trade-off between financial self-sufficiency and gross portfolio yield, by organizational form.

rates. If this conjecture is true, microfinance providers in the sample that contained their costs of lending should be more profitable than others.

Table 2.4: Cost per unit of currency lent and financial performance.

Indicator	Total costs/GLP	Capital costs/GLP	Labor costs/GLP
Financial self-sufficiency	-0.276	-0.133	-0.127
	(5.13)***	(3.52)***	(3.51)***
Financial self-sufficiency (coops)	0.273	0.118	0.097
	(4.66)***	(2.74)***	(2.62)**
Financial coops dummy	-0.408	-0.181	-0.164
	(7.05)***	(2.97)***	(3.60)***
Age of the institution	-0.001	0.003	-0.003
	(0.29)	(1.72)*	(2.43)**
Institutional size (in total assets)	-0.023	-0.018	-0.007
	(1.14)	(0.91)	(0.46)
Average loan size indicator	-0.008	-0.008	-0.003
	(0.82)	(1.43)	(0.50)
% of women borrowers	-0.001	-0.014	-0.002
	(0.02)	(0.46)	(0.08)
% of rural borrowers	-0.023	-0.012	-0.013
	(0.95)	(0.71)	(1.03)
Donation over loan portfolio	0.001	-0.016	0.017
	(0.03)	(0.87)	(0.91)
Length of client relationships	0.002	-0.003	0.004
	(0.64)	(1.37)	(2.46)**
Amhara region	-0.023	-0.009	0.030
	(0.79)	(0.39)	(1.44)
Oromia region	0.023	0.010	0.010
	(0.89)	(0.50)	(0.75)
Other regions	-0.024	-0.032	0.005
	(1.01)	(1.64)	(0.26)
Constant	0.553	0.268	0.227
	(6.87)***	(3.01)***	(3.88)***
R-squared	0.67	0.46	0.51
Number of obs.	107	107	107

Note: *** significant at 1%, ** significant at 5%, and * significant at 10%.
Source: Author's calculations, based on primary data collected between April and June 2012.

For NBFIs, the estimated coefficient for financial self-sufficiency (our measure of financial performance) clearly suggests that cost containment is strongly related to improved financial performance. The results in Table 2.4 show that financially self-sufficient NBFIs are estimated to have 28 percent lower costs per unit of currency lent than others within the same group that are not financially self-sufficient. Although less in magnitude, when *FSS* and *FSS* interaction coefficients are summed, the effects of costs of loans on financial performance is also negative and significant for financial cooperatives, indicating that cost containment results in profitability. Self-sufficient financial cooperatives are estimated to have 0.3 percent[21] lower costs per unit of currency lent than financial cooperatives that are not financially viable. Moreover, the financial cooperative dummy indicates that, as a whole, cooperative lenders outperformed NBFIs in cost reduction[22]. Financial cooperative are estimated to have 41 percent lower costs per unit of currency lent compared to NBFIs, with the difference being statistically significant.

Experience measured in terms of age of the institution has effects on capital cost and labor costs of similar magnitude, which offset its effect on total cost of loans. More experienced microfinance providers in the sample tend to reduce labor costs, but face higher capital costs per unit of currency lent. The coefficient for size suggests that large asset bases can reduce costs of lending (although insignificant). While the coefficient signs hints that deeper of outreach can entail higher costs, neither of the outreach indicators and controls for microfinance location are significantly linked to cost of loans.

2.5.2 *Outreach*

Outreach is the customary matrix used to measure microfinance social performance and includes breadth, depth, scope and length of lenders product (Schreiner, 2002). The breadth of microfinance providers in the sample is encouraging. On average, each microfinance provider extends services to about 19,915 individual borrowers. However, when disaggregated by organizational type, the coverage of NBFIs is show to be much wider. Each of the NBFIs on average extends financial services for about 70,397 individuals[23], while financial cooperatives are very limited in their breadth of outreach - on average they serve about 247 individuals. This, however, does not mean

21 The small percentage is due to lower cost difference among financial cooperatives.

22 This result is consistent with prior work by Mersland (2008) and theoretical predictions. While cost of ownership can be higher, cooperatives are effective in mitigating the cost of market constraints or contracts (Hansmann, 1996). Such mitigation of market costs is highly relevant for the issue at hand, since MFIs in Ethiopia operate in an inefficient financial market.

23 It should be noted that this figure on average breadth of NBFIs is influenced by three to four big microfinance institutions that are partly owned by regional public bodies. The median size of active borrowers is rather 10,592 and there are NBFIs with less than 200 active borrowers.

that the coverage of financial cooperatives is very tiny in the country as a whole. As they are very large in number (i.e., above 7,000), the number of individuals served by financial cooperatives in total is comparable to that of the NBFIs clients.

From the descriptive statistics, it was evident that NBFIs do better than financial cooperatives in terms of depth of outreach, as measured by average loan sizes and percentage of women borrowers. Woman borrowers constitute 58 percent of NBFIs total clients, and, on average, their average loan size is small at 46 percent of the regional income per capita. Financial cooperatives, on the other hand, extend loan with average sizes equivalent to the regional income per capita, and their female borrowers account for only 40 percent of their total members. However, financial cooperatives are in better position in terms of length of outreach. On average, they have more than eight years of a repeated borrowing relationship with their members, compared to five years of average client relationship in the case of NBFIs. Overall, microfinance providers in our sample extend a loan size equals to 95 percent of regional income per capita and female borrowers account 45 percent of their total clients/members.

This section look into the implications of depth of outreach (measured in terms of average loan size per regional income per capita) on cost of lending. Understanding the extent to which lowering loan sizes to the needs of the poor reduces financial viability by increasing average costs is the issue examined at this point (i.e., the cost - loan size trade-off). Table 2.5 presents estimated coefficients from a regression that correlates the total cost per unit of currency lent to average loan sizes of microfinance providers in the sample (equation 2.3). It also includes quadratic average loan size to capture non-linear effects and allow loan size indicators to vary by organizational form. For the interpretation of the results that follows, the estimates reported on column (2) of Table 2.5 are mainly used.

While the magnitude varies across organizational form, the estimated coefficient for average loan size indicates that large loan sizes are associated with lower average costs, but only up to a certain point. For NBFIs, the linear and quadratic loan size coefficients are negative and positive, respectively, with statistical significance. As shown in Table 2.5 column (2) and Figure 2.4, for NBFIs, relatively larger loan sizes are estimated to have 43 percent average lower costs per unit of currency lent up to a loan sizes equivalent to regional income per capita. Loan sizes above the regional income per capita are estimated to have 21 percent average higher costs per unit of currency lent.

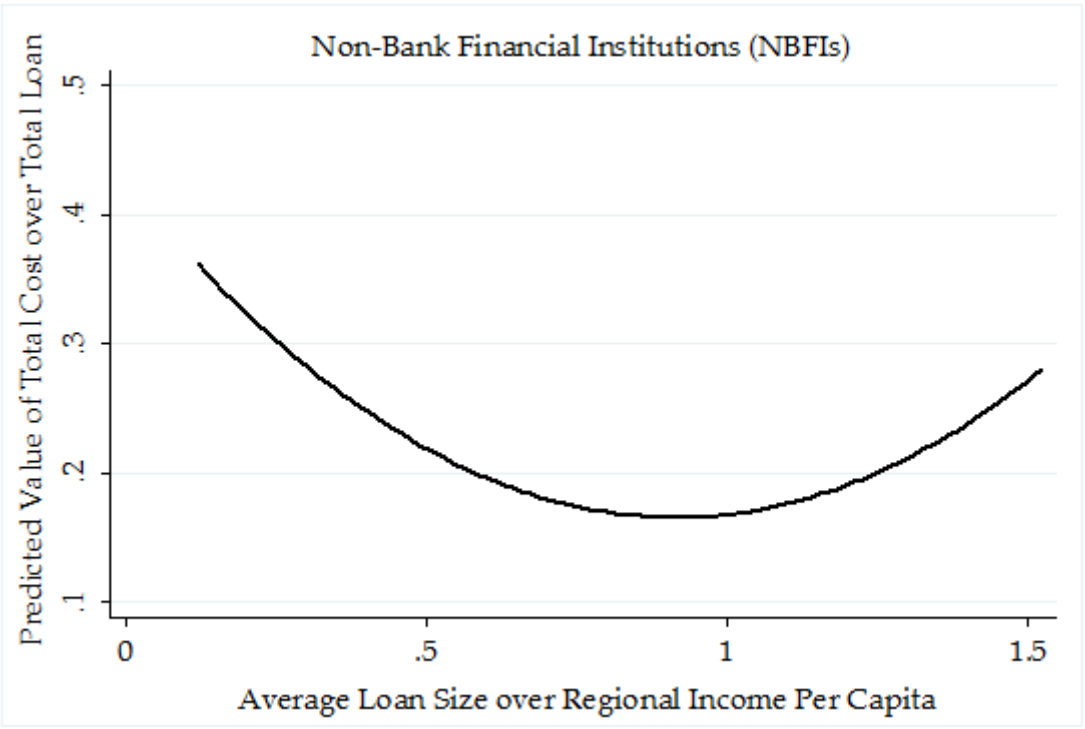
When the linear and quadratic terms are summed up, the effect of loan sizes on loan costs turns out to be the same for financial cooperatives as for NBFIs, but it is much smaller in magnitude. However, the organizational dummy introduced independently indicates that financial cooperatives perform well in cost containment, even after controlling for average loan sizes. The estimated coefficient suggests that microfinance providers in our sample that are financial cooperatives have a 33 percent average lower costs per unit of currency lent compared to NBFIs.

Table 2.5: Average loan size and cost per unit of currency lent.

Indicator	Total costs/GLP		Capital costs/GLP		Labor costs/GLP	
	(1)	(2)	(3)	(4)	(5)	(6)
Average loan size	-0.113	-0.433	-0.079	-0.360	-0.066	-0.074
	(2.12)**	(2.33)**	(2.10)**	(3.23)***	(2.39)**	(0.68)
Average loan size square	-	0.213	-	0.188	-	0.004
		(1.93)*		(2.50)**		(0.06)
Average loan size (coops)	0.115	0.409	0.076	0.346	0.067	0.054
	(2.09)**	(2.22)**	(1.92)*	(3.07)***	(2.23)**	(0.49)
Average loan size square (coops)	-	-0.210	-	-0.187	-	-0.001
		(1.91)*		(2.49)**		(0.02)
Financial coops dummy	-0.273	-0.326	-0.141	-0.198	-0.138	-0.120
	(4.55)***	(4.39)***	(2.92)***	(3.36)***	(3.28)***	(2.52)**
Age of the institution	-0.002	-0.002	0.003	0.002	-0.003	-0.003
	(0.60)	(0.73)	(1.57)	(1.39)	(2.03)**	(2.01)**
Institutional size (in total assets)	-0.064	-0.055	-0.040	-0.034	-0.031	-0.028
	(2.52)**	(2.18)**	(1.70)*	(1.45)	(1.93)*	(1.75)*
% of women borrowers	0.070	0.063	0.008	0.004	0.008	0.006
	(1.31)	(1.16)	(0.24)	(0.10)	(0.29)	(0.22)
% of rural borrowers	-0.035	-0.044	-0.018	-0.022	-0.018	-0.025
	(1.33)	(1.45)	(1.08)	(1.13)	(1.21)	(1.62)
Donation over loan portfolio	-0.022	-0.026	-0.025	-0.027	0.012	0.010
	(0.72)	(0.81)	(1.06)	(1.12)	(0.57)	(0.47)
Length of client relationships	0.001	0.002	-0.004	-0.004	0.003	0.003
	(0.37)	(0.45)	(1.68)*	(1.60)	(1.52)	(1.49)
Amhara region	-0.060	-0.059	-0.036	-0.032	-0.007	-0.012
	(2.01)**	(1.97)*	(1.50)	(1.46)	(0.46)	(0.70)
Oromia region	-0.003	0.004	-0.004	0.003	-0.007	-0.008
	(0.08)	(0.13)	(0.15)	(0.13)	(0.48)	(0.52)
Other regions	-0.008	0.005	-0.027	-0.017	0.006	0.009
	(0.23)	(0.13)	(1.47)	(0.97)	(0.27)	(0.36)
Constant	0.480	0.545	0.258	0.314	0.230	0.233
	(5.22)***	(5.55)***	(3.00)***	(3.36)***	(3.81)***	(3.88)***
R-squared	0.52	0.54	0.38	0.41	0.39	0.41
Number of obs.	107	107	107	107	107	107

Note: *** significant at 1%, ** significant at 5%, and * significant at 10%. Capital cost includes rent, transportation and depreciation (i.e., all administrative costs, except personnel costs). Labor cost includes all expense for personnel (i.e., salary, plus per diem).

Source: Author's calculations, based on primary data collected between April and June 2012.



Note: The graph is from specification 2 of Table 2.4.
Source: Author's calculations, based on primary data collected between April and June 2012.

Figure 2.4: Predicted trade-off between costs per unit of currency lent and average loan size for non-bank financial institutions in Ethiopia.

2.5.3 *Outreach and financial performance: is there a trade-off?*

The outreach to financial performance trade-off is an issue that has received attention from all observers (including policy makers) who are concerned about the social performance of microfinance providers. The concern largely emanates from proposition that asserts that focus on financial performance can crowd out the small loans demanded by the poor, as they are costly to service. Recently, the issue become more pressing following the growing commercialization, competition, and regulation in the microfinance industry that affected the way microfinance institutions do business and resulted in a shift in performance assessment criteria (Rhyne and Otero, 2006; Christen, 2001). Traditionally, the development impact of microfinance providers was assessed based on outreach as measured by breadth or depth (e.g., loan size, fraction of women to total clients, etc.). Institutions were considered successful if they expanded outreach to the poor (Robinson 2001; Yaron et al., 1997).

Currently, however, expanding outreach *per se* does not mean triumph over poverty. To be considered successful, a microfinance institution should provide durable and pro-poor financial services on a cost-covering basis. The later criterion opens the new debates mentioned above on the potential compatibility or trade-off of the two bottomlines - outreach and financial sustainability. As noted before, there are few systematic empirical works that examine the trade-off of outreach to the poor and financial sustainability and the evidence that has been developed is mixed (Bassem, 2012; Haremes et al., 2011; Quayes, 2011; Cull et al., 2007). This section further investigates this issue to understand possible varying effects of outreach to the poor on financial performance by organizational form.

Table 2.6 summarizes the results on the outreach to financial performance trade-off estimated following equation (2.4), which associates financial self-sufficiency with various measures of outreach to the poor. While the unreported specification for the whole sample and the simple correlation shows that outreach is not significantly associated with financial self-sufficiency[24], varying and strong evidences emerged when the estimation is allowed to vary by organization form.

As shown in column 1 of Table 2.6, the coefficient for financial self-sufficiency corresponding to NBFIs is positive and statistically significant for the average loan size variable, indicating that NBFIs that are financially self-sufficient are those that extend relatively large size loans. The negative and significant coefficient for women borrowers in column 2 of Table 2.6 also suggests that NBFIs that are self-sufficient are less focused on women borrowers. Moreover, NBFIs that are financially sustainable tend to provide loans with limited scope of outreach - they offer loans with relatively extended

24 The estimated coefficient for financial self-sufficiency in the specification that does not control for organizational design is negative but statistically insignificant, indicating no evidence of a relationship between financial performance and outreach to the poor.

installment periods that are less demanded by poor clients[25]. In all, the coefficients for NBFIs across the measures of outreach marked the presence of trade-off between financial self-sufficiency and outreach to the poor. In other words, the result suggests that NBFIs lend small size loans and serve more women borrowers face higher costs that eventually affect their financial viability.

On the other hand, the coefficients of financial self-sufficiency for financial cooperatives turn out to have the opposite signs to those for NBFIs in all measures of outreach. The estimated coefficient for financial self-sufficiency for average loan size is negative and statistically significant, indicating a positive complementary relationship between outreach to the poor and financial viability. While financial cooperatives overall did not cater more to women borrowers compared to NBFIs, the positive and significant coefficient for percentage of woman borrowers both before and after summing with the interaction term concurrently marked a harmony between outreach and financial self-sufficiency for cooperatives that are financially self-sufficient. It indicates that financially self-sufficient cooperatives serve higher fractions of women borrowers as compared to their counter-parts, implying greater depth of outreach along with financial sustainability. These results are also found to be insensitive for the samples considered (i.e., comparable results are found after omitting the four major semipublic NBFIs) (Table A.10).

As shown in the last column of Table 2.6, time between loan repayment schedule is positively linked with financial performance for both NBFIs and cooperative lenders that are financially self-sufficient (although less in magnitude and marginally insignificant for financial cooperatives). This results show that less frequent repayment schedules results in improved financial performance. This can be due to reduction of transaction costs. However, the welfare consequences of less frequent repayment schedules for borrowers are not clear cut. On the one side, given the presumed liquidity constraints of the typical microfinance clients, less frequent repayment can be pro-poor (wider in scope of outreach), as it does not require borrowers to have smooth income throughout the period. On the other side, more frequent loan repayment schedules can reduce the burden of one lump sum repayment for borrowers and therefore reduce potential defaults and delinquencies by inculcating fiscal disciplines. If the first conjecture is true, financial cooperatives are better in scope of outreach, as they provide loan terms with extended time between installments compared to NBFIs and *vice versa*.

Besides the commonly accepted measures of outreach, the study estimated the effect of catering to rural borrowers on financial performance, as serving the rural poor may involve additional costs. However, the results in column 3 of Table 2.6 show that percentage of rural borrowers is not significantly linked with financial self-sufficiency, irrespective of organizational form. What the study found is that, as compared to

25 The assumption is that loans with an extended repayment schedule are in the interest of better-off clients.

Table 2.6: Outreach and financial performance.

Indicator	Average loan size over GNP per capita	Percentage of women borrowers	Percentage of rural borrowers	Time between install-ment
Financial self-sufficiency	0.514	-0.245	-0.025	3.800
	(2.28)**	(2.39)**	(0.16)	(2.64)***
Financial self-sufficiency (coops)	-0.628	0.320	0.028	-2.582
	(1.99)**	(2.90)***	(0.16)	(1.55)
Financial coops	-0.648	-0.665	0.638	4.570
	(1.44)	(6.40)***	(2.42)**	(2.91)***
Age of the institution	-0.014	-0.002	0.049	0.189
	(0.51)	(0.32)	(3.81)***	(2.18)**
Age (coops)	0.076	0.006	-0.054	-0.124
	(1.68)*	(0.62)	(3.26)***	(0.91)
Institutional size	0.092	-0.062	-0.175	-1.632
	(0.58)	(0.99)	(1.64)	(2.51)**
Institutional size (coops)	0.664	0.100	-0.108	0.268
	(2.46)**	(1.29)	(0.76)	(0.21)
Length of client relationship	-0.048	-0.003	-0.005	-0.400
	(1.04)	(0.27)	(0.29)	(2.57)**
Donation over loan portfolio	0.098	0.234	-0.022	0.590
	(0.49)	(3.76)***	(0.14)	(0.41)
Number of source of capital	-0.532	0.118	0.116	0.463
	(2.59)**	(3.02)***	(1.27)	(0.60)
Individual/investor owned	-0.022	0.057	-0.077	-1.565
	(0.11)	(0.75)	(0.69)	(2.03)**
NGO owned	-0.087	0.013	0.345	-1.664
	(0.40)	(0.15)	(2.31)**	(1.60)
Constant	1.514	0.611	0.133	2.894
	(2.79)***	(4.19)***	(0.42)	(1.64)
R-squared	0.46	0.43	0.30	0.31
Number of obs.	107	107	107	107

Note: *** significant at 1%, ** significant at 5%, and * significant at 10%.
Source: Author's calculations, based on primary data collected between April and June 2012.

NBFIs client compositions by territory, a considerable proportion of clients served by financial cooperatives are from rural areas.

Additional trends that vary by organizational form also emerged from the controls of experience and scale. For NBFIs, no new evidence is found on the relationship between experience and institutional size on outreach indicators, with the exceptions of positive effects of age and size on the proportion of rural borrowers and scope of outreach, respectively. The significant positive coefficient for age and institutional size before and after summing up with respective interaction terms in the specification of average loan size indicates that experienced and large financial cooperatives do relatively poorly in outreach - large and experienced financial cooperatives have larger average loan sizes (Table 2.6). In this case, progressive lending, increasing loan sizes based on repayment records and with passage of time, can be at play. However, with the cross-sectional data at hand the effects of progressive lending and possible shifts in the composition of new members on average loan sizes as the institutions grow older, a phenomenon which is common in microfinance, cannot be identified.

The results on other variables accounted for in the specification are consistent with our predictions. On women borrowers, the positive and statistically significant coefficient of donation over loan portfolio indicates that donated microfinance providers in our sample tend to cater more to women borrowers. Their proportions of women borrowers are 23 percent higher than those of self-standing microfinance institutions. NGO-owned microfinance institutions, on the other hand, cater more to rural clients as compared to investor- and government-owned institutions. Furthermore, the significant negative and positive coefficient for the number of sources of capital in the specification of average loan size and percentage of women borrowers, respectively, suggests that microfinance providers with diversified sources of capital tend to focus on poor and women borrowers.

Overall, the evidence that emerged in this section clearly shows varying relationships between outreach to the poor and financial performance by organizational form. After controlling for experience and scale of operation, NBFIs that are financially self-sufficient perform poorly in outreach to the poor, signifying a tension between outreach and financial performance. In contrast, financially self-sufficient cooperatives perform well and are able to balance or achieve their dual objectives. The results show a positive complementary relationship between outreach and financial self-sufficiency for financial cooperatives. These results significantly mark the crucial role of organizational form in microfinance delivery. Specifically, it indicates that organizational form (with their differences in cost containment) matters most towards fulfilling the full promise of microfinance and achieving the double bottom-lines - serving the poor with financial sustainability.

2.6 CONCLUSIONS

From the early 19th century to the present, microfinance institutions have evolved as providers of customized financial services to the needy excluded by conventional banks. Through their innovative institutional arrangements and contract terms, they have overcome the high costs of market contracts and achieved high loan repayment rates, even in places where credit markets are inefficient. Financial cooperatives and non-bank microfinance institutions are typical models that disprove the traditional assumption that the poor are neither creditworthy nor able to save. They largely demonstrate that the poor can be bankable - the poor can borrow, pay substantial rates of interest, and save continuously. Nonetheless, their efforts used often to be backed by substantial subsidies in recognition of the costs involved in micro lending and their poverty focus. Providing financial services to the poor on cost-covering basis is a challenge that remains for most microfinance institutions.

Recently, however, growing commercialization and competition in the microfinance industry has driven a shift from reliance on subsidies to achieving financial sustainability - a goal that can be in conflict with outreach, as it requires the ability to cover costs out of the income generated, while serving the poor. The relevant policy question is, thus, whether and to what extent shifting the focus towards achieving financial self-sufficiency has impinged on outreach to the poor. Outreach and financial sustainability can be either complementary if the focus on financial viability attracts commercial funds, which at the same time contributes to expand outreach. Or it can be conflicting if it crowds out small loans that are often demanded by the poor, as they are costly to service.

Using Ordinary Least Square (OLS) regression that allows variables of interests to vary by organizational forms on data disaggregated by types of microfinance providers in Ethiopia, this study analyzed the implication of the pursuit for financial viability on outreach and the role of microfinance ownership or organizational form. It specifically compare financial cooperatives and NBFIs in their outreach and financial performance, and address whether and to what extent these two forms of organization vary in their ability to achieve financial self-sufficiency together with outreach to the poor. The study used a census of all NBFIs and a selection of financial cooperatives based on their audit status.

The results obtained from the analysis show that the effects of interest rates, potential compatibility or trade-off between outreach and financial sustainability, and cost-efficiency largely depends on organizational form. It shows that the NBFIs that charge higher interest rates are more financially self-sufficient than others, but only up to a certain point. Consistent with theoretical predictions, charging interest rates higher than the threshold results in lower profitability. For financial cooperatives, on the other hand, lower interest rates are linked with improved financial performance. Their bet-

ter performance in cost containment found in the cost of loans analysis could justify the profitability of financial cooperatives even when charging lower interest rates. The results also suggest that financial cooperatives charging higher interest rates are less profitable, indicating the extent of social compulsions and agency costs involved.

The evidence that emerged on the compatibility or trade-off of outreach to the poor and financial self-sufficiency, the primary issue this chapter sought to address, also varies by organizational form. The estimates show tensions between outreach and financial performance for NBFIs. The results obtained indicates that NBFIs lend small size loans and more to women borrowers, which are often taken to imply depth of outreach, face high costs that affect their financial viability. In contrast, the results show a positive complementary relationship between outreach and financial performance for financial cooperatives. On average, financially self-sufficient cooperative lend small size loans, serve larger fractions of women borrowers, charge lower interest rates, and reduce cost of loans compared to their counter-parts that operate below the cost-covering line.

Generally, the results suggest that the organizational form of microfinance providers has implications on both financial sustainability and outreach. NBFIs perform well in breadth and depth of outreach, but face higher costs, which strikes a tension between outreach and financial performance. On the other hand, with relative less breadth, financial cooperative are cost-efficient and earn better income after covering the costs incurred in serving the poor. Though it is probable that the development of financial market with a mixture of organizational or ownership form would best serve the clients, based on our findings, financial cooperatives better contain costs, balance the social and economic goals of microfinance, and enable the microfinance industry to fulfill its full promise - serving the poor on a cost-covering basis.

3

COST-EFFICIENCY AND OUTREACH OF MICROFINANCE PROVIDERS IN ETHIOPIA: TRADE-OFF AND THE ROLE OF OWNERSHIP

Abstract

Using a stochastic frontier approach, this chapter analyzes the cost-efficiency levels of microfinance providers in Ethiopia and spot the drivers of in/efficiency. It specifically examined the linkage between cost-efficiency levels and outreach of microfinance institutions so as to understand whether the recent imposition of financial sustainability and efficiency requirements in the industry influence microfinance institutions to compromise their traditional social mission. It also investigates the cost-efficiency differentials by ownership form of microfinance. The results show that operating at efficient cost frontier is an objective not yet achieved by the majority microfinance providers in Ethiopia. It indicated that most of the microfinance providers in the sample could have reduced their costs by half had they been achieved technical and allocative efficiency. The results from the drivers of cost in/efficiency suggested that serving the poor and more to women borrowers and cost-efficiency are challenging objectives to achieve altogether and can be contradictory. Microfinance providers that are closer to the best practicing cost frontier are those with higher average loan sizes and lower proportion of women borrowers. The results also indicated cost differentials by microfinance ownership form and financial cooperatives are found to be efficient in cost containment compared to non-bank microfinance institutions.

KEYWORDS: Microfinance; Financial cooperatives; cost-efficiency; Outreach; Trade-off; Ethiopia.

3.1 INTRODUCTION

Providing financial services tailored to the needs of small borrowers is a high cost business, as it requires considerable monitoring and enforcement costs. Due to the cost it entails, conventional banks in most of developing countries often exclude small borrowers from accessing financial services. Microfinance emerged as institutional innovation to overcome prevailing costs of market contracts and constraints in credit markets of low income communities where such costs are substantial. While their innovative loan terms and lending practices enable them to secure unusual high repayment rates in lending the poor, translating high repayment rates into profit and

perpetuating financial services to the poor on cost-covering basis have been a challenge remain for most microfinance, mainly because of high service or operating costs (Morduch, 1999).

Although lowering services costs can be beneficial both for borrowers and lenders in microfinance through reducing interest charges borne by poor borrowers and boosting credit demand and financial viability of lenders subsequently, microfinance institutions do little on cost reduction. Several decades after the introduction of microfinance, reducing high costs of services remain one of the greatest challenges facing the microfinance industry. For instance, recent estimates on the cost structure of microfinance still indicated higher interest charges to borrowers, of which about 62 percent are emanated from higher operating costs (Rosenberg, 2007; Gonzalez, 2007). Little attention on cost reduction by microfinance providers is partly because of a simplistic assumption which claims that poor borrowers demand financial services at any cost and microfinance institutions can pass costs of lending and associated risks onto borrowers and hence they should focus on expanding accessibility of financial services to the poor. Even in places where such costs cannot be adequately covered through interest charges to borrowers, they often tend to rely on subsides other than engaging on cost reduction experimentation and innovation (Morduch, 1999).

Recently, however, the growing commercialization and competition[1] in microfinance coupled with withdrawal of subsidies standout the need for cost-efficiency and achieving business viability in the industry. These recent developments which led microfinance institutions to strive for financial self-sufficiency and cost-efficiency in turn result a concern on its social mission or poverty focus. Despite its long term imperatives, the concern is that strife for profitability by microfinance institutions may shift its target to unbanked wealthier clients, as small loans are costlier to service and can be even challenging to serve on cost-covering basis (Weiss and Montgomery, 2005; Conning, 1999; Hulme and Mosley, 1996). In theory, however, these two goals - serving the poor together with financial self-sufficiency - can be in harmony if self-sufficiency requirements attract commercial funds and induce improvements in resource uses and allocations (Frank, 2008; Rhyne and Otero, 2006; Rosengard, 2004).

Despite growing concerns on the impositions of pursuing financial self-sufficiency on traditional social mission of microfinance (outreach to the poor), systematic empirical analysis on the drivers of microfinance efficiency is limited. Is serving the poor and more to women borrowers undermine cost-efficiency and profitability in microfinance is an open question. The evidence emerged from the existing few works is mixed. Stud-

1 Commercialization refers to the transformation of microfinance institution from heavily donor dependent sector of subsidized operation into financially self-sufficient and sustained microfinance that are part of the mainstream finance, which provides a wider range of financial services, that are saving, insurance, remittance, money transfer and so forth, in addition to credit. The competition on the other hand includes *ex ante* competitions from money lenders, competition among microfinance themselves and between microfinance and commercial banks (Christen, 2001; Kapper, 2007; Banerjee and Duflo, 2011).

ies by Hermes et al. (2011) and McIntosh et al. (2005) found tension between serving the poor and achieving efficiency and they indicated that wealthier client benefits from the strife for better financial performance. A global analysis of micro lenders by Cull et al. (2007) also corroborated the presence of potential trade-off between outreach and financial performance, which in their case varies by lending terms - for larger individual lenders the quest for improved financial performance considerably reduces outreach to the poor compared to other lending terms. In contrast, recent study by Quayes (2012) found profitable and efficient microfinance providers in serving the poor.

Building on prior works, of particular interest of this chapter is examining whether microfinance institutions in Ethiopia are reasonably cost efficient or do their expenses include avoidable or unnecessary expenses. It also tests whether relatively cost efficient microfinance institution do better in serving the poor. The information is useful for policy intervention, as microfinance institutions in Ethiopia involve considerable amount of public resources and promoted to expand financial services to the unbanked poor and hence failure to achieve wider breadth and deeper outreach in the pursuit of profitability can have a policy concern (Amha, 2007). The data set also allow us to compare and contrast the cost-efficiency or containment levels of the more traditional microfinance providers (i.e., financial cooperatives) with the recent non-bank microfinance institutions (the two dominate microfinance providers in Ethiopia) with the purpose of understanding the effects of ownership form (i.e., the way ownership is organized and practiced) on costs of microfinance delivery.

This study is distinctive compared to existing empirical works in two important aspects. First, it use disaggregated data that include both social oriented (financial cooperatives) and economic oriented (private-for-profit non-bank microfinance institutions) microfinance of varying size, which potentially reduces the large commercial firm and self-selection biases seen in prior studies[2]. Second, it deployed cost-efficiency as indicator of financial performance or sustainability and applied Stochastic Frontier Approach (SFA), a method that has not been widely applied in microfinance. The SFA is used to estimate cost-efficiency scores, which are used for comparing efficient use of available resources by ownership form, and to correlate outreach indicators with cost-efficiency estimated at a microfinance level.

The rest of the chapter is organized as follows: Section 2 review the relationship between outreach, ownership structure and cost-efficiency in microfinance and set hypotheses that guide the study. Section 3 describes the data used in the study, definition

2 The analysis of works by Cull et al. (2007), Hermes et al. (2011) and Quayes (2012) are largely based on microfinance institutions that self-select to voluntarily supply data to organizations like MIX Market and are united by their strong commitments to achieving financial self-sufficiency. Whereas, our data encompass both microfinance that are committed to achieving either economic viability or social visibility or both and the institutions are selected following stratified random sampling for financial cooperatives and census based for NBFIs.

of variables and results from the summary statistics. Section 4 presents the analytical approach followed to estimate and correlate cost-efficiency with outreach indicators. The results and discussions are presented in Section 5. The last section concludes by summarizing the main findings.

3.2 COST-EFFICIENCY, OUTREACH, AND OWNERSHIP STRUCTURE IN MICROFINANCE

Like any other goods and services, the pricing of microfinance products and services is a function of market contract and ownership costs. Interest charges to borrowers include costs of funds (i.e., financial costs), costs of associated risks, and operating costs - screening, monitoring and enforcement costs, agency costs, and decision making costs. However, such costs are not likely to be the same from microfinance to microfinance that varies by their target clients/orientation and ownership structures. These transaction and ownership costs are potentially affected by microfinance loan sizes, loan terms, scale, age, client location and density, and ownership form (i.e., which patron of the microfinance own the firm - investors/shareholders who supply capital, workers who supply labor or customers/clients who provide the demand).

While ownership costs may not greatly vary by orientation, microfinance providers targeting poor clients that demand small loan sizes and located in remote areas are likely to involve higher market contract costs than a microfinance serving unbanked wealthier clients or clients of a commercial bank (Armendáriz and Szafarz, 2009; Ghatak-Guinane, 1999; Morduch, 1999; Conning, 1999). In particular, costs related to screening, monitoring and enforcement of loans and costs of associated risks are expensive for microfinance providers that cater more poor borrowers. Consistent to theoretical predictions, despite the use of innovative loan terms like joint liability lending by microfinance institutions with poverty focus to deal with the likely consequences of these adverse characteristics of poor clients, costs are reported up the roof and still used as a rationale for higher interest charges to borrowers (Rosenberg, 2007).

In addition to the cost serving poor clients entail, microfinance reaching out poor and more women clients residing in rural areas with limited financial literacy also spent considerable energy and time on providing related services like training that doesn't directly contribute to output in terms of loan provided (Armendáriz de Aghion and Morduch, 2005). Moreover, continuous subsidies to microfinance providers targeting the poor owing to their poverty focus can be a disincentive for this type of lenders to engage in experimentation and innovation to avoid unnecessary expenses (Rosenberg, 2007; Morduch, 1999). These arguments on cost and efficiency differentials by microfinance orientation leads to the first hypothesis this chapter sought to test:

H1. *Microfinance providers that serve small size loans and more to women borrowers are less cost efficient (i.e., there is inevitable outreach cost-efficiency trade-off in microfinance).*

The way ownership is organized and practiced is another key determinant of microfinance performance. In theory, ownership is typically assigned to one or another class of firms patron (i.e., investors/donors, workers or customers) is to reduce the costs of ownership and market contracts between the firm and those patrons (Hansmann, 1996). Within the microfinance industry, despite their resemblances in products, services and client base, various ownership form exist, including Non-Bank Financial Institutions (NBFIs), credit unions/cooperatives, and Non-Governmental Organizations (NGOs). NBFIs are shareholder owned firms and distribute excess profits to investors. Credit unions/cooperatives are owned by their clients and distribute surpluses as a dividend for members. NGOs, on the other hand, are non-profit organization with no clearly defined owners and characterized by a non-distribution constraints.

Although microfinance institutions of all type face market contract and ownership costs, their ability to reduce such costs varies by ownership structure. For instance, as investor owned firms have clearly defined owners with pecuniary incentive, they are more able to reduce agency and decision making costs per output (Fama and Jensen, 1983). However, shareholder owned microfinance providers are at disadvantage position in terms of internalizing transaction costs which are significant component of microfinance cost structure, especially in imperfect financial markets where most of the microfinance providers operate. On the contrary, microfinance providers that are owned by their clients are more able to reduce costs stemming from market contracts through internalizing transactions (Desrochers and Fischer, 2002; Hasnmann, 1996). Taping on local information and dual roles of clients (i.e., clients as provider of both the demand for and the supply of loanable funds) that generate credible screening and monitoring incentives, credit unions/cooperatives can efficiently operate even in underdeveloped financial markets characterized by information asymmetries than NBFIs.

Moreover, while credit unions/cooperatives may involve collective decision making costs that doesn't directly contribute to output, pecuniary incentives that reduce agency costs are at a play, as they too have clearly defined owners like that of shareholder owned microfinance providers. In small financial cooperatives agency costs of controlling managers might not even arise, as there is no clear separation between ownership and control (Fama and Jensen, 1983). The ability of customer owned microfinance institutions in internalizing market contract costs and reducing agency costs related to delegation of authority over shareholder owned microfinance providers lead to the second hypothesis put forward in this chapter:

H2. *In microfinance provision institution that are owned by their clients/customers are more able to reduce transaction and ownership costs and achieve a maximum output given inputs than shareholder-owned non-bank microfinance institutions (NBFIs).*

The rationale for the H2 is also stems from low loan loss risks in credit unions/cooperatives. As most of them are saving-led in their approach, clients often cannot borrow

more than the sum of his/her saving and the saving of a co-signer (see examples from German credit cooperatives in Ghatak-Guinane, 1999). As a result, in case of default financial cooperative spent less time in loan recovery, as they can use the saving of the defaulter and co-signer to set-off unpaid loans. Whereas, NBFIs can be required to spend additional energy and time on loan recovery in case of default, extra activity which is not directly related to output production.

3.3 DATA AND VARIABLE DESCRIPTIONS

3.3.1 *Data source*

The study used primary data collected from 107 microfinance providers in Ethiopia between April and June 2012[3]. After dropping institutions with missing data points, the sample retained 107 microfinance institutions for analysis. This includes the whole NBFIs in Ethiopia, which are 30 in number and 77 financial cooperatives that account for about nine percent of the whole financial cooperatives. As indicated in chapter 2, in the case of financial cooperatives the data set is thus not representative of all. Together with NBFIs, however, the institutions in the data set serve the majority of microfinance clients in the country. The selection of financial cooperatives were mainly based on audit status of the institution, as most of the financial cooperatives are not audited continuously every year due to limited capacity of the supervisory authority[4]. For this reason, the institutions selected are those audited during 2011 and have audit report of the preceding year (2010). The availability of the audit reports for prior year enables the study to get reliable historical financial data for calculating some of our variables of interest.

As noted above, the sample include both specialized microfinance institutions and financial cooperatives with varying degree of social and economic motives. Considering both microfinance institutions with social and economic orientation offers substantial variations in institutional structure, size, loan terms, prices, costs, and risk taking strategies. It considerably reduces uniformity of products and lending terms which often make it difficult for researchers to systematically portray effects of products, loan terms and institutional changes on social and economic outcomes of microfinance (Cull et al., 2007; Morduch, 1999). Moreover, as the sample includes both small and

3 The data is collected afresh using a structured interview with the help of European Research Institute on Cooperatives and Social Enterprises (EURICSE), International Food Policy Research Institute (IFPRI), Association of Ethiopian Microfinance Institutions (AEMFIs) and Federal Cooperative Agency (FCA) of Ethiopia.

4 The cooperative promotion office audits financial cooperatives in Ethiopia, a public body organized to promote and supervise the cooperative businesses, or by a person assigned by this office. They are not allowed to independently arrange auditing services from the market (Federal Democratic Republic of Ethiopia: Proclamation No. 147/1998).

large microfinance providers, it also potentially reduces the large firm bias of prior studies, which relies on microfinance institutions that self-select to supply data and are united by their size and strong commitments to achieving financial sustainability (see Quayes, 2012; Hermes et al., 2011; Cull et al., 2007).

3.3.2 *Variable definitions*

Total costs and output

The study follow the financial intermediation approach suggested by Sealey and Lindley (1977) to measure the total costs. The approach define the production process of financial institutions as borrowing of funds from surplus spending actors and lending those funds to deficit spending actors. The paper used this approach with the assumption that an efficient microfinance institution would minimize the total operating expenses and interest expenses involved in the intermediation for any given output. The total cost is therefore measured as the sum of operating expenses and interest expenses by microfinance.

In selecting a microfinance product that measures output, the study consider financial activities that produce a flow of services linked with the use of capital and labor expenses and other material inputs. Based on this criterion, loan and deposit are the potential measures of output for microfinance, as it is difficult to measure earning asset which is often used to measure the output of banks[5]. Moreover earning assets doesn't directly relate to the microfinance objectives. The analysis used only one output measure that is loan to customers, which include all loans outstanding of microfinance, as deposit is not produced by all microfinance institutions in the sample. While loan to customer is produced by all microfinance, the quality of the loan might not be comparable. For instance, the loans can vary by size, repayment schedule, risk, collateral requirement and contracts to be enforced. For this reason, the study include loan loss expense and loan loss reserve over gross loan portfolio in our estimation of cost-efficiency to account for potential differences in output quality.

Input prices

Three input prices, one for labor, one for financial capital and the other for physical capital are included as measures of microfinance input. Salary, a price of unit of labor for a period, is used to measure labor input price. It is measured as a ratio of total

5 Ideally, the output of financial institutions is viewed as a services flow and the physical units of this flow are measured by earning assets, which is essentially a stock variable and consistent with the idea of profit maximization or cost minimization in competitive markets (Sealey and Lindley, 1997).

employee costs faced by microfinance to total number of employees for a period under consideration. Interest rate paid for borrowing and deposit is used to account for the price of financial capital, as the amount of financial capital hold based on the institution level of risk preference can have varying effect on total costs[6]. Total amount of deprecation for a period is used to proxy the third input price, which is a portion of physical capital involved in the production process.

Cost in/efficiency correlates

According to theoretical and empirical works on efficiency analysis of financial institutions by Sealey and Lindley (1997) and Berger and Mester (1977) the difference in efficiency across financial institutions can be associated with a set of factors. Such factors encompass identity and ownership structure of the institution (for example, holding vs. independent vs. member-based), market structure or concentration, market power, asset size, experience, level of capitalization and size of CEOs stock ownership in the institution. By the same token, in the estimation this study include ownership structure of microfinance, as cost-efficiency or containment often vary by ownership forms and lending terms in micro-lending (Morduch, 1999). The analysis contrasts two forms of microfinance ownerships, which vary in their identity: financial cooperatives vs. specialized or non-bank microfinance institutions.

It also includes age and size of microfinance, as they are major drivers of operational expense in microfinance provisions (Gonzalez, 2007). They are measured in number of years and volume of assets, respectively. Besides the common in/efficiency correlates suggested in finance literature, the estimation include two measures of microfinance outreach, average loan size and proportion of women borrowers, as correlates of microfinance in/efficiency. The assertion is that lending small size loans and more to women borrowers, which implies greater depth, entails higher costs in microfinance. Incorporating these outreach measures in the estimation also enable to understand the potential trade-off between outreach to the poor and cost-efficiency in microfinance, which is one of the primary focus of this chapter.

3.3.3 *Summary statistics*

Table 3.1 summarizes the descriptive statistics of the main variables used in the analysis. It reports the sample mean and standard deviation by ownership form (NBFIs vs. financial cooperatives), for the outcome and explanatory variables. The summary statistics comparison shows significant variations in total cost, output, input prices

6 See Berger and Mester (1997) for the implications of financial capital in cost-efficiency measurement of financial institutions.

Table 3.1: Summary statistics by organizational form.

Indicator	Non-Bank Financial Institutions (NBFIs) (n=30)		Financial cooperatives (n=77)		Sig. mean difference
	Mean	Std. Dev.	Mean	Std. Dev.	
Total cost (in millions of *birr*)	22.23	43.56	0.140	0.298	*Yes*
Gross Loan Portfolio (in millions of *birr*)	232.8	537.4	1.564	3.267	*Yes*
Salary (per personnel)	17325	6047	6803	6272	*Yes*
Depreciation (in millions of *birr*)	0.624	1.041	0.003	0.011	*Yes*
Interest expenses	0.084	0.048	0.051	0.039	*Yes*
Loan loss reserves over loan portfolio	0.080	0.160	0.035	0.035	*Yes*
Loan loss expenses (in millions of *birr*)	1.891	3.290	0.002	0.019	*Yes*
Average Loan Size (ALS)	0.464	0.340	1.135	1.224	*Yes*
Total number of active borrowers	70397	149377	247	600	*Yes*
% of women borrowers	0.581	0.168	0.395	0.233	*Yes*
Labor cost to asset	0.067	0.054	0.021	0.031	*Yes*
Capital cost to asset	0.076	0.076	0.021	0.048	*Yes*
Cost per unit of currency lent	0.263	0.157	0.099	0.074	*Yes*
Age of the institution	10.8	4.3	11.5	7.4	*No*
Asset size	2.6	0.674	1.42	0.637	*Yes*

Note: *Birr* is currency unit of Ethiopia. US$1 was officially exchanged for *birr* 17.2941 on December 30, 2011.
Source: Author's calculations, based on primary data collected between April and June 2012.

and outreach between financial cooperatives and NBFIs. The mean total cost of NBFIs is found to be significantly higher as compared to financial cooperatives. Such a difference is as expected, as the volume of output and associated input costs are comparatively higher for NBFIs. Whereas, as shown in Table 3.1, the volume of output, as measured by gross loan portfolio and outreach breadth, and input prices of financial cooperatives are significantly lower. It can be because financial cooperatives are small in size and constrained by local resources to expand breadth which at the same time affects costs and output. Additional measures of cost at the bottom of the summary table, labor and capital costs over assets also indicated variation in cost containment between the two microfinance lenders in Ethiopia.

The outreach indicators in Table 3.1 suggest that NBFIs cater more poor borrowers relative to financial cooperatives. On average NBFIs offer relatively lower loan sizes and serve higher proportion of women clients. The difference on loan sizes, however, can be due to differences in breadth of outreach. As shown at the middle of the same table, financial cooperatives are characterized by limited breadth, but have repeated interaction with their borrowers. Financial cooperatives in the sample serve a small set of members compared to NBFIs, which are 247 to 70,397[7], respectively. This difference on breadth of outreach is as expected, as financial cooperatives in Ethiopia are confined to a particular location or communities by their nature. And their breadth can be further constrained by local resources, since they have limited sources of capital compared to NBFIs, - financial cooperatives heavily rely on members equity and deposit for lending. NBFIs, on the other hand, are at an advantage in attracting various sources of capital and cover wider areas of operation.

3.4 EMPIRICAL APPROACH

Stochastic cost[8] frontier approach is used to measure efficiency of the microfinance institutions. In this approach cost-efficiency is measured in terms of how close a microfinance costs lie to the efficient cost frontier for a given technology (similar outputs and working conditions). The efficient frontier is determined by two conditions: minimum use of inputs (technical efficiency) and optimal mix of inputs (allocative efficiency) (Kumbhakar and Lovell, 2003; Battese and Coelli, 1995). The absence of either technical or allocative efficiency or both inevitably results in excess costs that make institutions deviate from cost minimization frontier and creates inefficiency.

Thus, cost inefficiency in this case measures the reduction in cost that could have been achieved if the microfinance institution were both technically and allocatively efficient. In other words, it measures the magnitude of cost that could be reduced to enable the microfinance institutions achieve both technical and allocative efficiency. As cost functions are not directly observable, inefficiencies are measured relative to an efficient cost frontier that is estimated from the data. Thus, microfinance cost inefficiency is defined as the difference between observed costs and predicted minimum costs for a given output, input prices and other institution specific variables.

7 It should be noted that the figure on average breadth of NBFIs is influenced by three to four big microfinance institutions that are partly owned by regional public bodies. The median size of active borrowers is rather 10,592 and there are NBFIs with less than 200 active borrowers.

8 There are three main concepts in measuring financial institutions level of efficiency; that are cost, profit and alternative profit efficiency. Considering the heterogeneity in underlying objectives (for instance, services motive, profit motive and so forth) of microfinance institutions in our sample, we deployed cost-efficiency concept, which relatively suites for either institutions with either social or economic objectives or both (Berger and Mester, 1997).

There are non-parametric and parametric methods to measure efficiency of units (for example, individual institutions, households and so forth). The non-parametric approach is often criticized because of its ignorance to the possible influence of measurement errors and other statistical noises in the data - it does not allow for random error caused, for instance, by luck (Coelli et al., 2005). Within the parametric approach, which accounts for random error caused by data problem and measurement errors, there are again two approaches, namely stochastic frontier approach (SFA) and distribution free approach (DFA), which vary in their treatment of random shocks on the production process that are not in the control of, for example, a microfinance institution (Kumbhakar and Lovell, 2000; Ainger et al., 1977).

This study use SFA, as it allows composite error terms that control both for measurement errors and other random effects that are not within the control of microfinance. Specifically, it follow the one-step SFA proposed by Battese and Coelli (1995), which estimates the cost frontier and inefficiency correlates simultaneously. The two steps SFA, on the other hand, involves a contradiction of assumptions and the inefficiency depends on the explanatory variables that could be partly affected by institution input choices based on knowledge of their level of inefficiency (see Wang and Schmidt, 2002 for detailed discussion).

The estimation of a microfinance relative efficiency using cross-sectional data is performed by estimating a stochastic cost function of the general form suggested by Berger and Mesters (1997) and Battese and Coelli (1995), as follow:

$$\ln C_i = f\left(y_i, w_i, z_i; \beta\right) + u_i + v_i \tag{3.1}$$

where C is the observed total cost faced by microfinance institution i; $f(\cdot)$ is suitable functional form; y_i is output measured by loan to customers; w_i is the vectors of input prices; z_i microfinance specific control variables; and β is vectors of unknown parameters to be estimated. The error term u_i is a non-negative random variable reflecting cost inefficiency $\left(u_i \sim N^{+}\left(\mu_i, \sigma_u^2\right)\right)$, which may increase costs above the best practice level. It specifically captures the effects of expenses on inefficiency, either on technical or allocative inefficiencies or on both (Kumbhakar and Lovell, 2003). v_i is the symmetric error component, which is assumed to be independently and identically distributed as $v_i \sim iidN\left(0, \sigma_v^2\right)$. It accounts random variations in cost due to measurement errors and other statistical noises.

As indicated above, the cost-efficiency is defined as the proportion of the minimum possible costs that can be obtained for specific inputs under using similar technology, in this case, if microfinance i were as efficient as microfinance in the sample operating at the efficient cost frontier (Berger and Mesters, 1997; Battese and Coelli, 1995). Thus, the cost-efficiency of microfinance i, adjusted by random error facing the same variable y, w, and z can be represented as follow:

$$CE^i = \frac{\hat{C}^{\min}}{\hat{C}^i} = \frac{\exp\left[\hat{f}\left(y^i, w^i, z^i\right)\right] \times \exp\left[\ln \hat{v}_i^{\min}\right]}{\exp\left[\hat{f}\left(y^i, w^i, z^i\right)\right] \times \exp\left[\ln \hat{v}_c\right] \times \exp\left[\ln \hat{u}_c^i\right]}; \; CE_i = \exp\left[-\hat{u^i}_c\right] \quad (3.2)$$

The cost-efficiency (CE_i) ratio indicates the proportion of costs or resources that are used efficiently. It can be also thought as the amount of cost that would have been saved if microfinance i had been technically and allocatively efficient (i.e., equivalent to $1 - CE_i$).

The inefficiency term (i.e., the excess costs incurred from not operating within a minimum cost possible) is modeled as a linear function of a set of microfinance specific variables. Specifically, the inefficiency term μ_i are assumed to be a function of a set of explanatory institution specific variables, z_n, and vectors of coefficients to be estimated, δ. Its general form is specified as follows:

$$\mu_i = \alpha + \sum \delta_{n,i} z_{n,i} \quad (3.3)$$

As mentioned above, equation (1) and (3) are estimated simultaneously in one-step SFA suggested by Battese and Coelli (1995), using maximum likelihood estimation method.

For the empirical specification of the cost function the study use some of the output and input measures of financial institutions suggested by Hermes et al. (2011), Fries and Taci (2005), Sealey and Lindley (1997), and Berger and Mester (1977). Specifically, it use loan to customers as a measure of output based on the value-added criterion applied by Fries and Taci (2005), and total expense per unit of labor and interest expense per unit of deposit as input prices following Hermes et al. (2011) and Sealey and Lindley (1977), which are consistent with the intermediation approach to modeling the production of financial institutions. Besides output and input prices, the estimation include microfinance specific variables to account for potential heterogeneity in output quality. The specification of the cost function estimated is given as follows:

$$\begin{aligned} \ln(TC) = \alpha + \beta_1 \ln(Salary) + \beta_2 \ln(Intexp) + \beta_3 \ln(LLP) + \beta_4 \ln(GLP) + \\ \beta_5 \ln(LLR) + \beta_6 \ln(Depreciation) + u_i + v_i \end{aligned} \quad (3.4)$$

where TCi is the sum of interest and operating expense of microfinance institution i; $Salary$ is the price of a unit of labor for the period, which is average salary per unit of labor per annum; $Intexp$ is the interest expense faced by a microfinance per unit of borrowing and deposit held; LLP is loan loss provision expense for the period; GLP is gross loan portfolio; LLR is loan loss provision over gross loan portfolio which

measures an microfinance risk taking strategies; and *Depreciation* is financial expenses as a result of obsolescence of physical capital.

Besides estimating cost-efficiency level of each microfinance institutions, describing the correlates of inefficiency is the rationale behind using a two step SFA. Towards this end, the inefficiency component of the error term denoted by μ_i (i.e., the first moment of the inefficiency distribution for microfinance i) is specified as a function of a set of outreach and microfinance specific explanatory variables in order to understand the trade-off between outreach to the poor and cost-efficiency. The estimation also introduced organizational dummy to understand the effect of the way ownership is organized and practiced (NBFIs vs. financial cooperatives) on cost containment. The complete lists of specifications of the inefficiency function estimated are as follows:

$$\begin{aligned}
\mu_i &= \alpha + \delta_1 loansize_i \\
\mu_i &= \alpha + \delta_1 woman_i \\
\mu_i &= \alpha + \delta_1 orgform_i \\
\mu_i &= \alpha + \delta_1 loansize_i + \delta_2 woman_i + \delta_3 orgform_i \\
\mu_i &= \alpha + \delta_1 loansize_i + \delta_2 woman_i + \delta_3 orgform_i + \delta_4 age_i + \delta_5 size_i
\end{aligned} \tag{3.5}$$

μ_i represents the inefficiency component of an MFI i, as defined above. *loansize* is one of the generally accepted measures of outreach omnipresent in the microfinance literature. It is the ratio of total loan outstanding and total number of active borrowers. The lower is the ratio, the greater the depth of outreach and *vies versa*. *women* is another accepted measure of outreach, which measures the proportion of female active borrowers. Higher percentage of women borrowers indicates greater depth of outreach. $orgform$ denotes organizational form dummy (i.e., 1 if the microfinance is financial cooperatives and 0, otherwise). The proposition here is that the inefficiency of microfinance may depend on the type of organizational designs, as some organizational forms are more effective in reducing or internalizing market contracts and ownership costs.

Besides outreach variables and organizational dummy, the estimation introduced *age* and *size*, as they are also major drivers of operational expense in microfinance provisions (Gonzalez, 2007). *age* controls for the effect of experience and learning on cost-efficiency. The presumption is that the older the microfinance institution, the more the experience to overcome excess costs and optimize mix of inputs. However, as far as age is concerned, the other way round can also hold, as more recently established microfinance institutions have the opportunity to learn from the existing knowledge accumulated by their antecedents. *size* is measured in total assets of microfinance, and controls for scales of operation. It allows the study to test the hypothesis that large microfinance institutions are more efficient, as they could benefit from economies of

scales or from the potential intensity of fixed costs over a large client bases and hence risk diversification.

3.5 ESTIMATION RESULTS AND DISCUSSIONS

3.5.1 *Input prices and output*

As indicated before, one of the greatest challenges facing microfinance providers is lowering their costs of lending. Reducing costs are beneficial both for microfinance providers and borrowers, as it can reduce interest charges to borrowers and improve repayment rates and financial performance of microfinance institutions subsequently (Gonzalez, 2007). The evidence emerged from the estimates of cost-efficiency indicated that operating at the efficient cost frontier is an objective not yet achieved by the majority of microfinance providers in Ethiopia. The predicted cost-efficiency scores[9] suggest that most of the microfinance in the sample could have reduced their costs by half had they been technically and allocatively efficient. The average cost-efficiency score for the whole sample is 63 percent[10], which implies 58.7 percent efficiency gap between the average microfinance and microfinance operating at the frontier (i.e., what costs 1 *birr* for the efficient microfinance, costs 1.587 *birr* for microfinance with average efficiency level, to produce similar outputs).

Panel A of Table 3.2 summarizes the estimation results of total costs with respect to output and input price variables from the cost frontier. The directions of relationships for the cost function are as expected in all cases. The estimated elasticity for the measures of input prices (salary and interest expenses) and output (gross loan portfolio) have statistically significant relationship with total cost. For a percentage fall in total cost, output falls by 0.76 to 0.84 percent, labor cost by 0.20 to 0.32 percent, cost of capital by 0.22 to 0.28 percent and cost of physical capital by 0.01 to 0.03 percent. In all, these positive coefficients denote higher costs, reflecting that salary, interest expenses and volume of gross loan portfolio are significant shares of the total costs of microfinance institutions in the sample. The elasticity of loan loss provision expense to total costs that accounts for output quality is also positive and statistically significant, indicating that the lower the quality of output (loan to customer), the higher the operating and interest expenses faced by the institutions. This can be due to high costs of contract enforcement in case defaults.

9 cost-efficiency score is defined as the ratio of the best practice cost to the actual observed costs, resulting in a score ranging from 0 to 1 representing the continuum between 100 percent inefficient and 100 percent efficient firms, respectively.

10 This result is comparable with what has been recently found by Kebede and Berhanu (2012). In their comparative studies of MFIs and Commercial Banks efficiency in Ethiopia they found a 64.7 percent cost-efficiency score for microfinance institutions.

3.5.2 *Outreach and cost-efficiency: is there a trade-off?*

Following the growing commercialization of microfinance, outreach-financial performance trade-off is a topic debated by both academic scholars and policy makers from all corners of the world and yet uncorroborated. The fundamental issue is that whether and to what extent the quest for achieving financial self-sufficiency has implication on the traditional social mission of microfinance - outreach to the poor. In other words, whether microfinance providers with poverty focus serving small size loans and more to women borrowers generate additional expenses that dont directly contribute to output in terms of loans provided and undermine cost-efficiency. This section presents the results from cost-efficiency frontier analysis that estimate efficiency scores and correlate estimated inefficiency with observed microfinance specific outreach variables in order to understand the existence and extent of trade-off between serving the poor and more to women borrowers and cost-efficiency in microfinance.

As shown in Panel B of Table 3.2, the results found across columns with different specifications suggest the presence of trade-off between cost-efficiency and outreach to the poor, as measured by loan size and proportion of women borrowers. The estimated coefficient for average loan size is negative and statistically significant, even after controlling for organizational form, experience and scales of operation. This signifies that microfinance with higher average loan size are more cost efficient than microfinance with lower average loan balance, that is often demanded by the poor. The results from the specification in column (2) and (4) for proportion of women borrowers in the loan portfolio has a positive and statistically significant coefficients, indicating that microfinance providers who cater more to women borrowers are less cost efficient.

Besides the evidences that emerge from inefficiency correlates, the results from unreported simple OLS regression that associate estimated cost-efficiency scores with outreach indicators (i.e., average loan size and proportion of women borrowers) also substantiate the tension between serving the poor and achieving cost-efficiency. The results found a statistically significant positive and negative relationship between cost-efficiency scores and average loan size and fraction of women borrowers, respectively, after accounting for age, asset size, donation over loan, average length of borrowing relationship and ownership. This result further marked that serving the poor and more to women borrowers is not in harmony with the pursuit of achieving cost-efficiency in microfinance.

Over all, the results that emerged from the cost frontier analysis are in line with the first hypothesis - microfinance providers that cater the poor and more women borrowers are less cost efficient - and correspond to the findings of prior studies by Hermes et al. (2011) and Cull et al. (2007) and are consistent with general theoretical predictions that asserts the presence of cost differential between serving poor and less poor or unbanked wealthier clients (Armendáriz and Szafarz, 2009; Conning, 1999).

Table 3.2: Maximum Likelihood (ML) estimation of the parameters for Stochastic Cost-efficiency Frontier (SCF) and correlates of inefficiency.

Cost function	Dependent variable: Total Cost in *Birr* (logged)				
Panel A: Input and output variables	(1)	(2)	(3)	(4)	(5)
ln (Salary (per personnel))	0.272 (3.51)***	0.323 (4.12)***	0.248 (3.06)***	0.223 (3.16)***	0.201 (2.86)***
ln (Interest expenses (per unit of deposit))	0.236 (5.28)***	0.220 (5.25)***	0.236 (5.27)***	0.272 (6.37)***	0.278 (6.65)***
ln (Gross loan portfolio)	0.835 (18.7)***	0.760 (19.7)***	0.793 (19.1)***	0.839 (21.6)***	0.856 (23.6)***
ln (Loan loss reserve over gross loan portfolio)	-0.006 (0.23)	-0.011 (0.40)	-0.002 (0.07)	0.001 (0.05)	0.004 (0.18)
ln (Loan loss provision expenses)	0.046 (2.76)***	0.070 (4.63)***	0.055 (3.15)***	0.050 (3.12)***	0.044 (3.05)***
ln (Depreciation)	0.022 (1.00)	0.029 (1.33)	0.023 (1.02)	0.007 (0.36)	0.020 (1.13)
Constant	-2.365 (3.61)***	-1.967 (3.07)***	-1.621 (2.31)**	-1.438 (2.37)**	-1.507 (2.62)***
Panel B: Cost inefficiency correlates					
Average loan size	-0.001 (1.67)*			-0.003 (2.86)***	-0.004 (2.25)**
% of women borrowers		1.896 (2.44)**		4.802 (1.68)*	1.129 (0.30)
Financial cooperatives			-1.034 (1.91)*	-0.865 (0.87)	-4.770 (2.09)**
Age of the institution					-0.018 (0.13)
Size of the institution (in total assets)					-2.099 (2.33)**
Constant	-0.237 (0.74)	-1.702 (2.84)***	-0.082 (0.22)	0.360 (0.20)	8.791 (2.24)**
Number of obs.	107	107	107	107	107
Wald chi2 test	3059.29	3047.94	1972.25	2697.22	3038.35
Prob > chi2	0.000	0.000	0.000	0.000	0.000
Log likelihood function	-78.511	-76.976	-78.446	-70.672	-67.614

Note: *** significant at 1%, ** significant at 5% and * significant at 10%.

Source: Author's calculations, based on primary data collected between April and June 2012.

Table 3.3: Cost-efficiency scores and t-test on mean difference between Financial Cooperatives (FCs) and Non-Bank Financial/Microfinance Institutions (NBFIs).

Ownership form of MFIs	Obs.	Mean	Std. Dev.	t-test with NBFIs
FCs	77	0.658	0.194	2.30 (0.041)**
NBFIs	30	0.562	0.191	
All MFIs	107	0.631	0.197	

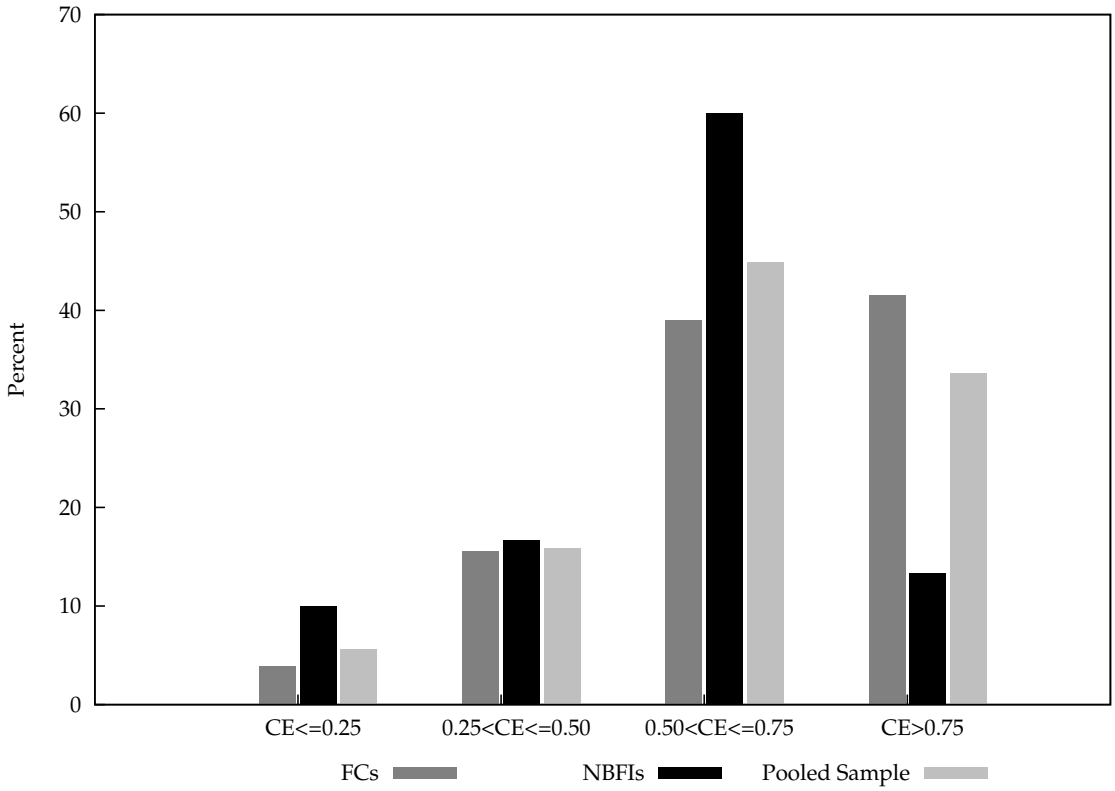
Note: ** significant at 5%. Standard error in parenthesis.
Source: Author's calculations, based on primary data collected between April and June 2012.

The difference in costliness of lending small size loans relative to larger loans can be even more significant in low income communities where most of the microfinance institutions operate. For instance, in countries like Ethiopia, such a trade-off between cost-efficiency and outreach to the poor can easily arise due to additional costs linked with difficulty of access to poor rural clients and monitoring and follow up efforts required from credit agents or microfinance institutions to deal with less educated borrowers, labor-intensive activities that doesn't directly contribute to the production process of outputs.

3.5.3 *Do non-bank microfinance institutions contrast with financial cooperatives in cost-efficiency?*

Another issue the study sought to analyze is the difference in cost-efficiency among microfinance institutions in the sample by ownership form. The question the study put forward is whether or not the way ownership is organized and practiced has implication on cost-efficiency or containment in microfinance. According to ownership theory, organizations that are owned by agents with pecuniary incentives are more able to reduce agency costs (Fama and Jensen, 1983; Jensen and Meckling, 1976). Moreover, organizations that are closer or owned by their customers are more able to reduce transaction or market contracts costs (Hansmannn, 1996). While pecuniary incentives can be at a play for both organizational forms in the sample, if this conjectures are true, financial cooperatives should be cost efficient as compared to specialized microfinance institutions, as they possess a better position to reduce delegation costs and overcome costs of market contracts which are higher in low income communities where both institutions operate.

In line with the second hypothetical prediction, the results from the mean difference test of predicted cost-efficiency levels show that on average financial cooperatives that are owned by their clients are cost efficient than NBFIs. The mean cost-efficiency score of financial cooperatives and NBFIs is 66 and 56 percent, respectively. This denotes



Source: Author's calculations, based on primary data collected between April and June 2012.

Figure 3.1: Frequency distribution of cost-efficiency scores by organizational form.

that what costs 1.0 *birr* for financial cooperatives, costs 1.17 *birr* for NBFIs to produce similar outputs. In other words, financial cooperatives in the sample are 17 percent more efficient than NBFIs and the efficiency gap is statistically distinguishable from zero (Table 3.3). Concurrently, as shown in Figure 3.1, about 41 percent of financial cooperatives have an efficiency score closer to the efficient cost frontier. On the other hand, more than 35 percent of the NBFIs operate at higher costs compared to the best practicing microfinance providers in the sample.

Besides the average cost-efficiency scores, the financial cooperatives dummy included as the correlates of inefficiency in the cost-efficiency estimation indicates relative cost containment among financial cooperatives. As shown in Panel B of Table 3.2, the estimated coefficient for financial cooperatives dummy is negative and statistically significant, implying that financial cooperatives are more cost efficient. They better reduce technical and allocative inefficiencies in microfinance delivery compared to NBFIs. This can be due to the fact that financial cooperatives benefit from better information and cheaper enforcement mechanisms available to them, as the owners are providers of both the demand for and supply of loanable funds. In other words, it can be due to

the fact that financial cooperatives better mitigate cost of market contracts, which account significant proportion of operating costs in microfinance, as they are embedded to the community where they operate. Whereas, non-bank microfinance institutions are top down in their approaches and serve wider client bases and the extent of knowing each other, which serves as screening, monitoring and enforcement mechanism is relatively imperfect. Their deeper outreach to the poor (poverty orientation) which founds to be in trade-off with cost-efficiency in this study can be also a potential explanation for excess expenses by NBFIs.

3.6 CONCLUSIONS

This study estimated cost-efficiency levels of microfinance providers in Ethiopia and analyze the implications of financial performance endeavor, a phenomena driven by the recent commercialization and competition in microfinance, on the traditional social mission of micro-lenders. The results indicated that microfinance institution in the sample are on average cost inefficient and can double their output in terms of loan provided using existing resources. Serving poor clients and achieving financial sustainability, as measured by levels of cost-efficiency, are found to be contradictory objectives. The results show that providing small size loans and catering more women borrowers, which implies greater depth of outreach, are positively and negatively linked with level of cost-efficiency, even after controlling for ownership structure, experience and scale of operation. It implies that microfinance providers that are closer to the best practicing cost frontier are those with higher loan sizes and lower proportion of women borrowers. Hence, to achieve complementarity, striving for financial self-sufficiency should focus on cost containment or reduction of excess costs. For instance, relying on commercial funds as a major source of loanable funds could be one among the creditable incentive or compulsion for improved cost-efficiency in microfinance.

The results also indicate the presence of a wider cost-efficiency gap between financial cooperatives and non-bank microfinance institutions, the second issue the study sought to address. The mean cost-efficiency score of financial cooperatives and non-bank microfinance institutions is 66 and 56 percent, respectively, implying a 17 percent efficiency gap between financial cooperatives and non-bank microfinance institutions. This cost-efficiency gaps can be due to the inherent ability of financial cooperatives to dispense with information and enforcement costs compared to non-bank microfinance institutions. Financial cooperatives are relatively at an advantage to effectively utilize social collateral as screening, monitoring and contract enforcement mechanisms, which potentially reduces cost of microfinance delivery. Members as a providers of both the demand for and the supply of loanable funds in financial cooperatives also can generate a credible incentive for individual clients to exercise economic and non-economic sanctions in case of default (Banerjee et al., 1994; Guinnane, 2001a). On

the other side, the commitment to expand outreach through increasing branches, reliance on non-commercial funds and lack of pecuniary incentives in some of multi-stakeholder owned NBFIs may have also resulted in this efficiency gap.

While institutional diversification and resulting competitions can benefit clients by lowering costs and improving services, based on the findings, financial cooperatives should enable the microfinance industry to deliver improved financial services at lower costs compared to non-bank microfinance institutions, as they are found to be relatively better in cost containment and efficient in resource allocation.

4

HETEROGENEOUS IMPACT OF ACCESS TO INSTITUTIONAL FINANCE ON AGRICULTURAL TECHNOLOGY ADOPTION: EMPIRICAL EVIDENCE FROM ETHIOPIA

Abstract

Whether financial institutions have an impact on technology adoption is a relevant research question to guide institutional development processes. Using farm household survey data and propensity score matching techniques, this chapter examines the impact of access to financial services from financial cooperative and microfinance institutions on the rates and levels of technology adoption and use in Ethiopia. The results show a robust and positive impact of access to institutional finance on farm households adoption and application rates of agricultural technologies, suggesting a large scope for increasing the diffusion and application intensities of modern farm inputs among smallholders through enhancing their access to financial services. Furthermore, disaggregating impact by farm size and ownership of the institution from where farmers receive financial services reveals considerable heterogeneity concealed by the mean estimates. In particular, greater impact on technology adoption is observed for farm households who use financial cooperatives, compared to those who use non-bank microfinance institutions. Moreover, while the effect of financial services on small farmers fertilizer application rates is relatively higher, its significant impact on adoption and application rates of improved seeds is observed only for large farmers. The study strongly recommend the need for institutional finance development and targeting in terms of farm size and form of financial institutions in the process of promoting rural financial services.

KEYWORDS: Institutional finance; Agricultural technology adoption; Impact; Ownership; Farm size; Ethiopia.

4.1 INTRODUCTION

Following the experience of the Green Revolution that led to doubling of yields for the major food grains, technological innovation and change in agriculture attracted greater attention among policy makers and scholars. Increased adoption of new technologies is generally believed to be a powerful force in reducing poverty. Recent studies by de Janvry and Sadoulet (2010), Minten and Barrett (2008), and Mendola (2007) also corroborated the crucial role of agricultural technology adoption on farm households

well-being and poverty alleviation. However, despite its considerable welfare impact, the diffusion of productivity enhancing technologies in agriculture remain slow, and many innovative technologies have met with only partial success (Feder et al., 1985). The diffusion rates are even slower in Sub-Saharan Africa where the gains from technology adoptions are direct (de Janvry and Sadoulet, 2010).

Substantial research work has been conducted to understand the determinants of differential speed and extent of technology adoption throughout the world and limited access to financial services (i.e., limited access to credit, saving and insurance) found to be one among the binding constraints[1] that deter adoption of technological innovations in smallholder agriculture (e.g., Dercon and Christiaensen, 2011; Croppenstedt et al., 2003; Feder and Umali, 1993; Bhalla, 1979; Lipton, 1976). Studies indicated the need for capital in the form of either accumulated saving or greater access to agricultural credit to the rapid and widespread adoption of agricultural technologies - differential rates of adoption are ascribed to differential access to capital.

The assertion is that access to financial services can allow resource constrained small farmers to adopt new technologies to some extent. Once they initially adopt, overtime cash availability to farmers is increased by the increased profit from partial adoption. Financial constraints, on the other hand, can discourage adoption, impede the intensity of uptake or introduce an element of substitutability in adopting technologies that are introduced as a package and complementary in yield (Feder et al, 1985; Clay, 1975). Access to financial services can go beyond the problems of credit or capital availability, as delivering other financial products that allow farmers to commit saving when they have cash available, such as immediately after harvest, can positively affect technology adoption (Duflo et al., 2008).

The conventional policy advance to overcome the adoption-discouraging effects of financial market inefficiency is subsidization of agricultural credit, mainly through state-owned development banks. Relaxing credit constraint through subsidies was believed to have positive effects on adoption by making credit available at lower rates and minimizing adverse effects of risks, uncertainties, and land market inefficiencies on adoption of agricultural technologies (Kelsey, 2011; Adams et al., 1984). While agricultural credit subsidies have played crucial roles to kick-start credit markets in poor rural economies (Dorward et al., 2004), directed subsidies, such as keeping interest rates on farmers loan unnecessarily low, have been largely criticized for generating allocative inefficiencies and failing to achieve their primary objective of overcoming credit constraint of small farmers and increasing agricultural investment, production and income subsequently (Binswanger et al., 1993; Adams et al., 1984; Adams and Graham, 1981).

1 Other factors that inhabit adoption of agricultural technology include risk and uncertainty, imperfect information, land size, tenure structure, labor availability, lack of insurance mechanisms and availability of the technology itself-supply side constraints (Fisher and Lindner, 1980; Lindner, 1980; Just and Zilberman, 1983; Feder et al., 1985; Dercon and Christiaensen, 2011).

In recent years, the dissatisfaction from prior directed agricultural credit program shifted the agricultural finance discourse from subsidies to a more market-oriented financial systems approach that adhere the principles of market mechanism. Along with the so-called smart subsidies the financial systems approach represents the state of the art in agricultural lending. Unlike the top-down government and donor credit programs, the financial system approach emphasis more on the creation of sustainable financial institutions and pricing of financial products and services to cover costs and associated risks (Meyer, 2011). This new paradigm guided the revolution of specialized microfinance institutions and revival of financial cooperatives (i.e., member-based financial institutions) across developing countries. Currently, financial cooperatives and specialized microfinance institutions have made inroads in the agriculture sector with loans tailored to seasonal and smallholder agriculture. There are many examples[2] demonstrating that these institutions have found mechanisms to deal with costs and risks of agricultural lending.

In Ethiopia, as of 2010, specialized microfinance institutions and numerous financial cooperatives channeled about two third of their loan portfolio to smallholder farmers (Amha and Peck, 2010). And all of the financial cooperatives and the majority of the microfinance also provide saving services that allow farmers to commit saving for future investments. However, there has not been any systematic study that evaluates the effects of these institutions on farm households technology adoption decision. Their successes often measured in terms of the breadth of loan disbursement and repayment rates rather than based on their impact at farm household level. They are often considered successful if they are able to expand availability of credits to agricultural and rural areas and generate high repayment rates. Despite the fungibility of credit, there is a need to better understand the impact of access to credit and other financial products from financial cooperatives and NBFIs on agricultural investments by smallholder farmers. Whether access to institutional financial services contributes to the diffusion and extent of technology adoption among smallholder farmers is the empirical question this chapter sough to address. The study also investigate the importance of the way the ownership of the institutional finance providers are organized and practiced and landholding size on adoption decision within farm households who have access to institutional finance.

The organization of the chapter is as follows. The next sections review the history of institutional finance provisions for smallholder agriculture in Ethiopia. The third section present the data used and definition and measurement of main variables of in-

2 As of the end of 2006, 20 MFIs in Nicaragua reported that 47 percent of their portfolios were in agriculture and forestry. In 2007, 37 MFIs in Uganda reported that 38 percent of their total portfolios were in agricultural loans. The Economic Credit Institution in Bosnia and Herzegovina, the Banco del Estado de Chile, Small Farmer Cooperatives, Ltd. in Nepal, the Cresol and SICREDI systems of savings and loan cooperatives in Brazil, Confianza in Peru, and several community-managed village savings and credit organizations (CVECAs) in parts of West Africa developed innovations to serve agriculture (Meyer, 2011).

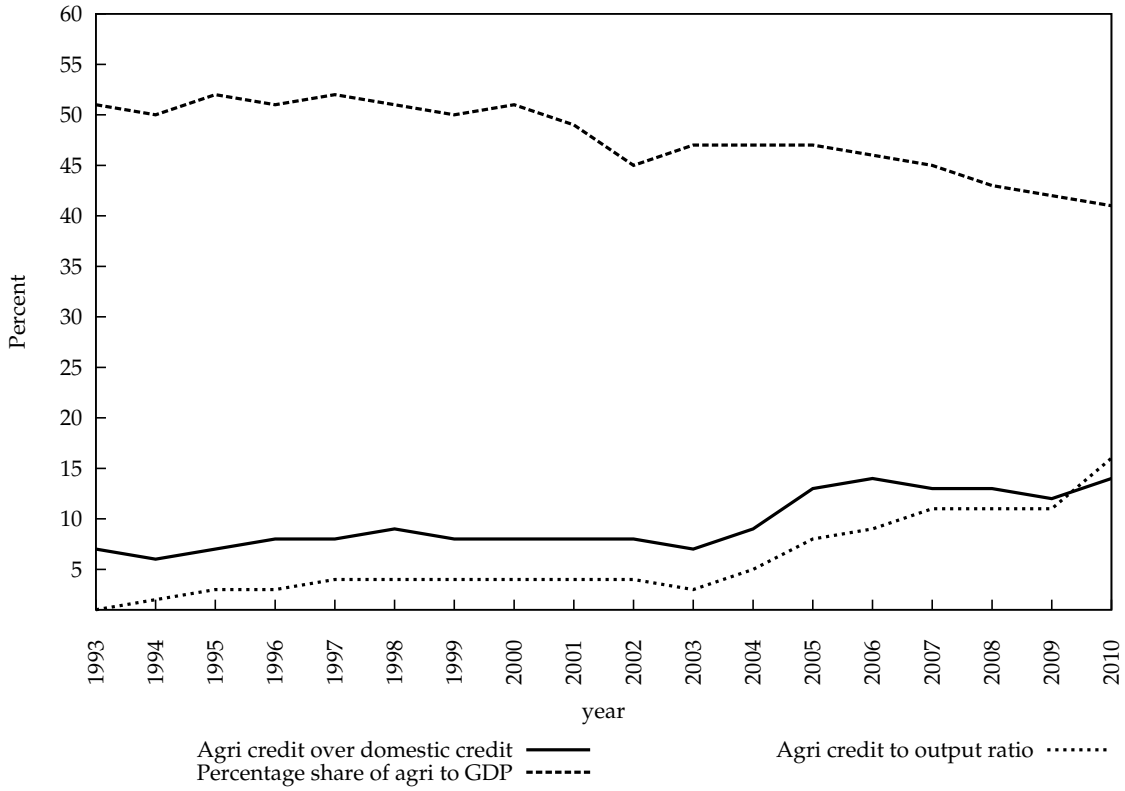
terest, while the fourth section discuss the empirical approach - the impact evaluation problem, propensity score matching and *p-score* estimation procedures, and results. The fifth section presents the results from the descriptive statistics and matching estimators. The final section concludes and sets policy recommendations.

4.2 INSTITUTIONAL FINANCE AND SMALLHOLDER AGRICULTURE IN ETHIOPIA

Smallholder agriculture in Ethiopia, which accounts 95 percent of the total agricultural production, remain less attractive for conventional commercial lenders mainly due to small transaction size, lumpy cash flows, covariant risks, and geographically dispersed farmers living in difficult locations to reach (Amha and Peck, 2010). Different policies have been practiced to address largely unmet credit demand in the agriculture sector. The most routine policy advance since 1960s is extending financial services to smallholder farmers through specially designed institutions that aimed at developing smallholder agriculture. However, most of these institutions often failed to meet the demands of smallholder farmers due to low repayment rates, capacity shortage and elite captures.

During the pre-reform periods in Ethiopia, financial products and services for the smallholder agriculture were provided by an array of banking and non-banking financial providers including development banks, investment corporations and cooperatives. Specifically, during the imperial regime (1960s - 1974), a period where agriculture was considered as a leading economic activity and received about half of the total domestic credit, there were two intermediary institutions - the grain corporation and farmers cooperatives - that received credit funds from state-owned banks and extended credits to farmers at concessional rates (EEA, 2000). However, as in most of the directed credit program elsewhere in the same period, the efforts to extend agricultural credit to small farmers were not a success. Of the 42-65 percent of the total domestic loan went to agriculture during the period, smallholder farmers received only 7.5 percent - agricultural credits were mainly accrued to large and influential farmers (Admassie, 1987; 2004).

Later on, even though the socialist regime (1974 - 1990) perpetuated the tradition of assigning specialized financial institutions to serve the smallholder agriculture sector with monopoly power, smallholder farmers were deprived of credit due to the credit policy of the period, which gave priority for the socialized sector. For instance, over the ten-year period of the regime, within the agriculture sector, about 89 percent of the credits were channeled to state farms and private smallholder farmers received only 9-11 percent (EEA, 2000). Furthermore, towards the end of the socialist era, depletion of capital faced by some of these lending institutions led to the complete termination of the negligible credit shares of smallholder farmers (Amha, 2010).



Source: the percentage share of agriculture to GDP is collected from the yearly national account statistics published by Ministry of Finance and Economic Development (MOFED). The total domestic credit and amount of credit channeled to agriculture are obtained from the National Bank of Ethiopia (NBE).

Figure 4.1: Percentage share of agricultural to GDP, share of agricultural credit to total domestic credit and agricultural credit to agricultural output ratio.

The post-reform period (1991/92 onwards), which started with the Structural Adjustment Program (SAP) to reverse financial distortions of all kinds, neither made agriculture attractive sector for conventional banks nor delivered adequate financial services for smallholder farmers. As shown in Figure 4.1, during the years after the economic reform, the total share of agricultural credit shrank considerably and its average share has been 10 percent for the last two decades. A recent study by Amha and Peck (2010) estimated a USD 3 billion credit shortage in the overall economic systems, and it seems that smallholder agriculture is suffering more strongly from this credit crunch than other sectors of the economy. While the core agriculture provides about 41 percent of the total gross domestic product (GDP) in 2010/2011, the share of total lending of the sector is only 14 percent (Figure 4.1). The resulting ratio of shares of lending to shares of GDP is again lower - only 34 percent. Moreover, the credit to output ratio for the same period indicates substantial credit shortage in the agriculture sector - the mean credit to aggregate value of total agricultural production over the last two decades is six percent.

Such a gap in agricultural finance is largely because the conventional financial institutions in Ethiopia provide hardly any credit to the agricultural sector (see Table A.5 in the appendix). Smallholder farmers in search of financial services mainly stumble upon microfinance institutions and financial cooperatives. Currently, microfinance institutions and cooperatives are the only institutions putting a clear focus on smallholder agriculture with roughly two-third of their loan portfolio (Amha and Peck, 2010). Along with the regional governments, these financial institutions act as intermediaries between banks and small farmers. While there have been cases of default that necessitated repayment out of regional state budget and these intermediary institutions (DSA, 2010), the institutions manage to channel a greater deal of credit to smallholder agriculture compared to previous regimes. As shown in Figure 4.1, since 2000 onwards, a period at which microfinance spread and cooperatives are revived, the share of agricultural credit and credit-to-output ratio are slightly growing.

Nonetheless, most of the microfinance and cooperatives in Ethiopia are very small in size and lack the capacity to lend large loans for indivisible agricultural investment (e.g., tractor, tubewell, oxen, etc.). Most of them lend small amounts aimed at increasing the productivity and income of small farmers through enabling them to adopt divisible technologies, such as improved seeds and fertilizer. Moreover, to our knowledge there is no systematic empirical evidence that examines adoption behaviors of the clients of these financial providers compared to independent farmers. In the absence of such evidence, the effects of credits and other financial services delivered by these institutions on farmers agricultural investment remain an open question, as use or diversion of credits for purposes other than agriculture is not impossible[3].

3 For instance, test of significance on product-moment correlation coefficient relating average annual rate of growth in institutional credit for agriculture and average annual rate of growth in gross domestic

4.3 SAMPLING, DATA AND VARIABLE DEFINITION

4.3.1 *Sampling and data*

Despite the presence of numerous financial cooperatives (i.e., more than 7000) and specialized microfinance institutions with considerable size of outreach (i.e., about 2.5 million clients) operating in various parts of Ethiopia, access to financial services is still rare, found only in a few *kebeles*[4] or villages. Many *kebeles* in Ethiopia do not have any institutional financial service providers. For this reason the study found randomly selecting farm households unfeasible at any geographic level above *kebeles*. As it was necessary to include enough farm households who have access to institutional financial services and choose to participate for this particular impact study, the only practical alternative was to stratify along the *kebele* status of financial access with a random selection of households in each stratum.

For this reason, the data used in the analysis come from a three month (April - June, 2012) farm household survey of 817 households selected by stratified random sampling from 21 *kebeles* in 21 districts of Ethiopia (i.e., one *kebele* from each districts)[5]. The *kebeles* are two types. The first group of *kebeles* is those where either specialized microfinance institutions or financial cooperatives are operating (not both) and it accounts for 46 percent of the total sample households. The list of farm households who have received financial services, credit in particular, from microfinance institutions and financial cooperatives is used as a sampling frame to randomly select households who have access to finance and choose to participate. The second group includes *kebeles* where no institutional financial service providers operate and represents the remaining 54 percent of the total sample. In this case households who have not access to financial services were randomly selected from the complete lists of households residing in the respective *kebeles*.

4.3.2 *Variable definition and measurement*

This study take in to account both supply side (i.e., the availability of institution providing financial services) and demand side (i.e., the choice of farm households to participate) factors in the construction of treatment variable - access to finance. Hence,

product from agriculture for the last two decades show a weak interdependence. The lack of strong relationship between growth in agricultural credit and agricultural output can be due to diversion of credit funds away from agricultural production purpose, if not due to time lag-questions.

4 Kebele is the lowest administrative unit in Ethiopia. Each kebele consists of at least five hundred families, or the equivalent of 3,500 to 4,000 persons.

5 The data is collected with the financial and technical support from European research institute on cooperatives and social enterprise (Euricse) and International Food policy Research Institute (IFPRI).

farm households who have access to finance (treatment group) are those residing in *kebeles* where there is/are institutional finance provider(s) and choose to participate (i.e., received agricultural credit for 2011/2012 production year). On the other hand, the comparison group constitutes farm households residing in *kebeles* where there are no formal sources of finance or financial service providers and who have never received institutional finance.

The outcome variables include adoption of the three most common divisible agricultural technologies in Ethiopia: that are; fertilizer, improved seeds, and pesticides. Given the complexity of adoption definition, both dichotomous and continuous measures of adoption are used for two of the technologies considered. The dichotomous fertilizer, improved seeds and pesticide dummy measures whether or not farm households make use of these technologies during 2011/2012 production year. However, in most of the cases knowing that a farmer is using fertilizer or improved seed may not provide complete information. It is because in divisible agricultural technologies, the majority of technology issues relate more to the extent and intensity of uses at individual farm level rather than the initial decision of adoption (Feder et al., 1985; Schutjer and Van der Veen, 1977). Thus, the study include a measure of intensity for fertilizer and improved seed technologies.

As shown in Table 4.1, farm households demographic, social and economic characteristics and attributes of financial services are also introduced in the estimation of the probability of access to finance (*p-score*). The selection of these variables is guided by previous theoretical and empirical works on the determinants of access to finance in similar contexts by Demirgüç-Kunt and Klapper (2012), Ibrahim et al. (2007), Hussien (2007), Bigsten (2003), and Diagne (1999), among others. The definition and measurement of the variables are presented in Table 4.1.

4.4 EMPIRICAL MODEL AND ESTIMATION STRATEGY

4.4.1 *The impact evaluation problem and propensity score matching (PSM)*

While there are many theoretical and practical reasons that access to financial services, mainly credit, can increase smallholder farmers adoption of agricultural technologies, but a *priori* one cannot be sure that (increased) adoption is caused by having access to finance. It demands a systematic observation of adoption patterns or behaviors of farmers both in the absence and availability of financial services. Ideally, randomized experiment would provide with the data on what would have been the status and intensity of adoption in the face of financial constraint (i.e., the counterfactual) and the outcomes in the two groups can be directly compared, as their units are likely to be similar (Rosenbaum and Rubin, 1983). Whereas, observational studies like this,

Table 4.1: Definition of variables and measurement.

Variable	Type	Definition and measurement
Treatment variable		
Access to finance	Dummy	= 1 if a household have access to finance and received loan during 2011/2012 production year.
Outcome variables		
Fertilizer adoption	Dummy	= 1 if adopted fertilizer in 2011/2012 agri production season.
Fertilizer per hectare	Continuous	Volume of fertilizer applied per hectare (in Kg).
Improved seeds adoption	Dummy	= 1 if adopted improved seeds in 2011/2012 agri prod season.
Improved seeds Volume	Continuous	Volume of improved seeds used (in Kg).
Pesticide adoption	Dummy	= 1 if adopted pesticide in 2011/2012 agri production season.
Independent variables		
Sex	Dummy	= 1 if male-headed and 0 if female-headed
Age	Continuous	Age of household head in number of years
Literacy	Dummy	Equal to 1 if the household head can read and write
Family size	Continuous	Number of household members
Distance to FCs/MFIs	Continuous	Walking distance from home to saving and FC or MFI
Distance to bank	Continuous	Distance from home to the nearest commercial bank (in km)
Distance to road	Continuous	Walking distance from home to the nearest road (in minute)
Remittance	Dummy	= of the household received remittance during 2011/2012 year
Off-farm income	Dummy	= 1 if the household generate off-farm income
Radio ownership	Dummy	= 1 if the household own radio
Land holding size	Continuous	Size of landholding in hectare
Irrigation	Dummy	Equal to 1 if the household own irrigated land
Livestock (in TLU)	Continuous	Livestock ownership in tropical livestock units
Safety net	Dummy	= 1 if the household participate in safety net program
Extension	Dummy	= 1 if the household participate in gov't extension program
Farmer training center	Dummy	= 1 if there is farmer training center in the *kebele*
Extreme risk averse	Dummy	= 1 if the household is extreme to sever risk averse
Moderate risk averse	Dummy	= 1 if the household is moderate risk averse
Neutral risk averse	Dummy	= 1 if the household is risk preferring to neutral

Note: Tropical Livestock Unit (TLU) is calculated based on conversion factors suggested by Asfaw et al. (2010), Chilonda and Otte (2006), and Jahnke et al. (1988). Fertilizer includes both DAP and UREA and improved seeds includes all types of High Yield Varieties (HYV) used during 2011/2012 production year.

Source: Author's calculations, based on primary data collected between April and June, 2012.

would not provide with the data on the counterfactual situation - there is always missing data or observation problem (Holland, 1986; Rubin, 1973; 1977). One can only compare farm households that have received credit with those who have not access to credit. However, direct comparison of these two groups may be misleading, as the self-selected household who have access to finance can generally differ systematically from the comparison group (Caliendo and Kopeinig, 2008; Dehejia and Wahba, 2002; Heckman et al., 1998).

Thus, in order to estimate meaningful impact of access to institutional finance on farm households status and intensity of agricultural technology adoption using observational data, one have to reduce some statistical pitfalls of cross-sectional inference while seeking to isolate the effects of access to finance from other socio-economic determinants of households technology adoption (e.g., education, landholding, risk preference, etc.). The most important is that the potential interdependence between access to institutional finance and adoption of agricultural technologies - farm households decision to be users or non-users of financial services can be associated with the net benefits from receiving institutional financial services. This section discuss a model that link treatment and outcome measures to show the scenario the study is in and review the commonly-used parametric and non-parametric methods to solve the problems of impact evaluation.

As noted before, the primary interest is to disentangle the effect of access to institutional finance from other potential household characteristics that influences technology adoption. Following Mendola (2007), the reduced-form model that define household access to finance and technology adoption can be referred in Eq. (4.1) and (4.2) to have a clear picture of the link between the treatment variable and output measures.

$$Y_{Di} = f_D(x_i) + \epsilon_{Di} \qquad D = 0, 1 \tag{4.1}$$

$$D = g(W_i) + \eta_i \tag{4.2}$$

Where Y_{Di} refers to status (intensity) of adoption of farm household i that have access to finance, D. Hence, Y_{1i} and Y_{0i} would refers to status (intensity) of technology adoption in farm household i who have access to finance and who have not access to finance, respectively. And agricultural technology adoption depends on a vector of observed explanatory variables x_i and a vector of unobserved variable ϵ_{Di}. In the second equation, D is a treatment variable equal to 1 if farm household i have access to finance and 0, otherwise. W_i is a sub set of x_i and include observable explanatory variables that determine the use of financial services. η_i summarizes other unobservable household specific characteristics that influence households access to financial services.

In such a situation, does access to financial services (mainly credit) improve technology adoption among farm households is the empirical question this chapter seek to address. In particular, the quantitative interest here is the average impact of access to institutional finance on status and intensity of technology adoption, which is Average Treatment Effect on the Treated (ATT) in impact evaluation terminology and can be specified as follows:

$$\begin{aligned} \tau_{ATT} &= E\left(Y_{1i} - Y_{0i} \mid D_i = 1\right) \\ \tau_{ATT} &= E\left(Y_{1i} \mid D_i = 1\right) - E\left(Y_{0i} \mid D_i = 1\right) \end{aligned} \tag{4.3}$$

Where $E\left(Y_{1i} \mid D_i = 1\right)$ is the outcome of farm households who have access to finance and $E\left(Y_{0i} \mid D_i = 1\right)$ is the outcome of these households had it been they do not have access to institutional finance (i.e., non-treatment outcome of treated units).

The basic problem in estimating the casual effect specified in Eq. (4.3) is that one can observe only $E\left(Y_{1i} \mid D_i = 1\right)$ from households who have access to institutional finance. We cannot observe the counterfactual - what would have been farm households decision to adopt technologies in the absence of access to institutional finance (i.e., $E\left(Y_{0i} \mid D_i = 1\right)$). In observational studies like this, the outcome of farm households who have not access to institutional finance (i.e.,$E\left(Y_{0i} \mid D_i = 0\right)$) is often used to overcome the missing observation problem and approximate $E\left(Y_{0i} \mid D_i = 1\right)$. However, approximating non-treatment outcome of treated units using self-selected non-users will have a selection bias $(B) = E\left(Y_{0i} \mid D_i = 1\right) - E\left(Y_{0i} \mid D_i = 0\right)$(Caliendo and Kopeinig, 2008; Heckman et al., 1998).

There are different parametric and non-parametric estimation methods that can be applied to reduce the bias arise from such approximation. The commonly-used parametric methods include control-function regression and instrumental variable (IV) estimators. If one assume that conditioning on a vector of observable characteristics restores the condition of randomization (i.e., conditional independent assumption: $(Y_1, Y_0) \perp D \mid x$), one can estimate the casual effect of access to finance on technology adoption using control-function OLS regression). However, if the conditional independent assumption does not hold, which is probable in cases where the selection into the treatment is not only due to observable variables, but also due to characteristics unobservable to the analyst, OLS regression could lead to biased estimates.

A variation on parametric OLS regression is to use an instrumental variable (IV) estimator, another parametric approach that can bring consistent estimation under the hypothesis of selection on unobservable (Caliendo and Kopeinig, 2008; Heckman et al., 1998). It solves the problem by treating the treatment variable as endogenous. But the application of IV estimator requires availability of at least one valid instrument Z, that is relevant and exogenous (i.e., $Cov\left(Z, D\right) \neq 0$ but $Cov\left(Z, e\right) = 0$) - the basic exclusion restriction under which IV estimator works. While this approach has the

advantage to restore the conditions in a natural experiment, it is fairly difficult to find variable that explains the selection and at the same time having no relation with the outcome. When such a variable is available its exclusion restriction is not easily testable. Furthermore, the validity of the casual inference using these commonly-used regression methods rests on ad hoc functional form assumptions required by standard parametric approaches (Jalan and Ravallion, 2003).

Propensity score matching (PSM) is another non-experimental, but non-parametric approach used for casual inference under the same hypothesis for parametric OLS regression (i.e., selection on observable, unconfoundedness or conditional independence). It is a method which substitutes for the absence of experimental comparison units using a set of potential control units that are not necessarily drawn from the same population as the treated units but from whom we observe the same set of parametric covariates (Dehejia and Wahba, 2002; Rosenbaum and Rubin, 1983). The study used PSM to estimate the impact of access to institutional finance on technology adoption, as it is generally preferred than parametric regression approaches for at least three reasons. One, it does not require parametric model linking treatment to outcome, it does not impose any functional forms (Smith and Todd, 2005). Two, it can impose a common support condition that improves the quality of the match - it confines attention to the matched sub-samples; unmatched comparison units are dropped. By contrast, the regression methods commonly found in the literature use the whole sample (Jalan and Ravallion, 2003). Three, it reduce the number of comparison groups to a sub-sample with characteristics more homogenous to the treated once (Cameron and Trivedi, 2005).

A further distinction relates to the choice of control variables. In the parametric regression approach one naturally looks for predictors of the outcome measure and predictors that are exogenous to outcomes are preferred. Whereas, in PSM one should consider covariates of treatment along with variables that are even poor predictors of outcomes, as the variables with weak predictive ability for outcome measure can still help reduce the bias in estimating casual effects (Jalan and Ravallion, 2003; Rubin and Thomas, 2000).

4.4.2 *The p-score matching procedure and estimation results*

As indicated above, the analysis deployed PSM procedure that restore the missing observations from non-users of institutional financial services for whom we observe the same set of characteristics to that of households with access to institutional finance. To do this, we need the conditional independence assumption from Lechner (1999), Heckman and Robb (1985), and Rosenbaum and Rubin (1983), which in this case states that access to institutional finance is random and uncorrelated with status (intensity) of technology adoption, once controlled for farm households pre-exposure characteris-

tics. Hence, the study first estimated the conditional probability of access to finance (i.e., $p(x_i) = \Pr(D_i = 1 \mid x_i)$), which allow to identify similar farm households given their observed characteristics since conditioning on all relevant covariates is limited or difficult in the case of high dimensional vectors like ours (Rosenbaum and Rubin, 1983). Here the estimation follow the common practices in PSM applications of using the predicted values from standard probit model[6] to estimate the propensity score of each observation with and without access to finance.

The estimated probit model is statistically significant at below 1% level and the model correctly classified 74 percent of farm households among users and 76 percent of farm households among non-users with a total correct prediction rate of 75 percent for the whole sample. The estimated propensity scores range between 0.000018 and 0.982266 with mean value of 0.453064 and standard deviation of 0.287863. The propensity score of farm households with access to finance ranges between 0.126941 and 0.982266 with mean value of 0.634021 and standard deviation of 0.187312. In contrast, with mean value of 0.298779 and standard deviation of 0.268204 the propensity scores of farm households without access to finance vary between 0.000018 and 0.966109. Hence, following the minima and maxima criterion the common support region for the distribution of estimated propensity scores of farm households with and without access to finance would range between 0.126941 and 0.966109. About 20 percent of farm households whose propensity scores lie outside this range are dropped from the analysis that follows (see Figure 4.1).

The results from the probit estimation are summarized in Table 4.2. From the results it was evident that farm households that are female headed and literate have higher probability of access or participation in formal financial institutions. Households that are literate and female head have higher probability of access to finance by 6.5 and 13.5 percentage points, respectively. This is plausible, because education can provide

6 In our estimation of the probability of access to finance, the decision of farm households to receive a financial product (e.g., credit) is analyzed using a random utility framework following similar applications by Abebaw and Haile (2013), Wollini and Zeller (2007), and Feder et al. (1985) on farmers decision to adopt technologies and participate in cooperatives, among others. We assume that the willingness or the decision to receive financial services is based on the maximization of an underlying utility function. Even though the actual utility function of each farm household U_i is unknown, farm households choose to receive financial product if the utility gain from receiving finance U_i^R is greater than the utility of not-receiving U_i^N. Hence the utility gain from receiving financial services (i.e., U_i^R- U_i^N) can be expressed as a function of a vector of observable variables x_i and a vector of parameters to be estimated $\beta : f_i(\beta' x_i)$, where $U_i = f_i(\beta' x_i) + \epsilon_i$. Following the random utility framework, the probability of receiving financial services by a farmer can be given by $\Pr(\epsilon_i < \beta' x_i)$. The error term in the model is assumed to have a standard normal distribution, thus validating the use of probit model. The empirical probit model estimated can be specified as follows: $\Pr(access = 1) = \Pr(\epsilon_i < \beta' x_i) = \beta' x_i + \epsilon_i$, where $access = 1$ if $U_i^R > U_i^N$ and $access = 0$ if $U_i^R \leq U_i^N$. The observed variables in the model include attributes of financial services and farm households demographic, social and economic variables (Table 4.1 and Table 4.2). The choice of the variables is guided by previous theoretical and empirical works in similar contexts by Demirgüç-Kunt and Klapper (2012), Ibrahim et al. (2007), Hussien (2007), and Diagne (1999), among others.

farm households with the information and ability to intermediate their financial resources. And greater access to finance among female headed household can be due to the special focus of microfinance providers on female borrowers in Ethiopia. The results also indicate that farm households engaged in off-farm activities besides farming and households residing in *kebeles* with farmers training center have higher propensity to receive institutional financial services. This hints that income from off-farm activities can provide households with insurance and thus increased demand for financial services, like credit.

On the other hand, farm households that are relatively wealthy (as measured by livestock ownership and ownership of durable assets) and have access to irrigated land are less likely to receive services from formal financial institutions. This may be due to the fact that households that are relatively better-off and with continuous harvest have less demand for external source of capital, as they may not face financial constraints. The results also indicated that participating in a safety net program is inversely linked with using financial services. This is also conceivable, because the majorities of households participating in safety net program are the very poor and are not attractive for lenders or the cash transfer from the safety net program satisfied their credit demand or loosen their liquidity constraint. Other variables included in the estimation of the propensity score like family size, remittance, participating in extension services and households degree of risk aversion do not have significant effects on households access to institutional financial services.

After getting the predicted propensity scores from the probit model, the study impose the common support or overlap condition (i.e., $0 < p\left(D = 1 \mid x\right) < 1$) in order to improve the quality of the match, as it drops all the comparison the value of whose $p\left(x\right)$ is higher or smaller than that of the treated[7]. The density distribution of propensity scores for users and non-users of institutional financial services by common support are presented in Figure 4.2. As it can be seen in the figure, the distributions appear with sufficient common support region that allows for matching. Besides, the difference between users and non-users in their propensity score distribution validates the use of matching techniques to ensure comparability. From several matching techniques applicable in impact evaluation, the study used three extensively applied matching techniques - non-parametric kernel based matching, five nearest neighbors matching, and radius matching - that use the similarities captured by *'p-score'* to match farm households that have access to finance with his/her closer non-users.

The non-parametric kernel regression method is used to allow matching of users with the whole sample of non-users, since the technique uses the whole sample of the

7 By the common support condition, the propensity score is bounded away from zero and, excluding the tails of the distribution $p\left(x\right)$ - between 0.126941 and 0.966109 in our case. This condition rules out the phenomenon of perfect predictability of D given x and ensures that farm households with the same x value have a positive probability of being both users and non-users of institutional financial services (Caliendo and Kopeinig, 2008; Heckman et al., 1997; Heckman et al., 1999).

Table 4.2: Probit estimation of determinants of smallholders access to institutional finance

Variables	Coefficient	Std. Err.	Marginal effect
HH head gender	-0.486***	0.149	-0.135
HH head age	-0.002	0.005	-0.000
HH head Literacy	0.234**	0.115	0.065
Family size	0.030	0.027	0.008
Distance to FCs or MFIs	0.011***	0.001	0.003
Distance to bank	-0.049***	0.003	-0.013
Distance to road	-0.005***	0.001	-0.001
Remittance	0.238	0.218	0.066
Off-farm income	0.337***	0.114	0.094
Radio ownership	-0.409**	0.161	-0.113
Land holding size	0.004	0.042	0.001
Irrigations	-0.389**	0.170	-0.108
Livestock (in TLU)	-0.031**	0.015	-0.008
Safety net	-1.791***	0.580	-0.498
Extension	0.164	0.132	0.045
Farmer training center	0.530***	0.204	0.147
Risk preference			
Moderate	-0.222	0.165	-0.062
Neutral	-0.111	0.159	-0.030
Constant	-0.044	0.485	-
Pseudo-R2	0.286		
LR chi2(18)	322.55		
Prob > chi2	0.000		
Number of obs.	817		
Sensitivity (%)	74.20		
Specificity (%)	75.74		
Total correctly classified (%)	75.03		

Note: Tropical Livestock Unit (TLU) is calculated based on conversion factors suggested by Asfaw et al. (2010), Chilonda and Otte (2006), and Jahnke et al. (1988). Extreme to sever risk averse is a reference category for risk preference dummy. *** significant at 1% and ** significant at 5%.

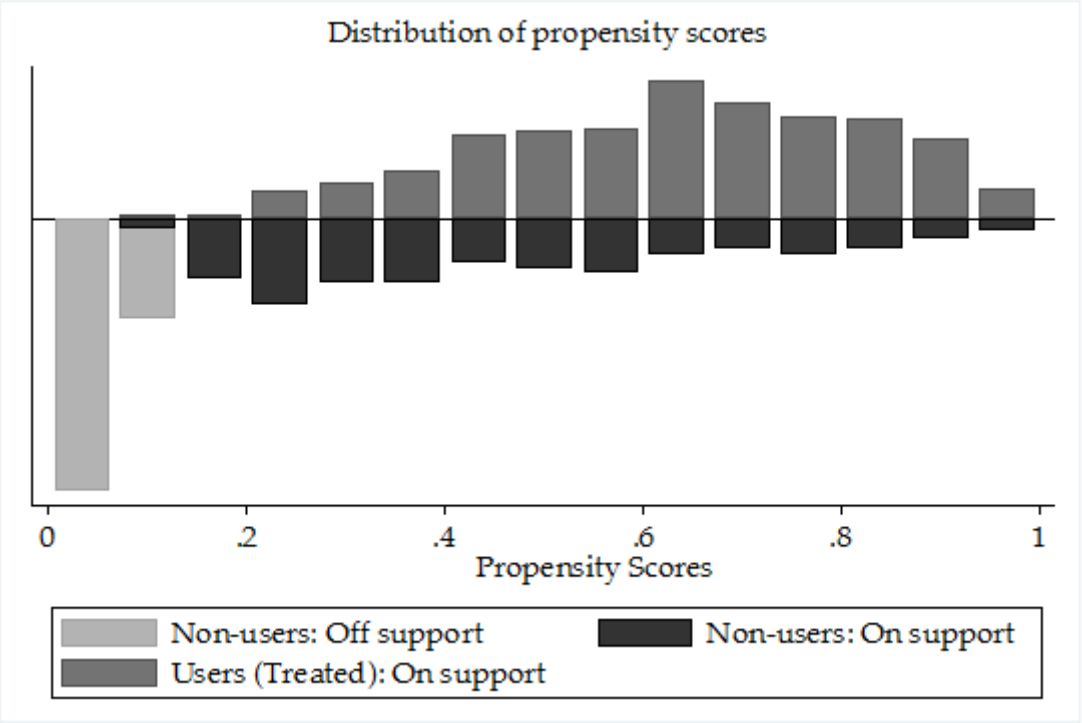
Source: Author's calculations, based on primary data collected between April and June, 2012.

comparison with common support to construct a weighted average match for each treated (Heckman et al., 1998; Heckman et al., 1997). That is, the entire sample of non-users in the comparison group is used to construct a weighted average match to each user in the treatment group. On the other hand, the five nearest neighbors matching is used to match each user with the mean of the five non-users who have the closest propensity score.

In the nearest neighbors matching, while all treated units find a match, some of the matches can be fairly poor because for some treated units the nearest neighbor may have a very different propensity score and nevertheless the unit will be considered to the estimation of the treatment effect independently of this difference (Caliendo and Kopeinig, 2008; Becker and Ichino, 2001). The study used a radius matching which offer a solution if poor matching prevails in case of nearest neighbors matching. With radius matching each treated unit is matched only with the control units whose propensity score falls in a predefined neighborhood of the propensity score of the treated unit. The smallest the dimension of the radius, the higher the possibility of unmatched treated units and the better is the quality of the matches (Becker and Ichino, 2001).

It should be noted that, as propensity score ($p(x)$) estimated from the probit model are used to ranks farm households according to their own behavior towards accessing or receiving financial services, matching based on $p(x)$ denotes evaluating the effect of access to institutional finance among a group of farm households having similar behavior towards receiving financial services. In other words, households preference for financial services is taken into account in evaluating its casual effect on technology adoption decision. The point is that, as it assume access to institutional finance is random within the group of farm households that have similar probability of access to financial services, the conditional independent assumption is now more plausible than in case of OLS - it reduce the bias due to observable heterogeneity.

However, the validity of this assumption relies on the extent to which the matching techniques construct a comparison group that resembles the treatment group. The study perform a balancing hypothesis test of covariates within blocks and covariates across matching techniques (i.e., $D \amalg x \mid p(x)$) in order to ensure that farm households with similar probability of access to financial services have the same distribution of pre-exposure characteristics. From multiple variations of balancing test exist in the literature, the study make sure that balancing across inferior bounds prevails in the estimation of the probability model (Becker and Ichino, 2002) and performed mean equality test across covariates suggested by Rosenbaum and Rubin (1985). As shown in Table A.4 and Table 4.3, the balancing property is satisfied in both cases. In particular, the balancing test based on mean equality test of covariates between households with access to finance and corresponding households without access to fi-



Source: Author's calculations, based on primary data collected between April and June, 2012.

Figure 4.2: Distribution of estimated propensity score by financial access and common support.

nance sampled by the matching techniques shows that the two groups are statistically comparable.

As shown in Table 4.3, the unmatched sample fails to satisfy the balancing property. Although the groups are found to be comparable in terms of age, family size, landholding, livestock ownership and risk preference, it shows a systematic difference between users and non-users in the majority of their observed characteristics before matching. The balancing test results after matching that compares users of financial services to the sub-set of comparison non-users selected through five nearest neighbors matching, kernel-based matching, and radius matching shows no systematic or statistical difference in observed characteristics between the two groups (the balancing test results based on the radius matching are not reported to conserve space). Moreover, the standardized bias[8], another indicator to assess the balance of all covariates suggested by Rosenbaum and Rubin (1985), found to be less than 5 percent across the covariates, except for sex and age of household head. In all, the results from the balancing hypothesis test suggest that the comparison is valid from statistical point of view.

Hence, assuming that the implicit unconfoundeness holds, since the estimation accounts for variables that influence access to institutional finance (e.g., distance, education, off-farm income, etc.) and technology adoption decision (e.g., landholding size, extension services, degree of risk aversion, etc.), the estimated average effect of access to institutional finance for farm households with similar propensity score can be specified as follows:

$$\tau_{ATT}^{PSM} = E_{p(x)|D=1}\left[E\left(Y_{1i} \mid D_i = 1,\, p\left(x\right)\right) - E\left(Y_{0i} \mid D_i = 0,\, p\left(x\right)\right)\right] \tag{4.4}$$

Where $E\left(Y_{1i} \mid D_i = 1,\, p\left(x\right)\right)$ is the outcome of households who have access to institutional finance and choose to participate and $E\left(Y_{0i} \mid D_i = 0,\, p\left(x\right)\right)$ is the outcome of households who have not access to institutional finance and have similar observable pre-exposure parametric characteristics with that of households received institutional financial services.

It has to be also noted that, even if PSM has become popular in impact evaluation under the hypothesis of selection on observables, the procedure is not free from other potential source of biases. Among others, the need to consider a rich set of explanatory variables related to treatment and outcome, geographic mismatch (i.e., the failure

8 It is the standardized mean difference between treatment and comparison group and can be specified as $B\left(x\right) = 100 \times \frac{\bar{x}_T - \bar{x}_c}{\sqrt{\frac{V_T(x)+V_C(x)}{2}}}$, where $\bar{x}_T$ and $\bar{x}_C$ are the sample means for the treatment and comparison groups, respectively. $V_T\left(x\right)$and $V_C\left(x\right)$are the corresponding sample variances. Total standardized biased is estimated as an unweighted average of all covariates, and the percentage bias reduction can be calculated as $BR = 100 \times \left[1 - \frac{B_{after}}{B_{before}}\right]$. Standardized bias below 5 percent after matching is seen as sufficient (see Rosenbaum and Rubin (1985) and Caliendo and Kopeinig (2008) for detailed discussion).

Table 4.3: Balancing test of matched sample.

Variables	Unmatched samples			Kernel-based matching			Five-nearest neighbors matching		
	users	Non-users	Diff: p-value	users	Non-users	Diff: p-value	users	Non-users	Diff: p-value
HH head gender	0.88	0.77	**0.000**	0.78	0.85	**0.015**	0.78	0.84	**0.031**
HH head age	41.9	42.9	0.161	41.9	43.7	**0.018**	41.9	43.8	**0.014**
HH head Literacy	0.63	0.46	**0.000**	0.63	0.65	0.597	0.63	0.63	0.964
Family size	5.99	6.18	0.242	6.01	6.15	0.400	6.01	6.12	0.504
Distance to FCs/MFIs	60.1	53.5	**0.099**	60.1	58.8	0.774	60.1	59.3	0.873
Distance to bank	15.0	30.6	**0.000**	15.1	14.7	0.740	15.1	14.4	0.561
Distance to road	65.2	69.4	0.289	65.6	60.6	0.150	65.6	62.3	0.343
Remittance	0.06	0.04	0.140	0.06	0.07	0.576	0.06	0.07	0.554
Off-farm income	0.46	0.34	**0.000**	0.46	0.44	0.518	0.46	0.44	0.528
Radio ownership	0.84	0.92	**0.000**	0.84	0.85	0.901	0.84	0.86	0.632
Land holding size	2.39	2.27	0.346	2.39	2.47	0.512	2.39	2.51	0.311
Irrigation	0.09	0.16	**0.003**	0.09	0.09	1.000	0.09	0.08	0.817
Livestock (in TLU)	6.43	6.64	0.508	6.45	6.84	0.189	6.45	6.97	**0.079**
Safety net	0.01	0.04	**0.000**	0.01	0.01	0.423	0.01	0.00	0.318
Extension	0.76	0.72	0.286	0.75	0.75	0.974	0.75	0.76	0.810
FTC	0.93	0.86	**0.001**	0.93	0.94	0.610	0.93	0.94	0.608
Risk preference									
Moderate	0.37	0.36	0.614	0.38	0.36	0.707	0.38	0.36	0.694
Neutral	0.47	0.49	0.704	0.47	0.47	0.951	0.47	0.47	0.861

Note: Tropical Livestock Unit (TLU) is calculated based on conversion factors suggested by Asfaw et al. (2010), Chilonda and Otte (2006), and Jahnke et al. (1988). Extreme to sever risk averse is a reference category for risk preference dummy. Bold p-value indicates differences significant at a 10% level or lower. The balancing test for matched sample presented in Table 4 is for the outcome fertilizer dummy. The balancing test results based on radius matching are not reported to conserve space. Moreover, the analysis calculated balancing tests for all outcome variables and the results are found to be more or less similar.
Source: Author's calculations, based on primary data collected between April and June, 2012.

to control local differences when matching treated and control units), the need to measure dependent variable in the same way for both groups, and selection on unobservable are some of the potential sources of bias identified in the empirical literature (Smith and Todd, 2005; Heckman and Navarro-Lozano, 2004). In the matching analysis that follows we eliminate some of the concerns related to considering relevant variables that explain treatment and outcome and measurement issues of dependent variable.

With regard to selection on unobservable, since the study employ PSM that compare users and non-users of financial services whose propensity score have the same distribution, it is assumed that the distribution of unobservable characteristics are the same or at least not so different for both groups independent of treatment to induce a bias (Becker and Ichino, 2002). In other words, the conditional independent assumption rule out potential unobserved household characteristics in the propensity score estimation. Furthermore, since the conditional independent assumption cannot be directly tested with observational data, the estimation took the following three measures suggested in the literature to address possible underestimation or overestimation due to unobserved selection. One, it impose common support condition (Heckman et al., 1997). Two, it include several relevant variables in the *p-score* estimation to overcome omitted variable bias (Smith and Todd, 2003). Three, it performed Rosenbaum bounds (i.e., rbound) sensitivity analysis to test the sensitivity of the results to possible hidden biases due to unobservable household characteristics when this assumption is relaxed (Rosenbaum, 2002)[9].

Finally, the estimation checked for the robustness of the results using *p-scores* estimated based on reduced probit specification (excluding potential endogenous variables), whole sample (that include households who have access to institutional finance but choose to not participate), and alternative estimation method (control-function regression). The analysis also checked for possible heterogeneous effects by plotting the impact distribution of access to institutional finance on agricultural technology adoption for user households and disaggregating the impact estimates using subrogate

9 From multiple variations of sensitivity test for matching analysis, the basic issue addressed by rbounds approach is whether inference about the treatment effects may be changed by unobserved covariates. To check for the sensitivity of the matching analysis for unobserved heterogeneity, it is assumed that the participation probability π_i is not only determined by observable covariates,x_i, but also by unobservable factors $u_I : \pi_i = \Pr(D_i = 1 \mid x_i) = F(\beta x_i + \gamma u_i)$. u_i is the unobserved variables, and γ is the effect of u_i on the decision to participate (i.e., on the decision to receive institutional finance in this case). If the study is free from hidden bias, γ will be equal to zero and the participation probability will be only be determined by x_i. However, if there is a hidden bias, two individuals with the same observed characteristics x have differing probability of receiving a treatment. Varying the value of γ allow to assess the sensitivity of the results with respect to hidden bias. Based on that, for each value of Γ, bounds for significant levels of the treatment effect under the assumption of selection on unobservable in the treatment status and confidence intervals can be derived (Rosenbaum, 2002; Caliendo and Kopeinig, 2008; Keele, 2010).

variables, which potentially capture households and institutional factors that influence farmers adoption decision.

4.5 RESULTS AND DISCUSSIONS

4.5.1 *Descriptive statistics*

Table 4.4 presents the summary statistics and mean difference test results between farm households with and without access to institutional finance across the outcome measures and household demographic, social and economic characteristics. The results from the summary statistics bring some good news on the adoption rates of agricultural technologies, in particular on adoption rate of fertilizer[10]. Of the total farm households who have access to institutional finance 99 percent of them use fertilizer during 2011/2012 production year. The corresponding figure for households without access to institutional finance is 74 percent, which is still substantial proportion. The adoption rates of improved seeds are also encouraging. From the total sample, 63 percent of farm households among users of institutional finance and 42 percent of non-users adopt one or more varieties of improved seeds. However, when looking at the intensity of use, which is more important than the initial adoption decision, the majority of households in the sample use these technologies below the recommended rates. In particular, application rates of fertilizer among households who have not access to institutional finance is far below the recommended rate by about 50 percent[11].

Overall, the results from the descriptive statistics on the outcome measures (i.e., adoption and application rates of fertilizer, improved seeds and pesticides) indicate statistically significant differences between households with and without access to institutional finance on adoption and application rates of agricultural technologies. On average farm households who have access to institutional finance and choose to participate have higher rates of adoption and intensity of uses. However, as stated in the previous sections these results cannot be used to make inferences regarding the impact of access to finance on improved agricultural technology adoption since the results does not account for potential confounding factors (i.e., factors correlated with both access to finance and, independent of access, are causally related to agricultural technology adoption).

Table 4.4 also reports sample mean values and mean difference test results for farm and household characteristics of households living in *kebeles* with access to finance

10 It has to be noted that the adoption and application rates of fertilizer and improved seeds might not be the same everywhere in the country. We presume that the majority of the 21 districts considered in this study are relatively accessible.

11 The recommended dose is 200kg per hectare as cited in Zerfu and Larson (2011).

Table 4.4: Summary statistics of sample households by access to institutional finance.

Indicators	Users of institutional finance (n=376)		Non-users of institutional finance (n=441)		Difference in mean (p-Value)
	Mean	Std. Dev.	Mean	Std. Dev.	
Fertilizer adoption	0.99	0.07	0.74	0.43	**0.000**
Fertilizer per hectare	157.2	91.65	95.06	90.31	**0.000**
Improved seeds adoption	0.63	0.48	0.42	0.49	**0.000**
Volume of Improved seeds	36.21	42.67	17.86	30.65	**0.000**
Pesticide adoption	0.76	0.42	0.68	0.46	**0.016**
HH head gender	0.88	0.32	0.77	0.41	**0.000**
HH head age	41.94	10.14	42.96	10.54	0.161
HH head literacy	0.63	0.48	0.46	0.49	**0.000**
Family size	5.99	2.10	6.18	2.46	0.242
Distance to FCs/MFIs	60.17	66.89	53.54	47.25	**0.098**
Distance to bank	15.02	16.80	30.62	16.65	**0.000**
Distance to road	65.21	44.77	69.44	65.32	0.289
Remittance	0.06	0.24	0.04	0.20	0.140
Off-farm income	0.46	0.49	0.34	0.47	**0.000**
Radio ownership	0.84	0.36	0.92	0.25	**0.000**
Land holding size	2.39	1.54	2.27	1.87	0.346
Irrigation	0.90	0.28	0.16	0.36	**0.002**
Livestock (in TLU)	6.43	3.58	6.64	5.30	0.507
Safety net	0.002	0.05	0.04	0.20	**0.000**
Extension	0.76	0.42	0.72	0.44	0.286
Farmer training center	0.93	0.24	0.86	0.34	**0.000**
Risk preference					
Moderate	0.37	0.48	0.36	0.48	0.613
Neutral	0.47	0.50	0.49	0.50	0.704

Note: Tropical Livestock Unit (TLU) is calculated based on conversion factors suggested by Asfaw et al. (2010), Chilonda and Otte (2006), and Jahnke et al. (1988). Extreme to sever risk averse is a reference category for risk preference dummy. Bold p-value indicates significance differences at a 10% level or lower.

Source: Author's calculations, based on primary data collected between April and June, 2012.

and choose to participate and households who have not access to institutional finance. The results show a statistically significant difference between the two groups of farm households on some of the households demographic, social and economic variables. It indicates that farm households who have access to finance are comparatively more of male-headed, educated, and residing closer to banks and farmer training centers. Despite higher probability for receiving institutional financial services and the special focus of microfinance institution on female borrowers, we suspect that the observed lower level of financial service use among female-headed households can be due to gender gaps in other dimensions, such as lower land ownership, income and education.

Closer proximity to banks and extension providers, on the other hand, may provide information on the availability and use of financial services for farm households who have access to institutional finance and choose to participate. It also appears that households who have access to finance more likely to have off-farm incomes. While additional income from off-farm activities and remittance might loosen liquidity constrain at household level and thus credit demand, the positive correlation between off-farm income and access to finance is also plausible, as off-farm income can provide households with the additional income and insurance and thus increases the demand for saving and credit, respectively.

On the other hand, farm households who have not access to institutional finance are more likely to participate in safety net programs. Even though increasing households use of credit is one among the aims of the productive safety net program in Ethiopia (Gilligan et al., 2008), this result show relatively lower use of credit among households participating in safety net program. For all other variables (i.e., family size, remittance, land ownership, livestock ownership, and risk preference) differences between the two groups are not statistically significant, hinting that there is no selection bias in receiving institutional financial services by wealth status and degree of risk aversion. In all, the results from the descriptive statistics are consistent with similar previous works on determinants of access to finance by Demirgüç-Kunt and Klapper (2012), Aterido et al. (2011), Richter (2008), Bigsten (2003), Schmidt and Kropp (1987), and Millar and Ladman (1983), among others.

4.5.2 *Average impact of access to institutional finance on technology adoption*

While there are many practical reasons that access to institutional finance (mainly credit) can encourage subsistence smallholder farmers to adopt agricultural technologies, a *priori* one cannot be sure that improved adoption of agricultural technologies is caused by having access to finance, as adoption decision can be equally influenced by many other factors (e.g., household characteristics, land size and tenure structure, access to information, households degree of risk aversion, etc.). This chapter seek to iso-

late the impact of access to institutional finance on farm households adoption and application rates of agricultural technologies following propensity score matching (PSM), a method which accounts for potential confounding factors.

Table 4.5 presents the average effect of access to institutional finance on adoption and application rates of technologies estimated following Eq. (4.4). The results across the three matching algorithms consistently show a positive and statistically significant impact of access to institutional finance on smallholders adoption and application rates of agricultural technologies, except for pesticides. On average, farm households who have access to institutional finance and choose to participate have higher rate of fertilizer adoption by at least 11 percent. Likewise, farm households that are users of institutional finance are characterized by higher intensity of fertilizer application per hectare compared to households without access to institutional finance. The results show at least a 51 kg/ha application intensity difference between the two group of farm households. In other words, in the absence of access to institutional finance farm households application rate of fertilizer diminishes by about 51 kg/ha (i.e., by about ij of the recommended application rate per hectare).

The matching results on adoption and application rates of improved seeds concurrently show a significant positive impact of access to institutional finance like that of fertilizer, with larger difference between the two groups in magnitude. Its shows that the adoption rates of improved seeds would be 30-32 percent lesser in the absence of institutions providing agricultural finance. One explanation for greater impact of access to institutional finance on adoption rate of improved seeds compared to fertilizer is that improved seeds are highly substitutable. In case of shortage of capital or financial constraint farm households may tend to use local seeds. However, in case of fertilizer, if there is a need to use, farm households who face financial constraint can go to the extent of selling or renting their productive assets to partially adopt fertilizer. The proxy measure of improved seeds intensity also indicates a statistically significant difference between the two groups on volume of improved seeds used by 25 kg - farm households who have access to institutional finance and choose to participate tend to use more volume of seeds. In relative terms this can also hint that households with financial access allocate more proportion of their lands for high yield varieties - the more the volume of improved seeds used the more the proportion of the land allocated for modern crop varieties.

Following similar procedure, the study further analyze the impact of access to institutional finance on combined adoption of fertilizer and improved seeds, as joint adoption of improved seeds and fertilizer is proven to be responsive from productivity point of view. The results across the three matching estimators show significantly higher rates of combined adoption among farm households who have access finance by about 32 percent. In other words, the combined adoption rate of fertilizer and improved seeds would be 32 percent less in a situation where farmers would not have

access to institutional finance. Regarding pesticides, the results show that adoption rate have not differed significantly between the two groups. This can be due to the fact that pesticides are not an innovation aimed at increasing yields - the innovations are more on application techniques. It is rather a technology that circumvents yield-reduction effects of pests and application is not based on freewill and can be less dependent on access to financial services and other common adoption factors.

In all, the statistically significant differences in adoption and application rates of fertilizer and improved seeds among the two groups of farm households indicates the crucial role of access to financial services on smallholders production decision. It appears that access to institutional credit and saving mechanisms encouraged smallholder farmers to invest in agricultural inputs. On the other hand, lack of access to institutional finance deter adoption or impede the uptake of agricultural technol-ogies. These results are in general consistent with the widespread notion that ascribes limited diffusion of agricultural technologies to financial market inefficiencies - in the absence of access to capital for investment, to withstand economic shocks and diffuse risks, farmers tend to mange risks through conservative production, for instance through the use of local seeds and reducing the amount of uptakes in case of fertilizer.

Nonetheless, the above results rely heavily on the assumption of conditional independence, selection on observables or unconfoundeness[12] (i.e., once the factors affecting access to institutional finance are taken into account, the condition of randomization restored) and are not robust against possible hidden bias. If there are unobserved covariates that affect access to institutional finance and adoption of agricultural technologies simultaneously, unobserved heterogeneity which affects the strength of the estimates might arise (Becker and Caliendo, 2007; Rosenbaum, 2002; Rosenbaum and Rubin, 1983).

The incidence of this problem is examined using Rosenbaum bounds sensitivity analysis when this key assumption is relaxed by a quantifiable increase in uncertainty. As shown in Table 4.5 (rbound:), in all cases the estimates found to be strong or insensitive to a bias that would double the odds of access to institutional finance, except for the estimates of pesticides. The majority of the results are insensitive to unobserved heterogeneity that would triple the odds of access to finance - the magnitude of hidden bias, which would make the finding of a positive and statistically significant effect of access to institutional finance spurious, should be higher than =2.5. Hence, the study deduce that the strength of the hidden bias should be sufficiently high to undermine

12 Conditional independence or unconfoundedness in this case denotes that access to institutional finance does not depend on farm households technology adoption, after controlling for the variations in adoption induced by differences in observable covariates. It is a strong assumption which implies that access to institutional finance is based on observable covariates and that variables simultaneously influencing access to finance and agricultural technology adoption are observable. Thus, systematic difference in adoption and application rates of technologies between farm households that are users and non-users of institutional finance with the same value of covariates are ascribed to access to institutional finance.

Table 4.5: Effect of access to institutional finance on agricultural technology adoptions.

Outcome variables	Kernel-based matching (bandwidth = 0.06)		Five-nearest neighbors matching		Radius matching (caliper = 0.05)	
	ATT (SE)	rbound	ATT (SE)	rbound	ATT (SE)	rbound
Fertilizer adoption	0.11** (0.057)	(31-32)	0.11** (0.050)	(23-24)	0.12** (0.048)	(31-32)
Fertilizer per hectare	53.15*** (18.12)	(2.4-2.5)	51.32** (21.71)	(2.2-2.3)	53.89*** (17.14)	(2.5-2.6)
Improved seeds adoption	0.32*** (0.105)	(3.8-3.9)	0.30*** (0.111)	(3.5-3.6)	0.32*** (0.107)	(3.9-4.0)
Improved seeds (volume)	24.83*** (5.01)	(2.4-2.5)	24.12*** (5.07)	(2.3-2.4)	25.28*** (5.40)	(2.3-2.4)
Pesticide adoption	0.01 (0.090)	-	0.00 (0.109)	-	0.01 (0.086)	-
Number of obs.	548		548		541	

Note: Bootstrap with 100 replications is used to estimate the standard errors. Common support condition is imposed across the three matching estimators. rbound () is estimated Rosenbaum bounds for critical values of hidden bias. The matched sample includes 252 users of institutional finance (treatment) and 296 non-users (control) for kernel and nearest neighbors matching and 245 users (treatment) and 296 non-users (control) for radius matching. *** significant at 1% and ** significant at 5%.

Source: Author's calculations, based on primary data collected between April and June, 2012.

the conclusion of positive and statistically significant effect of access to institutional finance on smallholders agricultural technology adoption and application rates.

4.5.3 *Robustness check*

Besides the rbound sensitivity analysis that tests the strengths of the estimates for covariates unobservable by the analyst, the analysis further check the robustness of the estimated ATT by using variations in the specification of the probit model, sample used and using a control-function regression model that rely on the hypothesis of selection on observable like that of PSM. The ATT results from these variations are reported in Table 4.6. The first variation, reported in column 1, uses the reduced probit model specification for the estimation of *p-score*, which excludes potential endogenous variables, including households literacy status, landholding size, off-farm income, livestock ownership, radio ownership, and degree of risk aversions. The second variation, presented in column 2, use the whole sample that includes farm households residing in *kebeles* with access to institutional finance and choose 'not' to participate. The balancing hypothesis is satisfied for both of these matches and only results from kernel-based matching technique are reported to conserve space.

Comparisons of the results suggest that the estimates are insensitive for the probit specification and sample used. Similar results is obtained from the reduced probit model both in magnitude and statistical significance with that of the results based on the base model. Likewise, the results from the whole sample revealed similar signs and levels of statistical significance, with lower impact in magnitude. Relatively lower impact for the whole sample that includes untreated units in treatment *kebeles* is plausible, as there can be possible spillover effects that can undermine the impact. Moreover, the comparable results observed from disaggregated samples while checking impact heterogeneity in the next section further ensures the insensitivity of the results for samples considered.

As indicated above, we also checked the robustness of the results using an alternative method to that of PSM - control-function regression. As it can be seen in column 3 of Table 4.6, the ATT results are comparable to those estimates from PSM reported in Table 4.5. In all, the robustness check indicates the positive and statistically significant impact of access to institutional finance on agricultural technology adoption is not sensitive for unobserved covariates, probit model specification, sample used and estimation method.

Table 4.6: Robustness of ATT for agricultural technology adoption.

Outcome variables	Treatment variable: access to institutional finance					
	Reduced probit model (Kernel-based matching)		Whole sample (Kernel-based matching)		Control-function regression	
	ATT	Std. Err.	ATT	Std. Err.	ATT	Std. Err.
Fertilizer adoption	0.13***	0.040	0.05***	0.015	0.24***	0.040
Fertilizer per hectare	66.72***	14.06	24.88***	8.85	69.84***	10.81
Improved seeds adoption	0.35***	0.120	0.08*	0.047	0.34***	0.053
Improved seeds (volume)	23.74***	4.97	8.14**	3.92	24.19***	3.91
Pesticide adoption	0.03	0.113	-0.04	0.033	-0.05	0.055
Number of obs.	548		814		672	

Note: Whole samples include farm households residing in *kebeles* with access to institutional finance and choose 'not' to participate (i.e., untreated units in treatment *kebele*). Bootstrap with 100 replications is used to estimate the standard errors. Common support condition is imposed across for the matching estimators. The matched sample includes 252 users of institutional finance (treatment) and 296 non-users (control) for the matching based on the reduced probit model and 373 users of institutional finance (treatment) and 441 non-users (control) for the matching based on the whole sample. *** significant at 1%, ** significant at 5% and * significant at 10%.

Source: Author's calculations, based on primary data collected between April and June, 2012.

4.5.4 *Impact heterogeneity*

The above results obtained from the matching estimates assume a homogenous impact of access to institutional finance on farm households adoption and application rates of agricultural technologies. However, there is no reason to believe a *priori* that access to institutional finance will result similar effects for farm households that are distinct in their demographic, social and economic characteristics. To check for possible impact heterogeneity, the impact distribution of access to institutional finance on agricultural technology adoption are plotted by type of technologies both for adoption rate and intensity of use. The plots in Figure 4.A1 show a significant amount of variation in user households response to accessing institutional finance. It was evident that for the majority of farm households the adoption and application rates of fertilizer and improved seeds would be much lower with varying degrees in a situation without access to institutional finance.

The study further examine the heterogeneity observed in Figure 4.A1 to identify sources of impact variations within farm households who have access to institutional finance. The data allow us to disaggregating the ATT estimates by landholding size - a potential surrogate variable for other factors affecting agricultural technology adoption - and by ownership of lending institutions. Disaggregation by land size is found to be representative, as it can substitute or proxy most of household variables that can potentially affect farm households decision on adoption and application rates of agricultural technologies, such as capacity to bear risk, wealth, and access to information. Many theoretical and empirical studies also shows the importance of farm size in adoption decisions - they indicated that adoption rates, intensity and the time pattern of adoption are strongly related to farm sizes (Feder et al., 1985; Feder and O'Mara, 1981; Just and Zilberman, 1983; Binswanger, 1978).

The estimates obtained from the ATT disaggregated by land size show strong impact variations between small and larger farmers. As shown in Table 4.7, while the results from the ATT show no differential impact of access to institutional finance on adoption rate of fertilizer by farm size, it indicates impact heterogeneity on intensity of use. The biggest effect of access to institutional finance on intensity of fertilizer use per hectare is observed for small farmers with the total landholding of less than 2 hectares. This suggests that access to institutional finance can help small farmers who often cannot afford optimal application of fertilizer. For instance, it can relax their level of risk aversion, a barrier for technology adoption and believed to be negatively related with farm size. Another explanation in the literature for this negative relationship between intensity of fertilizer use and farm size is that small farmers may farm land more intensively to meet subsistence needs compared to large farmers (Van der Veen, 1975).

Regarding improved seeds, the estimates show a strong differential impact of access to institutional finance by land size both on adoption and application rates. The re-

sults specifically shows that adoption and application rates of improved seeds have not differed significantly for small farmers with access to institutional finance. In other words, access to institutional finance does not have impact on improved seeds adoption and intensity of use among small farmers with a total land holding of less than 2 hectares. In contrast, for large farmers with more than 2 hectares of landholding, the estimates show a positive and statistically significant impact of access to institutional finance on adoption and application rates of improved seeds. This is plausible, as initial adoption of new improved varieties may entail considerable risks and setup costs in terms of learning and developing or locating markets for small farmers. Limited farm size for experimentation coupled with fear of the welfare consequences if shocks result in poor harvest can push small farmers to stick on conventional low risk and low return agricultural practices. Whereas, farm households with large sizes of land can overcome such uncertainties and costs by adopting on experimental plots increasing in size and through risk reducing infrastructures (e.g., irrigation).

As indicated above, another variable used for disaggregation towards investigating possible impact heterogeneity is ownership of the lending institutions. Difference in ownership is highly important, as who owns and controls a financial institution takes the decision on the types and terms of lending it should make, and in turn the relation of production it promotes. Besides the terms and conditions, the two lending institutions in the sample - the specialized microfinance institution and financial cooperatives - considerably vary on their approaches (saving-led vs. credit-led), size or coverage and monitoring and follow up efforts. The commonalities between the two are very few - their target market and the group aspect is perhaps where the closest resemblance between the two. Nonetheless, the group in microfinance does not assume an organizational and legal identity. In short, does the way these financial institutions organized and practiced induce impact variation at household level is the question the analysis seek to verify.

Table 4.8 reports the impact estimates of access to institutional finance on households technology adoption disaggregated by ownership of lending institutions. As shown in Panel A of Table 4.8, farm households who are users of financial cooperatives positively and significantly differ from households who have not access to institutional finance both in adoption and application intensity of agricultural technologies. In other words, statistically significant effect of access to institutional finance is observed only for households that are users of financial cooperatives and the impacts of financial services form the cooperatives on adoption and application rates of technologies are even somehow larger than the estimates of the whole sample reported in Table 4.5. In contrast, the study find that adoption and application rates of agricultural technologies have not differed significantly for farm households who have received financial services from specialized microfinance institutions, except on fertilizer adoption (Panel B of Table 4.8).

Table 4.7: Impact of access to institutional finance on agricultural technology adoption disaggregated by *landholding size*.

Outcome variables	Kernel-based matching (bandwidth = 0.06)		Five nearest neighbors matching		Radius matching (caliper = 0.05)	
	ATT (SE)	rbound	ATT (SE)	rbound	ATT (SE)	rbound
A: HHs with 2 ha of land						
Fertilizer adoption	0.10*** (0.041)	(17-18)	0.11* (0.062)	(12-13)	0.11** (0.054)	(16-17)
Fertilizer per hectare	67.19*** (22.38)	(2.9-3.0)	66.71*** (24.80)	(2.7-2.8)	67.41*** (21.97)	(2.7-2.8)
Improved seeds adoption	0.15 (0.121)	(1.7-1.8)	0.15 (0.126)	(1.7-1.8)	0.15 (0.124)	(1.7-1.8)
Improved seeds (volume)	7.51 (5.67)	-	7.66 (4.67)	-	7.60 (5.88)	-
Number of obs.	496		496		496	
B: HHs with > 2 ha of land						
Fertilizer adoption	0.12** (0.051)	(35-36)	0.11* (0.063)	(27-28)	0.13** (0.060)	(35-36)
Fertilizer per hectare	37.46** (19.13)	(1.8-1.9)	34.11 (21.97)	(1.4-1.5)	38.86** (17.96)	(1.9-2.0)
Improved seeds adoption	0.51*** (0.099)	(9.4-9.5)	0.47*** (0.110)	(7.5-7.6)	0.51*** (0.105)	(11.1-11.2)
Improved seeds (volume)	44.18*** (5.87)	(6.9-7.0)	42.50*** (6.93)	(6.3-6.4)	44.94*** (6.61)	(6.7-6.8)
Number of obs.	472		472		472	

Note: Bootstrap with 100 replications is used to estimate the standard errors. Common support condition is imposed across the three matching estimators. rbound () is estimated Rosenbaum bounds for critical values of hidden bias. The matched sample for Panel A includes 200 users of institutional finance (treatment) and 296 non-users across all the matching techniques. The matched sample for Panel B includes 176 users (treatment) and 296 non-users across all the matching techniques. *** significant at 1%, ** significant at 5% and * significant at 10%.
Source: Author's calculations, based on primary data collected between April and June, 2012.

The results from the users of specialized microfinance institutions hint possible diversion of credits for unintended purposes. We presume that lower follow-up efforts and limited information on clients, which emanated from bigger scales of operation in non-bank microfinance institutions, can results in lower impact on technology adoption. On the other hand, while financial cooperatives often constrained by limited local resources, the saving aspect and its follow up mechanisms that are finally twined in their organizational design (i.e., each member have an economic incentive to monitor the practices and efforts of fellow members) seems successful in helping smallholder farmers technology adoption. Overall, these results from ATT disaggregated by ownership suggest the importance of the way financial institutions are organized and practices in agricultural finance.

Table 4.8: Impact of access to institutional finance on agricultural technology adoption disaggregated by *ownership of lending institutions*.

Outcome variables	Kernel-based matching (bandwidth = 0.06)		Five nearest neighbors matching		Radius matching (caliper = 0.05)	
	ATT (SE)	rbound	ATT (SE)	rbound	ATT (SE)	rbound
A: Only users of FCs						
Fertilizer adoption	0.12** (0.050)	(45-46)	0.11** (0.056)	(34-35)	0.13*** (0.049)	(46-47)
Fertilizer per hectare	67.55*** (21.09)	(3.2-3.3)	65.19** (28.12)	(2.8-2.9)	70.13*** (20.55)	(3.4-3.5)
Improved seeds adoption	0.42*** (0.104)	(5.9-6.0)	0.40*** (0.123)	(5.3-5.4)	0.43*** (0.112)	(7.0-7.1)
Improved seeds (volume)	36.02*** (5.73)	(3.6-3.7)	35.45*** (5.75)	(3.7-3.8)	36.73*** (5.98)	(3.6-3.7)
Number of obs.	451		451		448	
B: Only users of NBFIs						
Fertilizer adoption	0.10* (0.059)	(12-13)	0.10 (0.073)	(9-8)	0.11** (0.057)	(11-12)
Fertilizer per hectare	30.15* (17.83)	(1.5-1.6)	29.15 (27.10)	(1.3-1.4)	27.30 (18.10)	(1.3-1.4)
Improved seeds adoption	0.16 (0.113)	(1.6-1.7)	0.14 (0.119)	(1.6-1.7)	0.15 (0.109)	(1.5-1.6)
Improved seeds (volume)	6.9 (6.03)	-	6.01 (5.38)	-	6.56 (5.06)	-
Number of obs.	393		393		389	

Note: Bootstrap with 100 replications is used to estimate the standard errors. Common support condition is imposed across the three matching estimators. rbound () is estimated Rosenbaum bounds for critical values of hidden bias. The matched sample includes 155 users of institutional finance (treatment) and 296 non-users (control) for Panel A kernel and nearest neighbors matching and 152 users (treatment) and 296 non-users (control) for radius matching. The matched sample for Panel B includes 97 users (treatment) and 296 non-users (control) for kernel and nearest neighbors matching and 93 users (treatment) and 296 non-users (control) for radius matching. *** significant at 1%, ** significant at 5% and * significant at 10%.

Source: Author's calculations, based on primary data collected between April and June, 2012.

4.6 CONCLUSIONS

Despite considerable public extension efforts, the diffusion and application rates of modern agricultural technologies among smallholder farmers are limited in Ethiopia. Large mass of smallholder farmers trapped in low return, lower risk farming practices, mainly due to shortage of funds or access to financial services to invest on productive technologies. The government of Ethiopia promotes specialized microfinance institutions and financial cooperatives to encourage technology adoption among resource constrained smallholder farmers through loosening their liquidity constraint. Currently numerous financial cooperative and specialized microfinance institutions are involved in the delivery of agricultural credits and saving services.

However, our knowledge on the contribution of the financial services delivered by these institutions on adoptions of agricultural technologies is limited. There have not been any systematic research works that examined whether access and use of institutional financial services impacted technology adoption behaviors of farm households in Ethiopia. The existing few methodical studies on specialized microfinance institutions focus on other outcomes, such as on income, housing and consumption improvements. Given that two third of the loan portfolio of financial cooperatives and microfinance institutions channeled to the agricultural sector with the purpose of improving technology adoption, evaluating its direct impact is imperative from policy perspective. This chapter aims at bridging this gap by examining the impact of access to institutional finance on adoption of divisible agricultural technologies using a farm household survey from 21 districts in Ethiopia. It also investigate potential impact variations by source of credit and farm size. The study used PSM, a non-parametric approach commonly used for casual inference under the hypothesis of selection on observables - a method that substitute for the absence of experimental comparison group using a control group who have the same set of parametric pre-exposure covariates - to construct comparison group and estimate impact.

The results obtained from the matching estimation indicate a positive and strong impact of access to institutional finance on both adoption and application rates of risky and highly productive agricultural technologies by smallholder farmers. The study noticed that the adoption and application rates of fertilizer and improved seeds would be 11 and 32 percent less in a situation where farmers would not have access to institutional services, respectively. Likewise, the results show a statistically significant application intensity differences between the two groups by at least 24 kg for improved seeds and 51kg/ha for fertilizer. Robustness checks indicate that these results are insensitive for probit model specification, matching technique and method of analysis used, unobserved covariates and sample considered.

Furthermore, testing for possible impact heterogeneity through disaggregation of farm households with access to finance by farm size and ownership of the institution from

where households received financial services indicates differential adoption and application rates. While access to institutional finance significantly improves the intensity of fertilizer use among small farmers, it does not have significant impact on adoption and application rates of improved seeds. Significant effects of access to institutional finance on improved seeds rate and extent of adoption is observed only for large farmers with farm size of more than two hectares. From the results differentiated by ownership of the financial institutions, it is observed that adoption and application rates of fertilizer and improved seeds have not differ significantly for farm households who receive financial services from specialized microfinance institutions. In contrast, farm households who are users of financial cooperatives exhibit significantly higher adoption and application rates of agricultural technologies compared to households without access to institutional finance.

The general conclusion drawn is that providing access to institutional financial services positively influences technology adoption behavior of smallholder farmers. The potential contributions of access to finance depends on farm sizes for improved seeds adoption - the adoption of improved seeds by small farmers with access to finance and farm size of less than two hectares have not significantly differ from comparable households without access to finance. In addition to credit and saving, providing insurance products may overcome the adoption-discouraging effects of farm size on application of improved seeds among small farmers. The findings also suggest that the ownership of the financial institutions from where farmers receive financial services matters most. Focusing on financial cooperatives that are owned and controlled by the users themselves seems to be a promising avenue to increase technology diffusion effects of financial services.

Part II

AGRICULTURAL COOPERATIVES IN ETHIOPIA - BACKGROUND

The second part of this dissertation focus on agricultural cooperatives in rural Ethiopia. It tested theoretical propositions on the existence of agricultural cooperatives, identified the drivers of farm households membership and patronage decisions, and distinguish various forms of membership in agricultural cooperatives with corresponding explanatory attributes. It also estimated the impact of agricultural cooperative membership on households levels of technical efficiency. This section provides readers a brief background on the history, prevalence and recent developments of agricultural cooperatives in Ethiopia.

TROUBLOUS HISTORY

Historically, agricultural cooperatives have played an important role all over the world in providing reliable market access and enhancing farmers market participation and bargaining position. In particular, agricultural cooperatives in the United States and Western Europe have had played an important economic role in providing competitive returns for independent farmers (Cook, 1995; Chaddad et al., 2005). Agricultural cooperatives in those countries traditionally operate as an independent service providers (as a separate firm) and primarily aimed at countervailing the market power of producers trading partners, preservation of market options and reduction of transaction costs and risks through pooling. They have also been accorded with a range of public policy supports that has perpetuated their market coordination and competitive yardstick roles in agri-food system still today (Cook, 1995; Staatz, 1987; 1983).

In Ethiopia, however, the tradition of agricultural cooperatives was completely different from the western type of agricultural cooperatives from the initial days of establishment to the socialist regime. Before the economic transition during 1991, agricultural cooperatives in Ethiopia did not espouse the concept of voluntary cooperation and have suffered from lack of autonomy and meaningful public policy and regulatory supports. During the imperial regime (1960s-1974), a period during which cooperatives were started, agricultural cooperatives were externally setup in the form of cooperative production or agricultural collectives to jointly produce commercial and industrial crops (e.g., coffee, tea and spices). Membership in cooperatives was restricted to farmers with larger landholding, excluding smallholder farmers. They were not also in a position to operate efficiently due to unenforceability of efforts, inequitable incentives or ill-defined property rights, high agency costs, and slow and centralized decision-making, which are inherent problems of collective production (Deininger, 1995)[13].

During the socialist regime (1974-1990) as well agricultural cooperatives were extended arms of the state and primarily used as instruments of the government in order to control the agricultural sector and prevent the rise of capitalistic forms of organization, following Marxist principles (Rahmato, 1990). There were two types of agricultural cooperatives during this period: production cooperatives engaged in collective production and service cooperatives handling modern inputs, credit, milling services, selling of consumer goods, and purchasing of farmers produce. Production cooperatives were expected to operate over 50 percent of the nations cultivable land in the same fashion of joint production and were believed to be more cost-effective

13 See Deininger (1995) for complete historical accounts on the inefficiencies of cooperative production systems as compared to agricultural cooperatives providing services (marketing, credit and information) to independent farmers in Cuba, Vietnam, Nicaragua, Peru and Ethiopia in terms of utilization of economies of scale, innovation, equity and provision of public goods.

(Rahmato, 1994). However, as documented by Rhamato (1994), ill-conceived policies coupled with shirking by coerced farmers resulted in lower output and underutilization of scale and deployed labors by producer cooperatives as compared to individual farmers. Besides the inefficiencies emanated from collective production, forced formation and routine intervention from the state agents were the critical factors that contributed to the poor record of agricultural cooperatives during the socialist regime (Rahmato, 1993).

Subsequently, when the new mixed economic system was introduced in 1991 farmers were given the choice to work on commonly or individually owned land; despite the tradition of both formal and informal collective actions in Ethiopia, the past negative experience on cooperative production led most of the farmers to reallocate common lands to individual holdings, which eventually led to the collapse of most production cooperatives (Abegaz, 1994). During the transition period, regardless of the efforts made to create an enabling environment for agricultural cooperatives through the issuing of new regulations[14], most of them continued to be burgled by individuals and others downsized due to competition from the private traders following trade liberalization (Kodama, 2007; Rahmato, 1994). In general, prior to 1990 agricultural cooperatives in Ethiopia were pseudo cooperatives both in their organizational structure, undertakings and membership.

RECENT DEVELOPMENTS AND PREVALENCE

Since 1990s, the Government of Ethiopia revived its interest in cooperatives and has made efforts to promote a new generation of cooperatives that differ from their predecessors that were put in place under previous regimes. Although externally induced formation is still prevalent[15], as proclaimed in the new legal framework, these new wave of cooperative organizations should be: based on the members free will to organize; able to fully participate in the free market; and free of government intervention. As part of the government support for cooperative promotion, cooperative governance was also reinforced through the establishment of the Federal Cooperative Commission in 2002, a public body to promote cooperatives at the national level (Bernard et al., 2010; Francesconi and Heerink, 2010; Kodama, 2007). The commission was established with a plan of providing cooperative services to two-thirds of the rural populations and to increase the share of agricultural cooperatives in input and output market coordination.

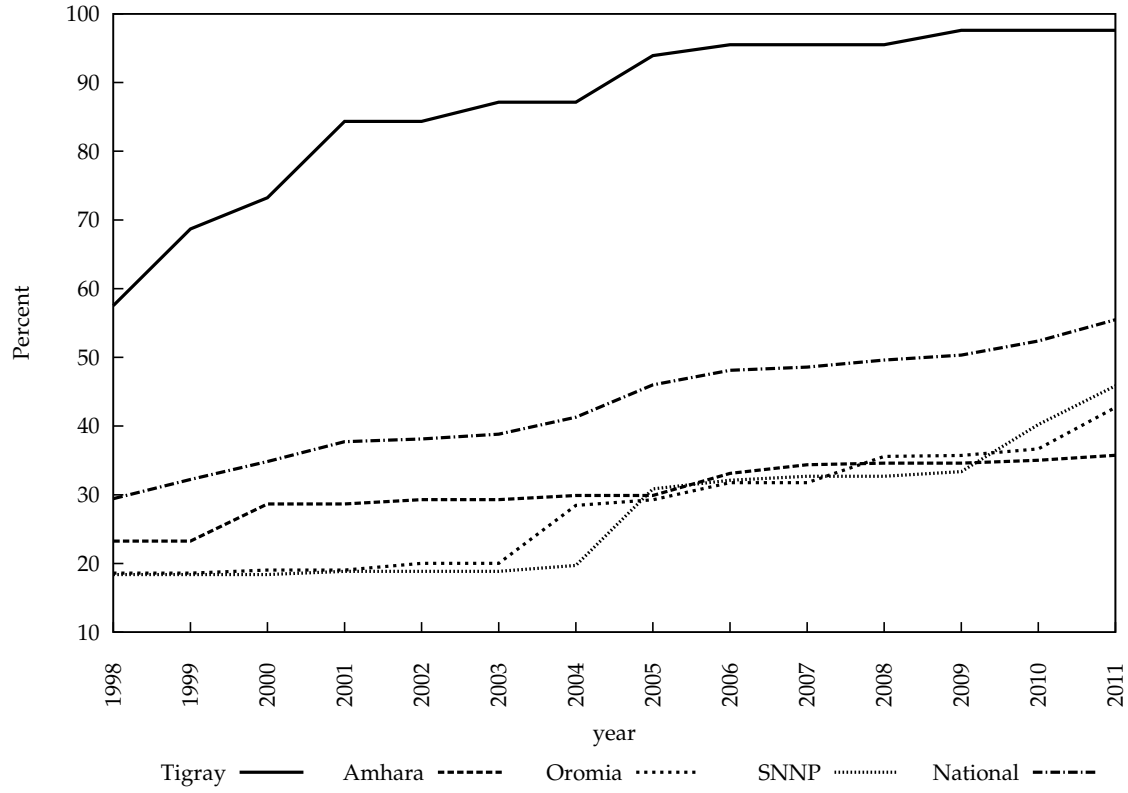
14 Agricultural Cooperative Societies Proclamation No. 185/1994.

15 In Ethiopia member initiated cooperatives account only for the 26 per cent of the total. The remaining 74 per cent of the cooperatives are externally initiated, mostly by government and donor agencies (Bernard et al., 2008).

In the agriculture sector in particular, cooperatives are meant to play a central role in efforts to develop the sector. For example, Ethiopias Sustainable Development and Poverty Reduction Program (FDRE, 2002) seeks to organize, strengthen and diversify autonomous cooperatives to provide better marketing services and serve as a bridge between small farmers (peasants) and the non-peasant private sector. Cooperatives are also expected to render vital services other than those related to agricultural marketing, including: (i) expanding financial services in rural areas; (ii) purchasing agricultural machinery, equipment and implements, and leasing them to farmers; (iii) setting up of small agro-processing industries where processed agricultural products with greater value added could be produced; and (iv) establishing various social institutions to provide different kinds of social services (FDRE, 2002).

There are evidences that indicate the new policy regime induce growth in the cooperative sector. For instance, of the total cooperatives in the country, about 60 percent are newly established after the economic reform (Bernard et al., 2013). According to the data from Federal Cooperative Agency, over the last six to seven years the number of cooperatives in Ethiopia grew by about 87 percent (i.e., from 23,084 to 43,256). The new policy regime has also considerably promoted the growth of agricultural cooperatives over the past 20 years. Agricultural cooperatives are the largest number of cooperative types in the country (i.e., 26.5 percent) and the proportion of *kebeles* with at least on agricultural cooperatives grew from only 10 percent in 1991 (Bernard et al., 2010) to 29 percent in 1998 and 55 percent in 2011 (Figure 4.1). About 43 percent of smallholders in Ethiopia live in a *kebele* with agricultural cooperative and the proportion of farm households participating in agricultural cooperatives grew from 9.1 percent in 2005 to 36 percent in 2012. If one account only households residing in *kebeles* with agricultural cooperatives where the choice to participate does exist, households membership rate grew sharply from 17 percent in 2005 to 51 percent in 2012 (Bernard et al., 2013; 2010).

With regards to performance, the impact of agricultural cooperatives is less studied. There have been only a few attempts made to understand their commercialization role in aggregating and selling members produces and the results showed a mixed picture of impact. Francesconi and Heerink (2010) found a higher commercialization rate for the farmers that belong to agricultural marketing cooperatives. Bernard et al. (2010; 2008) conversely found a similar commercialization rate for the farmers that belong to agricultural cooperatives (i.e., cooperative members tend to sell an equivalent proportion of their output to market as compared to non-members), notwithstanding the higher price obtained by the cooperatives for members per unit of output. Their role in providing a better price through leveraging collective actions (e.g., product aggregation) and inducing competition in favor of the producer is also corroborated by Teigist (2008).



Source: Bernard et al. (2013)

Figure 4.3: Proportion of *kebeles* with at least one agricultural cooperative in Ethiopia (1998-2011)

Other recent studies on impact of agricultural cooperatives by Abebaw and Haile (2013) and Getnet and Tsegaye (2012) respectively indicated better adoption of agricultural inputs and livelihood improvement among users of cooperatives as compared to non-users. What are scarce in the literature are studies on the drivers of agricultural cooperative incidence and farmers membership and patronage decisions. What explains the actual existence of agricultural cooperatives in some particular places and not in the others and what types of farmers are members and/or users of the services agricultural cooperatives provide are questions which are not empirically addressed. While there are the aforementioned few research works that have contributed to our understanding on the effects of agricultural cooperatives on price, commercialization, technology adoption and members livelihood, the direct impact of agricultural cooperatives on productivity and technical efficiency of members remain unknown, despite the fact that they are mainly used as a preferential channel to access agricultural inputs (i.e., fertilizer and improved seeds) and services (i.e., financial, training and extension). In an effort to address these gaps, the following two chapters in this part made an effort to identify the drivers of cooperative existence and farmers decisions to join and use agricultural cooperatives and estimated the impact of cooperative membership on farm households levels of technical efficiency.

5

DRIVERS OF AGRICULTURAL COOPERATIVES INCIDENCE AND FARMERS MEMBERSHIP AND PATRONAGE DECISIONS: AN ECONOMETRIC ANALYSIS

Abstract

Agricultural cooperatives are a prominent form of farmers economic organization in the world of agri-food system. Through leveraging collective actions, agricultural cooperatives in developing countries, in particular, are eminent in modern input supply and enhancing smallholders market participation and bargaining position. For instance, in Ethiopia, agricultural cooperatives commercialize more than 10 percent of the marketable surplus from small farmers and supply about 90 percent of modern inputs. However, despite its economic imperatives and policy supports agricultural cooperatives are not ubiquitous and membership rates and use of cooperative services by farm households are not anywhere closer to one would expect. Organizational and the new institutional economics theories explain the existence of agricultural cooperatives and farmers participation through their ability to develop countervailing power and internalizing transaction costs. Using a unique data set that includes community, cooperative, and household level survey data, this chapter empirically investigates the drivers of agricultural cooperatives incidence and farmers' membership and patronage decisions in Ethiopia. The results indicate that agricultural cooperatives in Ethiopia tend to exist in advanced kebeles that are connected to major roads and with relatively developed local market, supporting the market power argument. Farm households decisions to join and use agricultural cooperatives, on the other hand, are strongly related with their location, scale of operation, specialization, and human and relational capitals. Households membership and patronage decisions are also affected by the size, specialization, and integration of agricultural cooperatives. This chapter also distinguishes four types of membership from combining patronage and membership decisions, viz., strong, soft, shadow and no membership, and examined the corresponding household, cooperative, and location related attributes.

KEYWORDS: Agricultural cooperatives; Membership; Patronage; Ethiopia.

5.1 INTRODUCTION

Collective procurement of inputs, processing and marketing of outputs via cooperatives is one among the transaction governance structure in agriculture, along with

markets and hierarchies (Ménard, 2004; Williamson, 2000; Bonus, 1986). In most developing countries, considerable proportion of farmers heavily relies on agricultural cooperatives that are collectively set-up by producers to govern their backward and forward transactions. Producers join forces in agricultural cooperatives by becoming members and users of the services provided by their collective organization. However, given the similarities of market problems facing producers, such forms of organizational arrangements are not widespread everywhere. Moreover, even in places where agricultural cooperatives exist, all producers often not join forces and those who join are not necessarily users of the services their cooperative provides - membership and patronage are not solidly related, as one would expect.

In most of the cases agricultural cooperatives coexist with other firms and/or traders in markets and farmers have a decision space on where to procure their inputs and market or deliver their outputs. The data at hand from Ethiopia, for instance, make it evident that there are members of agricultural cooperatives who dont make use of services and, on the other hand, there are non-member farmers who are users of cooperative services. These observations on agricultural cooperative incidence and membership-patronage relations lead to the following interesting research questions this chapter aims to address. What determines the actual existence of agricultural cooperatives in some places, and not in the others? Which farmers become members of agricultural cooperatives and why? Which farmers make use of the services provided by agricultural cooperatives? Is there a link between farmers' membership and patronage decisions in agricultural cooperatives?

Addressing these questions is crucial if one looks at the raising expectations on agricultural cooperatives (producer organization) in achieving equitable growth and poverty reduction. In developing countries, in particular, agricultural cooperatives are expected to enhance smallholders market participation and bargaining position through leveraging collective actions (World Bank, 2008; Chen et al., 2007; Berdegué, 2001). For instance, in Ethiopia, where this chapter focuses, agricultural cooperatives are an accepted policy instrument towards this direction and they account for about 90 percent of modern input supply and commercialize more than 10 percent of the marketable agricultural surplus in the country (Rashid et al., 2013; GTP, 2010; Bernard et al., 2008; PASDEP, 2005). It is worth mentioning that the roles of agricultural cooperatives are not limited to underdeveloped market contexts. In matured markets, like in the USA and Europe, agricultural cooperatives continue to be farmers' integrating agency and account for about 30 percent of agricultural input and output marketing in the USA and 40-50 percent of the agro-food business in Europe (Bijman et al., 2012; Cogeca, 2010; Cook and Iliopoulos, 2000; Cook, 1995).

Despite the economic imperatives of agricultural cooperatives in integrating farmers to downstream and upstream trading partners, empirical studies that elucidate the rationales of cooperative existence are still very limited. Factors that actually drive the

incidence of agricultural cooperatives and the objective(s) agricultural cooperatives maximize are less evident. Equally lacking is empirical research on the determinants of membership and patronage decisions in this collective producers organization. While distinct or mixed, significant progress is made in the theoretical front. The dominant theoretical interpretations on the economic rationale behind the presence of agricultural cooperatives are found in the mixed-oligopoly/oligopsony literature and in the new institutional economics theories of contracting, agency and property rights.

The mixed-oligopoly/oligopsony literature characterizes the existence of cooperatives as a defensive response by producers towards the opportunistic behaviors of their trading partners - opportunistic behaviors of trading partners is asserted as a source of incentive for farmers to integrate via cooperatives (Staatz, 1987). According to this view point, agricultural cooperatives exist to countervail the potential adverse performance implications of oligopoly/oligopsony (Rogers and Sexton, 1994; Sexton and Sexton, 1987; Cotterill, 1987; Rhodes, 1983; Helmberger, 1964). Agricultural cooperatives are seen as a pro-competitive farmers' bargaining agency that beneficially regulate the performance of the market by acting as a yardstick of competition and playing a pacemaker role once price and service adjustments are effected (Giannakas and Fulton, 2005; Karantininis and Zago, 2001; Sexton and Iskow, 1993; Sexton, 1990; LeVay, 1983).

The new institutional economics literature, on the other hand, underlines information asymmetry and uncertainties in transactions as the drivers of agricultural cooperative. In general, cooperatives are seen as alternative transaction governance structure (alternative to market and hierarchy) that arises to internalize transactions that are characterized by uncertainties, demand high degree of trust and potentially lead to *ex pos*t renegotiation over the trade benefits (Valentinov, 2007; Hendrikse and Bijman, 2002; Sykuta and Cook, 2001; Bonus, 1986). In this literature, the efficiency gains from internalizing crucial transactions into firms jointly owned by the holders of transaction specific resources[1] is postulated as rationale behind the presence of cooperative firms. Another complementary theory by Hansmann (2012; 1996) claims that the type of ownership structure that will arise to govern a particular transaction is the one that minimizes ownership and market contract costs. In his argument, cooperatives are epidemic in agriculture because farmers generally face higher costs of market contracts that prompt them to join forces to economize/internalize such costs.

Building on these theoretical evidences that emphasis the institutional advantages created by agricultural cooperatives for producers mainly by economizing transaction costs and developing countervailing power, this chapter aims at empirically under-

1 In the presence of transaction specific resources cooperatives tend to arise as best transaction governance structure as their membership and patronage contract with the holders of such resources effectively address allocation of values, uncertainties and property rights, the three basic economic components of any transactions (Sykuta and Cook, 2001).

standing the drivers of cooperative incidence and determinants of producers membership and patronage decisions in rural Ethiopia. Towards this end, the chapter use unique data set that includes 200 community survey, survey on 102 agricultural cooperatives and 1450 farm household survey data from the four major regions of Ethiopia (Amhara, Oromia, SNNPR, Tigray. Probit and seemingly unrelated bivariate probit models are used to estimate the drivers of agricultural cooperatives incidence and to jointly estimate the determinants of farmers membership and patronage decisions, respectively.

The rest of the chapter is organized as follows. Section 2 presents a theoretical review on the economic rationales behind the presence of agricultural cooperatives and a framework on farmers membership and patronage decisions. Section 3 discusses the empirical approach followed to identify the drivers of cooperatives presence and investigates the links between membership and use of services in agricultural cooperatives. Section 4 describes the data used and results from summary statistics on the variables considered. Section 5 presents and discusses the main results from the probit and bivariate probit models. The last section concludes by summarizing the main findings of the chapter.

5.2 THEORETICAL FRAMEWORK

5.2.1 *Economic rationales for cooperative incidence*

Interest on alternative modes of organizing economic transactions - alternative to the price mechanism - is awaked by the seminal contribution of Coase (1937), who argues that the type of institution (market vs., firm) that will arise to organize transactions is largely a function of the relative costs of alternative modes of organization. Following Coases insight on the roles of firms in the organization of economic activities, significant progress has been made in understanding alternative forms of transaction governance mechanisms. Theoretical works that specifically studied organization of transactions via cooperative firms hold distinct thoughts on its nature: cooperatives are seen as (1) a vertical integration (Emelianoff, 1942), (2) a coalition and nexus of contracts (Staatz, 1983; Kaarlelto, 1955), (3) a hybrid that stand between markets and hierarchies (Chaddad, 2009; Ménard, 2004; Williamson, 1991; Bonus, 1986, among others), and (4) as independent transaction governance mechanism (Valentinov and Fritzsch, 2007; Valentinov, 2005).

According to the vertical integration argument by Emelianoff (1942), cooperatives are not a separate firm; rather they are integrating agency of multi-plant firms that exist to enhance market efficiency by acting as a yardstick of competition. A cooperative as a coalition and nexus of contracts is pioneered by Kaarlelto (1955) and viewed

cooperatives as an alliance of heterogeneous members that involves if they feel that their objective is being fulfilled by the coalition. Thoughts that viewed cooperative as a hybrid organization on the other hand, locate cooperative firms between markets and hierarchies and asserts that the need to combine the benefits of independent and collective organization of transactions as a driver of cooperative mechanisms. Cooperative as independent governance mechanism by Valentinov and Fritzsch (2007) and Valentinov, (2005) is a contention to the later thought. On the contrary to that of hybrid, this perspective locates hierarchies between markets and cooperative mechanisms and argues that the relationship between members in cooperatives is inconsistent with the use of both the price mechanism and authority relations.

Regardless of their differences in locating the cooperative mechanism in the transaction governance continuum, the economic rationales behind the existence of cooperatives governance mechanism advanced by these bodies of literature are analogous - the rationales for the incidence of agricultural cooperatives are largely related to the market-failure argument[2]. The first market-failure related cause for using cooperative mechanism by farmers is to *countervail market power*. Agricultural markets are characterized by pervasive market imperfections and farmers are confronted with information asymmetries and opportunistic behaviors of their trading partners. In such types of markets contractual agents have little to lose by acting opportunistically. Such behavior therefore creates an incentive to farmers to integrate via cooperatives and gain market power other than competing against each others (Valentinov and Iliopoulos, 2013; Hansmann, 1996; Sexton, 1990; Staatz, 1987). The incentive to withhold information is also lower in the case of trading with cooperatives, as the farmers are involved in both sides of the transaction (Sykuta and Cook, 2001; Cook, 1995).

Cooperative also exists to *internalize/economize transaction or market contract costs*. The efficient ownership assignment criteria of Hansmann (2012; 1996) argues that assigning transaction governance ownership to a patron or a contractual partner who faces the highest market contract costs enhance market efficiency and eliminate opportunistic behavior. Cooperatives are common in agriculture for the reason that producers are the one who assume the highest market contract costs compared to down and upstream trading partners. In other words, when transactions are characterized by high uncertainties and information costs, cooperatives are able to design agreements that enhance economic efficiency, as their membership and patronage contracts can effectively address allocation of values, uncertainties and property rights, the three basic economic components of a transaction (Valentinov, 2007; Sykuta and Cook, 2001; Bonus, 1986).

Achieving scale economies is another economic rationale for agricultural cooperatives formation. This cause is linked with the size of producers and local economy. Agricul-

2 One has to note, however, different types of cooperatives exist to deal with different kinds of coordination or market failure problems.

tural cooperatives arise in cases where the sizes of producers are small and demands aggregation to achieve gains from scale economies. The economies of scale argument for the presence of cooperatives also refers to the cases where the size or volume of transaction in the local economy justifies the operation of not more than one firm (Valentinov and Iliopoulos, 2013). In such contexts, producers established cooperatives, as they prefer to deal with their own monopoly instead of someone elses (Rohodes, 1983).

Another market-failure related cause for founding cooperatives is *filling missing markets or services*. This motive is directly related to the absence of markets and cases when other forms of transaction governance mechanisms (e.g., for-profit investor owned firms) doesn't find it profitable to function in a particular sector, industry or geographic location. In such contexts farmers join forces via cooperatives to fill missing markets (Valentinov, 2007; Sykuta and Cook, 2001; Karantininis and Zago, 2001). There are also theoretical arguments for founding cooperatives that are not directly related to market-failure causes. For instance, farmers establish cooperatives for *risk/uncertainty reduction* - to ration or transfer risks/uncertainties. Besides sharing and transferring risks, founding cooperatives give farmers an assurance that there will be a market for their produce as far as a head as their contemplated investments (Rhodes, 1983). Recent developments of New Generation Cooperatives (NGCs) also make it evident that cooperatives can also be formed to *achieve additional marketing margins* (Chaddad and Cook, 2004; Cook and Iliopoulos, 1999; Stefanson and Fulton, 1997).

Empirically, there is a growing evidence that agricultural cooperatives (producer organizations) offer one avenue for smallholders to participate in the market more effectively by providing access to markets, reducing/sharing transaction costs and improving their bargaining position in the market place (Bernard and Spielman, 2009; Markelova et al., 2009; Bernard et al., 2008; Thorp et al., 2005; Stockbridge et al., 2003; Kherallah et al., 2002). However, studies on the drivers of cooperative presence in the first place are very scarce. One of the particular interests of this chapter is, therefore, to empirically investigate the correlates of cooperative incidence using variables related to their environment (e.g., market structure and geographic isolation).

5.2.2 *Framers membership and patronage decisions*

Following Pascucci et al. (2011) and Masten and Saussier (2000), farmers decision to become a member of agricultural cooperatives is represented in a double discrete choice model. The assumption is that farmers will choose to become a member and/or users of cooperative services if the expected benefit or utility from membership and

patronage is greater than associated costs. Formally, farmers membership decision can be specified as follows:

$$M^* = \begin{cases} M^1 & if \quad U\left(M^1\right) > U\left(M^0\right) \\ M^0 & if \quad U\left(M^1\right) \leq U\left(M^0\right) \end{cases} \tag{5.1}$$

where M^1 represents membership in agricultural cooperatives and M^0 non-membership, $U\left(M^1\right)$ and $U\left(M^0\right)$ represent the expected benefit or utility of being a member and non-member, respectively, and $M^*$is the membership decision actually chosen by the farmer.

The above discrete choice model of membership in Eq. (5.1), in general, shows that farmers will become members of agricultural cooperatives if membership benefits exceed costs. The membership benefits in agricultural cooperatives range from getting prior access to its supply and marketing services to the receipt of additional incomes from redistribution of the cooperative rents (Sexton, 1990; Sexton and Iskow, 1988). In particular, membership in cooperatives provides farmers with the institutional mechanisms to bring economic balances under their control and prevent opportunistic and hold-up situations (Sykuta and Cook, 2001; Cook, 1995). Agricultural cooperatives that control the flow of production downstream and supply of inputs upstream can also result in a higher price for farmers produce and access to cheap inputs (Giannakas and Fulton, 2005; Sexton and Iskow, 1988).

Joining forces via cooperatives also gives the opportunity to share or internalize transaction costs (Valentinov, 2007; Staatz, 1987; Bonus, 1986). From internalizing transactions members in cooperatives directly benefit from common incentives (e.g., farmers wish to sell at the highest price possible and the cooperative wishes to pay its members the highest price possible) and free flow of information (Sexton and Iskow, 1988). Reducing the aspects of risks and uncertainties and providing assurance on the availability of markets for their produce in the future is another benefit of membership (Valentinov and Iliopoulos, 2013; Valentinov, 2007; Sexton and Iskow, 1988; Rhodes, 1983). While it may not provide the reason for joining cooperatives, the tax advantage for cooperatives in some contexts can be additional benefit for members when other benefits are also present. Furthermore, membership in cooperatives also provides intangible benefits, such as trust, fairness, reciprocity and the opportunity to assume leadership positions (Bijman and Verhees, 2011; Karantininis, 2007; Hansen et al., 2002).

On the other hand, membership in cooperatives has its own costs and detriments. The costs of membership mainly related to membership commitments and opportunity costs of participation (Bontems and Fulton, 2009; Fulton and Giannakas, 2001). A farmer who decides to become a member is required to allocate time to decision making processes, discharge leadership duties, and monitor the performance of the

appointed governing bodies. Ill-defined property rights in cooperatives and its associated problems[3] can also arise additional costs, which can discourage membership in cooperatives (Sykuta and Cook, 2001; Cook, 1995; Vitaliano, 1983; Jensen and Meckling, 1976).

Similar to farmers membership decision, the decision to make use of the services provided by agricultural cooperatives (i.e., patronage decision) can be specified as follows:

$$P^* = \begin{cases} P^1 & if \quad U\left(P^1\right) > U\left(P^0\right) \\ P^0 & if \quad U\left(P^1\right) \leq U\left(P^0\right) \end{cases} \tag{5.2}$$

where P^1 represents use of agricultural cooperatives services and P^0 non-use of services, $U\left(P^1\right)$ and $U\left(P^0\right)$ represent the expected benefit or utility of being a user and non-user, respectively, $P^*$is the patronage decision actually chosen by the farmer. Eq. (5.2) shows that farmers will become users of agricultural cooperative services if patronage benefits exceed costs (i.e., if the utility of being user of cooperative services exceeds the utility of being non-user).

User benefits in agricultural cooperatives are related to getting a higher price possible from better bargaining power by cooperatives (Cook, 1995; Sexton, 1990; Cotterill, 1987; Staatz, 1987). Cooperatives can offer users a better price using their inherent ability in reducing search and information costs and costs related to *ex post* renegotiation (Hendrikse and Bijman, 2002). For users that are at the same time members of the cooperatives, being user of cooperative services also offer additional benefits or incomes from premium payments and earnings that are redistributed based on patronage or use of cooperative services (Chaddad and Cook, 2004; Sykuta and Cook, 2001; Cook, 1995; Cotterill, 1987; Staatz, 1987; LeVay, 1983; Rhodes, 1983; Helmberger and Hoos, 1962). In other words, given the costs are assumed the same for both types of service providers in the market, the economic benefits are in the patronage dividend by the cooperatives for its users based on volume of use, but not by other firms. On the other side, using cooperative services can have costs like transportation (delivery and collections costs to and from cooperative centers) and costs related to meeting specific quality and delivery requirements. Collective decision making procedures can also have adverse effect on the speed of transaction in cooperatives.

As one can understand form the above discussions, there is an overlap of attributes that drive farmers membership and patronage decisions. This leads to joint analysis of these two discrete choice models following a framework deployed by Pescucci et

3 Free-riding, horizon, portfolio, control and influence problems, which often mentioned as incentive problems in cooperative organizations (Cook, 1995; Cook and Iliopoulos, 2000; Jensen and Meckling, 1976; Vitaliano, 1983).

Table 5.1: Farmers membership and patronage decision in agricultural cooperatives.

		Patronage decision (P^p)	
		Yes ($p = 1$)	No ($p = 0$)
Membership decision(M^m)	Yes ($m = 1$)	$U(M^1, P^1 \mid X, Z) = U_1(X, Z)$ strong-membership	$U(M^1, P^0 \mid X, Z) = U_2(X, Z)$ soft-membership
	No ($m = 0$)	$U(M^0, P^1 \mid X, Z) = U_3(X, Z)$ shadow-membership	$U(M^0, P^0 \mid X, Z) = U_4(X, Z)$ no-membership

Note: M^m and P^p refers to farmers membership and patronage decisions, respectively. X and Z represents the variables that affect the shape of the utility functions. U_1- U_4 represents the utility functions that are specified by the combination of membership and patronage decisions and variables that influence or drive farmers decisions. Source: Adapted from Pescucci et al. (2011).

al. (2011). Accordingly, as shown in Table 5.1, combining membership and patronage decisions results in four possible types of relationships between a farmer and a cooperative: member and user; members and non-user; non-member and user; and non-member and non-user. Pescucci et al. (2011) defined these relationships as strong, soft, shadow, and no membership, in that order.

Theoretically, besides the associated benefits and costs discussed above, cooperative membership and the use of cooperatives as a transaction governance mechanism is largely linked to the level of uncertainties, asset specificity and frequency of transactions. According to Ménard (2007) and Ménard and Valceschini (2005), transacting via cooperatives becomes attractive or advantageous governance solution in the presence of high uncertainty, asset specificity and less frequent transactions (see Pescucci et al., 2011 and Ménard, 2007 for the relationships between asset specificity and customary governance mechanisms and the type of cooperative membership that will arise across the continuum). In other words, farmers more tend to join and use cooperatives if they held specific assets and transactions that are less frequent and involve uncertainties. Taking into account the study context (research area) and availability of empirical data, the theoretical discussions that follows in this section on the drivers of farmers membership and patronage decision in agricultural cooperatives are limited to attributes related to location, size, specialization, human capital and social relation or networking of farm households.

The market structure and geographic isolation of the location where farmers and cooperative operate is one among the determinants of farmer-cooperative relationship. In particular, the existence of market in the locality and the level of concentration and competition are important to understand in what type of market structure farmers tend to join forces via cooperatives (Karantininis and Zago, 2001). The hypothesis this chapter sought to test with regard to market structure is that in locations where market exist and characterized by traders concentration the more likely producers are to join and use the cooperatives mechanism as response to their trading partners bargaining power and opportunistic behavior (Cook, 1995; Sexton, 1990; Staatz, 1987). The study used availability of markets and financial service providers and number of traders and input dealers in the locality as indicators of the local market structure.

The geographic area where the producers operate is another location specificity that determines the establishment and use of cooperative services by farmers. The study proposition is that in remote locations where infrastructures are less developed, fewer or no alternative service providers present, and information costs are higher the more likely farmers are to found, join and use cooperative services to take advantage of gains from transaction costs sharing/reduction (Sexton and Iskow, 1988). *Kebeles* distance to district center, major road, and to the nearest agricultural cooperatives are used as explanatory variables of geographic isolation.

Size and specialization of farmers are asset specificity related determinants of farmers membership and patronage decisions in agricultural cooperatives. The theoretical argument is that membership and use of cooperative mechanisms increases with asset specificity and decreases with frequency of transactions (Ménard, 2007; Ménard and Valceschini, 2005; Hendirikse and Bijman, 2002; Williamson, 1996). In the context of this chapter, relatively large-scale farmers tend to specialize and therefore have specific assets than subsistence farmers with mixed farms, consistent with the specialization vs., self-sufficiency argument. Hence, the hypothesis put forward is that large-scale producers and farmers that produce assets which require less frequent transactions are likely to join and use services provided by agricultural cooperatives. The study uses farmers landholding size and livestock ownership as measures of scale/size and the types of produces as indicators of specialization. Besides, the size and specialization of farmers, the study also controls for the scale and specialization of the nearest agricultural cooperatives found in the locality, as farmers commitment to join and use cooperative services is also linked with the cooperative ability to meet their demands (Fulton and Giannakas, 2001).

Finally, the study controls for the effects of human capital and affiliation in other networks on membership and patronage decisions. The assertion here is that farm households experience and level of education are important to understand the benefits and costs of alternative transaction governance mechanisms. Size of family labor in the household is also relevant, given the need to allocate times for discharging

membership commitments and meeting specific delivery or service use requirements by cooperatives. On the other hand, while it depends on the level of substitutability, farmers membership in other groups/networks can affect their membership and patronage decision in cooperatives. The study take into account for the effect of relational capital using a proxy indicator that measures whether a farmer takes part in rural saving and credit groups.

5.3 EMPIRICAL APPROACH

Probit and bivariate probit models are used to estimate the drivers of agricultural cooperative incidence in rural Ethiopia and farm households membership and patronage decisions, respectively. The discussion that follows in this section focus on the rationale and specification of the bivariate probit model.

As one can understand from Eq. (5.1) and (5.2), farmers are more likely to join agricultural cooperatives and make use of its services if the benefits of membership and patronage exceed the costs or the gains from using alternative transaction governance choices. In practices, however, the benefits and costs farmers expect from governing their transactions in different ways (markets, hierarchies or cooperatives) are very difficult to observe and measure (Masten and Saussier, 2000; Masten et al., 1991). In this study, following the suggestion by Masten and Saussier (2000), the empirical analysis relies on the observable attributes of the transactions (decisions) rather than the costs and benefits, which are very difficult to observe and measure, if not impossible. Thus, to the previous membership and patronage decisions one must include observable characteristics that affect the gains from joining and using the cooperatives transaction governance mechanism by farmers and residual terms. For the membership decision the relationship that takes into account observable attributes and disturbance terms can be specified as follows:

$$U\left(M^1\right) = U\left(M^1\right)(X, e_1) \tag{5.3}$$

and

$$U\left(M^0\right) = U\left(M^0\right)(X, e_0) \tag{5.4}$$

where X represents a vector of observable characteristics affecting the gains from membership in agricultural cooperatives, e_1 and e_0 are residual terms that accounts for variables that are omitted and misperceptions by farmers about the actual benefits and costs of membership.

Assuming a linear relationship between relevant observable characteristics, X, affecting membership gains and the utility from membership ($U\left(M^1\right)$) and non-membership ($U\left(M^0\right)$), the association can be specified as follows:

$$U\left(M^1\right) = \alpha^1 X + e_1 \tag{5.5}$$

and

$$U\left(M^0\right) = \alpha^0 X + e_0 \tag{5.6}$$

The likelihood that membership in agricultural cooperatives ($U\left(M^1\right)$) will be chosen can be specified by substituting Eq. (5.5) and (5.6) in Eq. (5.1) as follows:

$$\Pr\left(M^* = M^1\right) = \Pr\left[U\left(M^1\right) > U\left(M^0\right)\right] = \left[e_0 - e_1 < \left(\alpha^1 - \alpha^0\right) X\right] \tag{5.7}$$

Eq. (5.7) symbolizes that the observable characteristics X that have an effect of α^1 on the expected gains from membership ($U\left(M^1\right)$), which is greater than the effect of α^0 on the gains from non-membership ($U\left(M^0\right)$) will increase the likelihood that membership (M^1) is chosen.

Assuming similar linear relationship between relevant observable characteristics, Z, affecting patronage decision and the utility from using cooperative services ($U\left(P^1\right)$) and non-use ($U\left(P^0\right)$), and substituting it in Eq. (5.2), the probability that patronage or use of cooperative services will be chosen can be specified as follows:

$$\Pr\left(P^* = P^1\right) = \Pr\left[U\left(P^1\right) > U\left(P^0\right)\right] = \left[u_0 - u_1 < \left(\beta^1 - \beta^0\right) Z\right] \tag{5.8}$$

Eq. (5.8) represents that the observable characteristics Z that has an effect of β^1 on the expected gains from using cooperative services ($U\left(P^1\right)$), which is greater than the effect of β^0 on the gains from being non-user ($U\left(P^0\right)$) will increase the likelihood that patronage (P^1) is chosen.

In Eq. (5.7) and (5.8), the dependent variables (i.e., membership and patronage) are binary, providing the basic framework for two binary choice models. Given that both membership and patronage contracts are warranted to enhance economic efficiency of transactions via cooperatives, the study assumes a strong association between the two contractual decisions on their observed and unobserved drivers. Thus, a bivariate probit model, a natural extension of the probit model, which performs a joint estimation of the two binary choice equations, is used for empirical analysis. Formally, the estimated bivariate probit model can be specified as follows (Greene, 2007):

$$
\begin{aligned}
M_i^* &= \alpha X_i + e_i, \quad M_i = 1 \quad if \quad M_i^* > 0,\ 0\ otherwise \\
P_i^* &= \beta Z_i + \delta M_i + u_i, \quad P = 1 \quad if \quad P_i^* > 0,\ 0\ otherwise \\
E\left[e_i \mid \alpha, \beta\right] &= E\left[u_i \mid \alpha, \beta\right] = 0 \\
Var\left[e_i \mid \alpha, \beta\right] &= Var\left[u_i \mid \alpha, \beta\right] = 1 \\
Cov\left[e_i, u_i \mid \alpha, \beta\right] &= \rho
\end{aligned}
\tag{5.9}
$$

where $M^*$and $P^*$are latent variables for which only the dichotomous variables M and P can be observed, X and Z are vectors of exogenous variables that are not necessarily distinct, e_i and u_i are a vector of bivariate normally distributed residual terms with the usual restrictions, and $E\left(e_i\right) = E\left(u_i\right) = 0$ and $Var\left(e_i\right) = Var\left(u_i\right) = 1$. The covariance term ρ indicates that the two equations are related in their residual terms. In other words, it indicates whether the two equations have a common measurement error, shocks or omitted variables. If ρ is different from zero, a bivariate probit model is expected to yield a more efficient and consistent parameter estimates than the results from separate estimation of the two equations.

A concern in Eq. (9) is that the patronage equation contains the dependent variable of the membership equation, membership dummy (δM_i), which is endogenous. However, Greene (2007), Wooldridge (2002), and Wilde (2000), show that in the presence of variations in the data and in full information maximum likelihood estimations of a bivariate or two equation probit model, with one of the equation having the other's dependent variable as a regressor, one can proceed with no special attention to its endogeneity. It is because in the estimation the log-likelihood is maximized based on the joint probability[4] distribution defined by the different combinations of the binary variables, whereas in the linear regression cases the estimation is based on sample moment that does not necessarily converge to the necessary population parameter in the presence of simultaneity (Greene, 2007).

5.4 DATA AND SUMMARY STATISTICS

This chapter used the 2012 Ethiopian Agricultural Transformation Agency (ATA) baseline survey data collected by the International Food Policy Research Institute (IFPRI). The data set is suitable for the research questions, as it includes a survey data from 200 communities/*kebeles*, 102 agricultural cooperatives and 3000 farm households from the four main regions of Ethiopia. These three survey data altogether contain information on households, demographic and geographic characteristics, agriculture production

4 The joint probabilities in this case that yields four types of membership described in the previous section can be specified as follows (Greene, 2007): $\mathrm{Pr}_{11} = \phi\left(\alpha X_i, \beta Z_i + \delta M_i, \rho\right)$; $\mathrm{Pr}_{10} = \phi\left(\alpha X_i, -\beta Z_i - \delta M_i, -\rho\right)$; $\mathrm{Pr}_{01} = \phi\left(-\alpha X_i, \beta Z_i + \delta M_i, -\rho\right)$; and $\mathrm{Pr}_{00} = \phi\left(-\alpha X_i, \beta Z_i - \delta M_i, \rho\right)$.

Table 5.2: Summary statistics of *kebele's* characteristics by availability of agricultural cooperatives.

Indicators	*Kebeles* with agricultural cooperatives		*Kebeles* without agricultural cooperatives	
	Mean	Std. Dev.	Mean	Std. Dev.
Market availability	0.440	0.498	0.406	0.493
Number of trader (in number)	**4.788**	11.19	1.967	5.171
Credit provider availability	**0.944**	0.229	0.791	0.408
Feeder road availability	**0.697**	0.461	0.472	0.502
Distance to road (in minute)	**30.09**	31.56	51.98	56.14
Distance to district center (in minute)	157.8	97.65	171.3	122.6
Mobile penetration rate (in %)	**34.05**	26.66	27.32	25.29

Note: Bold refers a statistically significance mean difference compared to respective comparison groups at below 10%.
Source: Author's calculation based on data from the ATA baseline survey (2012).

and marketing, infrastructure and market structure, households access to basic services like credit, information and post-harvest facilities, and on the availability and services provided by agricultural cooperatives. Sample households were selected using stratified[5] random sampling, while all the randomly selected *kebeles* and agricultural cooperatives found in those *kebeles* are considered for the community and cooperative surveys.

The data from community and agricultural cooperative level surveys are mainly used to understand the drivers of agricultural cooperatives presence. The descriptive statistics presented in Table 5.2 indicates that agricultural cooperatives in Ethiopia tend to exist in *kebeles* with relatively better access to output traders and input dealers, credit services providers, roads, and information. The mean equality test in particular shows that *kebeles* with institutional credit providers, higher number of traders, and connected to main roads and mobile networks are more likely to have agricultural cooperatives.

For the analysis of farm households membership and patronage decisions or farmers-agricultural cooperatives relations, the chapter used a combination of the three survey

5 The sample is stratified by woredas/districts affiliation to Agricultural Growth Program (AGP) and location. In the first stage 100 woredas were selected and stratified into AGP and non-AGP woredas. In the second stage two *kebeles* were randomly selected from each of the 100 woredas. In the third stage 15 agricultural households were selected randomly from each 200 *kebeles*.

Table 5.3: Frequency of households in the sample by membership and patronage.

Membership in agricultural cooperatives	Use of cooperative services (Patronage)		
	Yes	No	Total
Yes	495	199	694
No	334	422	756
Total	829	621	1450

Source: Author's calculation based on data from the ATA baseline survey (2012).

data. However, only *kebeles* with agricultural cooperative and households residing in those *kebeles* where the choice to join and use cooperative services does exist are considered for this study. The analysis retained and used 1450 sample households after dropping farm households residing in *kebeles* where agricultural cooperatives doesn't exist. The two related dependent variables (i.e., membership and patronage decisions) are constructed based on information on farm households membership in agricultural supply and/or marketing cooperatives and whether they use the services provided by agricultural cooperatives found in their locality, respectively.

As shown in Table 5.3, from the total sample considered, 48 percent of the households found to be members of agricultural cooperatives. As indicated in Section 2, however, all member households may not be users of the services provided by cooperatives. Supporting this argument, the frequency results presented in Table 5.3 show that nearly one-third of member households don't make use of the services their agricultural cooperatives provide and only 34 percent of the total sample belongs to the *strong membership* category defined in Section 2. The remaining 14, 23 and 29 percent of the sample households made the *soft, shadow and no-membership* categories, respectively. Surprisingly, of the sample households that are non-member, 44 percent are users of agricultural cooperatives and they account for 40 percent of the total users of agricultural cooperative services in the whole sample (Table 5.3).

Table 5.4 presents the summary statistics of explanatory variables considered in the empirical analysis. The explanatory variables are selected based on the theoretical framework discussed in Section 2 and only indicators that are related to location, market structure, households scale of operation, specialization, human capital and networking, and attributes of agricultural cooperatives are included (Table 5.4). Simple mean difference tests by membership and patronage across the explanatory variables indicate that geographic proximity to major roads and agricultural cooperatives and availability of traders and credit providers encourages strong membership in cooperatives. That is, households that are members and users of agricultural cooperatives are those residing in *kebeles* closer to main roads and cooperative premises and where relatively large number of traders and credit providers are present. Households with

regular market in their *kebele*, on the other hand, are also more likely to become members of agricultural cooperatives, but they are not necessarily users of the services cooperatives provide.

The summary statistics on households scales of operation and specialization shows that relatively larger farmers (as measured by farm size and livestock ownership) are members of agricultural cooperatives, compared to small farmers. With regard to specialization, while households producing grains, pulses and oilseeds are more likely to join agricultural cooperatives, only households producing grains are users of the services agricultural cooperatives provide. This can be due to the fact that most of the agricultural cooperatives in Ethiopia mainly trade grains and supply inputs that are required for grain productions. Household demographic characteristics at the bottom of Table 5.4 also indicate that farm households experience (as measured by age), literacy, household size and affiliation in other groups or networks determines membership and use of cooperative services. It shows that households that are experienced, literate and with relatively large number of adults are members and users of agricultural cooperatives. Affiliation in rural saving and credit groups encourage households membership in agricultural cooperatives with no significant effect on patronage.

The analysis also includes explanatory variables that measure the size and specialization of agricultural cooperatives in order to understand the effects of cooperative related attributes in attracting farmers to become members and users of the services it provides. The descriptive statistics and mean difference tests in Table 5.4 clearly show that agricultural cooperatives that are integrated and active (as measured by affiliation to upper level cooperative unions), with large number of members and providing agricultural input supply and credit services tend to attract more members and users. In other words, households residing in *kebeles* where agricultural cooperatives are active, larger in size and provide inputs and credit services are more likely to join and use the cooperative transaction governance mechanism. Note, however, that conclusions cannot be made at this point, as the results from the descriptive statistics don't account for potential confounding factors.

Table 5.4: Descriptive statistics of explanatory variables by cooperative membership and patronage/use of agricultural cooperative services.

Indicators	Members (n=694)		Non-members (n=756)		Users (n=829)		Non-users (n=621)	
	Mean	STD	Mean	STD	Mean	STD	Mean	STD
Market availability	**0.53**	0.49	0.42	0.49	**0.44**	0.49	0.52	0.49
Trader availability	0.67	0.46	0.64	0.47	**0.73**	0.44	0.56	0.49
Credit providers	0.93	0.24	0.92	0.26	**0.95**	0.21	0.90	0.29
Distance to woreda	170	164	168	121	173	134	163	153
Distance to road	**163**	145	185	163	**157**	141	196	169
Distance to coop	**43.4**	48.6	51.6	51.2	**45.3**	44.5	50.9	56.4
Land size	**3.05**	0.98	2.68	1.07	2.89	1.00	2.80	1.10
Livestock (in TLU)	**7.53**	6.90	4.84	5.52	**6.49**	6.36	5.60	6.30
Produce gain	**0.98**	0.13	0.92	0.27	**0.97**	0.14	0.90	0.28
Produce pulses	**0.36**	0.48	0.31	0.46	0.34	0.47	0.32	0.47
Produce oilseeds	**0.25**	0.43	0.18	0.38	0.21	0.40	0.22	0.41
Produce root crops	0.17	0.38	0.19	0.39	**0.15**	0.36	0.22	0.41
Produce fruits	**0.05**	0.23	0.11	0.32	0.07	0.26	0.10	0.30
Produce permanent	**0.29**	0.45	0.37	0.48	**0.29**	0.45	0.38	0.48
Coop affiliation to union	**0.78**	0.41	0.69	0.46	**0.79**	0.40	0.65	0.47
Coop membership size	**1046**	1237	694	937	867	1014	847	1202
Coop provide inputs	**0.94**	0.23	0.84	0.35	**0.94**	0.22	0.82	0.38
Coop provide marketing	0.59	0.49	0.56	0.49	0.58	0.49	0.56	0.49
Coop provide credit	**0.82**	0.38	0.66	0.47	**0.82**	0.37	0.61	0.48
HH head age	**47.8**	13.3	45.7	15.6	**47.5**	13.9	45.6	15.4
HH head literacy	**0.51**	0.49	0.38	0.48	**0.49**	0.50	0.39	0.48
HH size	**3.35**	1.39	2.73	1.23	**3.19**	1.33	2.80	1.33
Membership in RSCG	**0.11**	0.31	0.07	0.26	0.09	0.29	0.09	0.29

Note: Tropical livestock unit. Tropical Livestock Unit (TLU) is calculated based on conversion factors suggested by Jahnke et al. (1988). RSCG denotes Rural Saving and Credit Group. Bold refers a statistically significance mean difference compared to respective comparison groups at below 5%.

Source: Author's calculation based on data from the ATA baseline survey (2012).

5.5 RESULTS AND DISCUSSIONS

5.5.1 *Drivers of agricultural cooperatives incidence*

What explains the presence of agricultural cooperatives in a particular *kebele* and not in other is a question of particular interest in this section. Based on theoretical arguments of the mixed-oligopoly and the new institutional economics literatures discussed in Section 2 and prior empirical observations, four factors may serve separately or jointly to determine the incidence of agricultural cooperatives or where agricultural cooperatives are more present in Ethiopia. One, following the new institutional economics (transaction cost economics) literature, one may argue that the main advantages of agricultural cooperatives is through reduction of information costs and economies of scale in physical transaction costs (Valentinov, 2007; Sykuta and Cook, 2001; Hansmann, 1996; Bonus, 1986). That is, agricultural cooperatives lower the incentive to withhold information and enable the bulking of inputs, outputs and other services such that transportation cost per unit to or from a supplier or downstream trading partners are lowered. Accordingly, one would expect to find more agricultural cooperatives in remote *kebeles* to enable farmers reduce/share transaction and information costs where such costs are higher.

Two, based on the mixed-oligopoly/oligopsony literature that characterize the presence of agricultural cooperatives as a defensive response by farmers to offset opportunistic behaviors of trading partners, one might also claim that an important service provided by agricultural cooperatives is through the enhanced bargaining power they offer farmers in purchasing inputs from suppliers or selling outputs to traders/processors (Karantininis and Zago, 2001; Sexton, 1990; LeVay, 1983, among other). According to this argument, one would expect to find more agricultural cooperatives established in *kebeles* where markets are available and relatively developed in order to strengthen the engagement and bargaining position of farmers in the existing markets.

Three, another practical explanation related to the mixed-oligopoly proposition is that agricultural cooperatives can be more present in *kebeles* where sufficient market-oriented agricultural productions exist. Lastly, empirical observation by Bernard et al. (2010) highlight that a majority of Ethiopian agricultural cooperatives were created under the impulse of external partner (public cooperative offices, NGOs and others) and thus their incidence in particular *kebeles* may not be directly linked to *kebele* or location related attributes. Various levels of political and social factors also could drive the presence of agricultural cooperatives in a given *kebeles*. While it is beyond the scope of this chapter to fully explain the process of agricultural cooperative formation and location, it nevertheless shade lights on the drivers of agricultural cooperative incidence based on the characteristics of their environment.

Table 5.5 presents *kebele*-level correlates to the establishment or presence of agricultural cooperatives from probit model analysis. Consistent to the descriptive statistics, the results indicate that the probability of agricultural cooperative incidence is higher in *kebeles* that have relatively developed market structure (as measured by availability of markets and institutional credit providers and number of traders) and are accessible (as measured by availability of roads and *kebeles* proximity to major roads). Number of traders based in the *kebele*, the availability of credit service providers, the availability of (feeder) road, and *kebeles* proximity to major roads by an hour increases the probability of agricultural cooperative incidence or establishment in the *kebele* by at least 2, 80, 51, and 42 percent, respectively.

In other words, the estimates indicate that relatively well developed market structure and *kebeles* connection to major roads drive the incidence of agricultural cooperatives in rural Ethiopia. Given that access to institutional credit providers and major roads are rare realities found in few advanced *kebeles*, significantly higher probability of cooperative existence in *kebeles* with markets/traders, institutional credit providers, and better road infrastructure indicates that more agricultural cooperatives present in advanced locations than in remote *kebeles*. This result is in line with the mixed-oligopoly literature that explains agricultural cooperatives as farmers bargaining agency. It argues that agricultural cooperatives exist not only to fill missing markets and internalize transaction costs, but mainly to bargain for better terms of trade and countervail the opportunistic behavior of farmers trading partners in places where markets exist. Nonetheless, the results in Table 5.5 indicate only a correlation between market availability and cooperative presence. Whether the presence of a cooperative kindles market development or the existence of market lead to a cooperative formation is an interesting research issue, which is not fully addressed due to the dearth of appropriate instrument/indicator.

The regional dummy variables included at the bottom of Table 5.5 also explain some additional regional variations on agricultural cooperatives presence. The estimates show that *kebeles* that are found in Tigray region (omitted reference category) are more likely to have agricultural cooperatives, compared to the other three main regions (i.e., Amhara, Oromia and SNNP). However, closer observation to the sample *kebeles* considered from Tigray region revealed that most of these *kebeles* are found in advanced location in terms of market structure and geographic isolation, supporting the main results. Of the total *kebeles* from Tigray region 71 percent are connected to major roads, all have access to institutional credit providers, and on average, they have higher number of traders and input dealers next to Amhara region.

Table 5.5: Determinants of agricultural cooperatives presence in a *kebele* (*probit*).

Indicators	Agricultural cooperative presence in a *kebele*		
	(1)	(2)	(3)
Market availability	-0.033 (0.192)	-0.044 (0.200)	0.110 (0.208)
Number of trader	0.027 (0.013)**	0.022 (0.010)**	0.016 (0.010)*
Credit providers dummy	0.889 (0.300)***	0.873 (0.332)***	0.800 (0.331)**
Feeder road		0.420 (0.210)**	0.510 (0.234)**
Distance to road		-0.008 (0.003)***	-0.007 (0.003)**
Distance to woreda center		0.002 (0.001)**	0.001 (0.001)
Mobile penetration		0.003 (0.004)	0.003 (0.004)
Amhara region			-1.370 (0.527)***
Oromia region			-1.567 (0.534)***
SNNP region			-2.178 (0.545)***
Constant	-0.739 (0.286)***	-1.150 (0.442)***	0.516 (0.721)
Number of obs.	200	200	200
Chi^2	14.34***	31.07***	44.59***
Pseudo R^2	0.05	0.11	0.24
Sensitivity (%)	94.50	77.06	67.89
Specificity (%)	19.78	50.55	73.63
Total correctly classified (%)	60.50	65.00	70.50

Note: *** significant at 1%, ** significant at 5% and * significant at 10%. Tigray region is omitted as a reference category.
Source: Author's calculation based on data from the ATA baseline survey (2012).

5.5.2 *Membership and patronage decisions in agricultural cooperatives*

As indicated in the previous sections, this study used a two equations or bivariate probit model to understand the links and determinants of membership and patronage decisions by farmers in relation to agricultural cooperatives. At first step the estimation checked for potential multicollinearity, as the analysis used 25 different types of explanatory variables in the two equations. Following the suggestions by Studenmund (2006), test for the presence of multicollinearity problem was performed by calculating the Variance Inflation Factor (VIF) values and pairwise correlation coefficients. The VIFs were calculated based on a separate estimation of the two equations using Ordinary Least Square (OLS) regression. The results for both of the equations show a much lower VIF values compared to the common rule of thumb or cut-off value, which is 5 (Studenmund, 2006; Kutner et al., 2004) - the highest VIF values were 1.71 and 1.70 with an average values of 1.32 and 1.29 for membership and patronage equations, respectively. The results from the pairwise correlations also don't show a strong association between the variables considered in the analysis. From 293 pairwise correlations only three correlation coefficients had a value greater than 0.4/-0.4 with the largest correlation coefficient being 0.48 and the majority of the pairwise correlation coefficients are between -0.01 and 0.01.

Table 5.6 presents the results from the bivariate probit estimation. The general Wald test statistics has a value of 1084.16 which exceeds 60.48, the critical chi square value at 44 degree of freedom, indicating that the null hypothesis that claim a zero slope for all of the 44 parameters in the two equations is rejected. The correlation coefficient of the residuals (ρ) is also significantly different from zero, indicating the relatedness of the two equations and significance efficiency gains from deploying the bivariate probit model.

The general research question the analysis sought to address in this section is whether there is a link or interdependence between farmers membership and patronage decisions in agricultural cooperatives. The result shows that the two farm household decisions are related - that is, the membership coefficient in the patronage equation is positive and statistically significant, indicating that farm households who are cooperative members are more likely to use the service provided by their cooperatives, compared to non-members. The correlation coefficient of the residuals (ρ) indicated above also show a significant association between the unobservables that relates to membership and patronage equations, corroborating the result from the parameter estimate.

The analysis also preformed a general hypothesis test on whether households location, size and specialization, and human and relational capital affect their membership and patronage decisions simultaneously. The Wald test of joint significance on location specificity that includes variables related to local market structure and geographic iso-

lation shows that households location matters. Farm households that are located in *kebeles* with relatively better market conditions and closer to major roads and cooperative premises are more likely members of agricultural cooperatives, but they are not necessarily users of the cooperative services. Only households that are closer to the cooperative premises and with no regular market in their locality are found to be users. Consistent to the results from the descriptive statistics, in the presence of local markets farmers tend to become members but not users of the services agricultural cooperatives provide. This is plausible, because producers can found and join cooperatives to induce competition and countervail trading partners opportunistic behavior in the market place and once price and service adjustments are effected they may tend to use the market mechanism to avoid costs related to specific use and delivery requirements by the cooperatives (Karantininis and Zago, 2001; LeVay, 1983).

Joint significance test on the explanatory indicators of size and specialization of farm households and agricultural cooperatives also clearly indicates that scale and specializations are important determinants of households membership and patronage decisions. The results show that households that are relatively larger scale (as measured by farm size and livestock ownership) and residing in *kebeles* where agricultural cooperatives are larger in size (as measured by number of members) are found to be members. However, larger farmers are less likely to use the services provided by their agricultural cooperatives. This can be due to the fact that the reduction in physical transaction costs from economies of scale or aggregation by cooperatives is relatively smaller for larger farmers. With regard to specialization, households producing grains are found to be members and users of agricultural cooperatives. This is conceivable, as the majority of agricultural cooperatives in Ethiopia mainly deal with grains and supply inputs that are mostly required for grain production.

Besides the specialization of households, the services provided by agricultural cooperatives also affect households membership and patronage decisions. The estimates show that agricultural cooperatives that provide input supply and credit services attain more members and patrons than those specialize or provide commercialization services. This can be due to lack of significant commercialization impact by agricultural cooperatives in Ethiopia (Bernard et al., 2008). The third Wald test on joint significance of variables related to households human capital and affiliation in other groups/networks is also positive and statistically significance. It indicates that farm households that are experienced (as measure by age), literate, and with large number of adults are more likely to become members of agricultural cooperatives. Affiliation in traditional saving and credit groups, on the other hand, encourage membership but negatively associated with farmers patronage decision, hinting the possible presence of close substitutes among the services provided by agricultural cooperatives and rural saving and credit groups.

Table 5.6: Determinants of membership and use of services in agricultural cooperatives (*bivariate probit*).

Core variables	Explanatory indicators	Membership	Patronage
Location (x_1)	Constant	-3.117 (0.331)***	-1.269 (0.258)***
	Membership	-	**1.764 (0.139)*** **
	Market availability	0.169 (0.077)**	-0.260 (0.072)***
	Trader/input dealer availability	-0.123 (0.080)	0.442 (0.074)***
	Credit providers availability	0.517 (0.127)***	-
	Distance to district center	0.001 (0.000)*	0.001 (0.001)
	Distance to road	-0.001 (0.000)***	-0.001 (0.000)**
	Distance to coop	-0.002 (0.001)**	0.001 (0.001)
	Wald test H1: x_1 = 0	**39.83*** **	**55.33*** **
Size and specialization (x_2)	Land size	0.137 (0.042)***	-0.103 (0.041)**
	Livestock (in TLU)	0.021 (0.007)***	-0.013 (0.006)**
	Produce gain	0.554 (0.197)***	0.496 (0.193)**
	Produce pulses	0.116 (0.075)	-0.017 (0.071)
	Produce oilseeds	0.022 (0.099)	-0.172 (0.092)*
	Produce root crops	0.169 (0.100)*	-0.150 (0.094)
	Produce fruits	-0.302 (0.134)**	0.090 (0.114)
	Produce permanent	0.141 (0.086)	-0.050 (0.081)
	Coop affiliation to union	0.175 (0.093)*	0.209 (0.091)**
	Coop membership size	0.000 (0.000)***	-0.000 (0.000)***
	Coop provide inputs	0.373 (0.138)***	0.200 (0.120)*
	Coop provide commercialization	-0.201 (0.082)**	0.075 (0.078)
	Coop provide credit	0.366 (0.100)***	0.230 (0.103)**
	Wald test H1: x_2 = 0	**111.02*** **	**80.19*** **
Human capital and networking (x_3)	HH head age	0.004 (0.002)*	-
	HH head literacy	0.348 (0.076)***	-0.070 (0.073)
	HH size	0.134 (0.031)***	-
	HH head membership in roscg	0.218 (0.123)*	-0.231 (0.116)**
	Wald test H1: x_3 = 0	**46.63*** **	**5.21***
Diagnostic statistics	Number of obs.	1450	1450
	ρ	-0.796 (0.111)***	
	Wald test $Chi^2(44)$	1084.16***	

Note: *** significant at 1%, ** significant at 5% and * significant at 10%.
Source: Author's calculation based on data from the ATA baseline survey (2012).

The bivariate probit estimation also revealed important empirical results that relate to the theoretical discussions presented in Section 2 on the four possible membership forms arising from combining households membership and patronage decisions, viz., strong membership, soft membership, shadow membership and no membership. *Strong membership* is when farmers join agricultural cooperatives and make use of the services it provide. Theoretically, such form of membership is common in agricultural cooperative that handle transactions that are specialized, less frequent, and have an element of uncertainties (Ménard, 2007; Ménard and Valceschini, 2005). In line with the theory, the empirical results reported in Table 5.6 correspond strong membership to specialization of farm households and agricultural cooperatives. It indicates that households specialized in grain production and residing in *kebeles* where agricultural cooperatives are specialized in input supply are more likely members and users of the services their cooperatives provide. Note, however, that this can be due to limited access to alternative input suppliers, as agricultural cooperatives in Ethiopia are the major suppliers of modern inputs that are mostly required for grain production (Rashid et al., 2013). Besides specialization, agricultural cooperatives that are integrated or affiliated to upper-level unions attain/attract strong members. This can be because forward and backward integration by agricultural cooperatives enables coordination of complex tasks (e.g., quality control) at lower costs and give farmers the assurance that they will have reliable market outlets for their production (Valentinov, 2007; Stenfanson and Fulton, 1997; Rhodes, 1983).

Soft membership, on the other hand, arises when farmers join forces and become members of a cooperative but not users of the services it provides. The results show that such form of membership or arrangement is prevalent among relatively large scale farmers and in *kebeles* where regular local markets exist and agricultural cooperatives are larger in size. The result is consistent with theories that characterize agricultural cooperatives as a countervailing force or a pacemaker in the market place (Fulton and Giannakas, 2001; Sexton and Iskow, 1993; LeVay, 1983). In that respect, agricultural cooperatives can be considered as playing their 'yardstick' role. As indicated before, in the presence of markets, farmers found and join agricultural cooperatives to reduce market power of their trading partners and after achieving better bargaining positions they tend to use the market mechanism because of specific use or delivery requirements by the cooperatives or integrate downstream through hierarchies due to high degree of uncertainties and transaction specificity, which is probably true for large scale farmers (Ménard, 2007; Ménard and Valceschini, 2005). Small farmers, on the other hand, tend to avoid ownership and control costs and accrue benefits from economies of scales in physical transaction costs by using cooperative services (e.g., aggregation).

The association between soft membership and cooperative sizes is also in line with theoretical expectations, as in open membership agricultural cooperatives (like the case in point) farmers may inclined to become members mainly because other house-

holds in the *kebele* are members or the socio-political condition requires them to join. However, they will not tend to use the services provided by cooperatives, seeing that the inherent problems of ill-defined property rights in cooperatives increases with number of members (Sykuta and Cook, 2001; Cook and Iliopoulos, 2000; Cook, 1995). Households affiliation in traditional saving and credit groups is also linked with soft membership. As indicated before, this can be because some of the services provided by this two producer groups are likely close substitutes (e.g., credit).

As one can see in Table 5.3, there are also farmers in the sample who are users of the services agricultural cooperatives provide without membership commitment. This group of farmers made the *shadow membership* category. With shadow membership farmers avoid the contractual costs of ownership and control and obtain benefits from using its services and cooperative induced competitions in the market (Ménard, 2007; Hendirikse and Bijman, 2002). The results in this chapter shows that such forms of membership more likely occurs among small scale farmers and households residing in *kebeles* where traders and input dealers are available. Finally, *no membership* refers to a situation where farmers use either the spot markets or hierarchies (vertical integrations) instead of agricultural cooperatives. The results related such forms of membership to geographic isolation or location specificity. It indicates that farm households that are away from major roads are neither members nor users of agricultural cooperatives. This can be explained by the nonexistence of agricultural cooperatives in their locality, as most of the agricultural cooperatives in Ethiopia are found at advanced locations that are connected to main roads (Table 5.5).

5.6 CONCLUSIONS

In Ethiopia, like anywhere in the world, cooperatives are among the major players in agriculture input supply, processing and output marketing. Over the last decade in particular, agricultural cooperative have been promoted as a policy instrument towards achieving agricultural transformation in the country - that is, through leveraging collective actions, they are expected to engage in value-addition and enhance farmers market participation and bargaining position. Although their role in value-addition is not that evident, agricultural cooperatives are playing crucial roles in input supply and first-stage output handling. Empirical works show that over the last five to seven years agricultural cooperatives in Ethiopia account 90 percent of modern input supply and market more than 10 percent of the marketable surplus from agriculture (Rashid et al., 2013; Bernard et al, 2008).

However, despite promotional efforts and its economic imperatives, agricultural cooperatives are not ubiquitous, as one would expect. Moreover, in places where agricultural cooperatives exist not all farm households are members and those who are members are not necessarily users of the services agricultural cooperatives provide.

This leads to the following research questions that are of particular interest of this chapter. What drives the actual existence of agricultural cooperatives in particular places and not in others? Which types of farmers become members and/or users of agricultural cooperatives and why? Is there a link between farm households membership and patronage decisions in relation to agricultural cooperatives?

In theory, the presence of agricultural cooperatives and farmers decision to join and use its services are largely linked with market power and transaction cost arguments. The mixed-oligopoly literature portray the incidence of agricultural cooperatives as a defensive response by farmers to countervail opportunistic behaviors of trading partners - farmers found, join and patronize agricultural cooperatives to induce competition and achieve better bargaining position. Accordingly, one could argue that agricultural cooperatives tend to present in places where market exists. The new institutional economics literature, on the other hand, characterizes agricultural cooperatives as alternative governance mechanism that arises to internalize transactions that involve specific assets, uncertainties and information costs. According to this literature farmers join forces via agricultural cooperatives mainly to reduce or share transaction costs. Thus, on the contrary to that of the mixed-oligopoly, one would expect more agricultural cooperatives in remote locations where transaction costs are relatively higher.

This study addressed the aforementioned research questions and theoretical propositions using a unique data set that includes three survey data from 200 communities/*kebeles*, 102 agricultural cooperatives and 1450 farm households. The empirical results on the incidence of agricultural cooperatives indicates that *kebeles* that are accessible and with relatively developed market environment are more likely to have agricultural cooperatives. In other words, availability of output traders and input dealers (markets) and *kebeles* connection and proximity to major roads are found to be the drivers of agricultural cooperatives incidence in rural Ethiopia. This result is in line with the market power argument, which asserts that agricultural cooperatives exist mainly to induce competition and bargain for better terms of trades in places where markets exist.

The links between farm households membership and patronage decisions (farmer-cooperative relations) is another general issue the chapter sought to address. Even if the descriptive statistics evident that there are member households that are not users of the services agricultural cooperatives provide and conversely non-members who are users, the results from the bivariate probit model shows a significant linkage between farmers membership and patronage decisions - that is, more of the households that are members make use of the services provided by agricultural cooperatives, compared to non-members. The chapter further investigate the determinants of households membership and patronage decisions. The results clearly shows that households location, size, specialization, human and relational capital and the ser-

vices agricultural cooperatives specialize in and its forward and backward integration affects farmers membership and patronage decisions.

The chapter also distinguishes four forms of membership that arises while combing membership and patronage decisions, viz., strong, soft, shadow and no membership, and examined their driving factors. *Strong membership* in agricultural cooperatives is more likely to occur among households that are specialized in grain production and residing in a *kebele* where agricultural cooperatives are active (integrated upstream and downstream) and specialized in input supply provisions. This is partly explained by the central role of agricultural cooperatives in modern input supply in Ethiopia and hence limited access for alternative suppliers. *Soft membership*, a form of membership that arises when farmers decide to join agricultural cooperatives but not to use its services, is found to be more probable among households that are relatively large scale, affiliated in other groups and residing in *kebeles* where markets are relatively developed and agricultural cooperatives are larger in size. These results substantiate the argument that in places where markets exist farmers join cooperatives to induce competition and once they gain better bargaining position or prices and services adjustments are effected they tend to use the market mechanism due to specific use or delivery requirements by cooperatives. The inverse relation between cooperative size and patronage is explained by potential ill-defined property right problems in cooperatives, which increases with cooperative size or number of members.

Shadow membership is a type of membership that arises when farmers decide to use the services agricultural cooperatives provide without membership commitments (e.g., contractual costs of ownership and control). This form of membership or arrangement corresponds to small scale households and households residing in a *kebele* where traders and input dealers are available and the cooperative specialized on commercialization of outputs. Finally, *no membership* is likely to occur in *kebeles* that are geographically isolated - farm households located away from major roads are neither members nor users of agricultural cooperatives and this is explained by the nonexistence of agricultural cooperatives in remote *kebeles*, as evident by this chapter.

6

IMPACT OF AGRICULTURAL COOPERATIVES ON SMALLHOLDERS TECHNICAL EFFICIENCY: EVIDENCE FROM ETHIOPIA

Abstract

Using household survey data from Ethiopia, this chapter evaluates the impact of agricultural cooperatives on smallholders technical efficiency. The study used propensity score matching to compare the average difference in technical efficiency between cooperative member farmers and similar independent farmers. The results show that agricultural cooperatives are effective in providing support services that significantly contribute to members technical efficiency. These results are found to be insensitive to hidden bias and consistent with the idea that agricultural cooperatives enhance members efficiency by easing access to productive inputs and facilitating extension linkages. According to the findings, increased participation in agricultural cooperatives should further enhance efficiency gains among smallholder farmers.

KEYWORDS: Agricultural cooperatives, Smallholder farmers, Technical efficiency, Ethiopia.

6.1 INTRODUCTION

Enhancing productivity and commercialization among smallholder farmers is widely perceived as a key strategy for rural development, poverty reduction, and food security in Sub-Saharan Africa (World Bank, 2008). For productivity gains to be achieved, smallholder farmers need to have better access to technology and improve their technical efficiency. It is important for smallholders to have easy access to extension services in order to optimize on-farm technical efficiency and productivity, given the limited resources available. While the private sector is gradually emerging as a contender, the public sector remains the major provider of extension services in most of these countries (Venkatesan and Kampen, 1998). A third option for providing services to smallholder farmers is agricultural cooperatives, which serve the dual purpose of aggregating smallholder farmers and linking them to input and output markets (Davis, 2008; Coulter et al., 1999).

Given that agricultural systems in Sub-Saharan Africa are typically fragmented into a myriad of small or micro farms over vast and remote rural areas, the role of agricultural cooperatives has become increasingly important (Wanyama et al., 2009). Despite the turbulent history sometimes associated with post-independence and highly

centralized governance regimes, agricultural cooperatives are nowadays omnipresent throughout the sub-continent. In recent days considerable public development programs or private initiatives are channeled through cooperatives in order to overcome prohibitive transaction and coordination costs (Pingali et al., 2005). However, it is still empirically unclear and highly contested whether these collective organizations can deliver and live up to their promises. Given the prominence of agricultural cooperatives, this is an important policy question for many African countries.

Since the downfall of the *Derg* regime in 1991, agricultural cooperatives in Ethiopia have become an integral part of the national strategy for agricultural transformation (MoFED, 2006; FDRE, 2002). With varying degrees of success, agricultural cooperatives are longstanding and widespread throughout the country (Getnet and Tsegaye, 2012; Francesconi and Heerink, 2010; Bernard and Spielman, 2009; Bernard et al., 2008; Teigist, 2008; Francesconi and Ruben, 2007). The recently established Agricultural Transformation Agency (ATA) has also strongly asserted agricultural cooperatives as preferential institutions for moving smallholders out of subsistence agriculture and linking them to emerging input and output markets. In conjunction with promotional activities by the National Cooperative Agency, this effort has resulted in considerable growth both in number of agricultural cooperatives and the services they provide to their members. In June 2012, the majority of both the 43,256 primary cooperatives and the 200 cooperative unions in the country were agricultural cooperatives engaged in input and output marketing.

By 2005, agricultural cooperatives had commercialized more than 10 percent of the marketable surplus in Ethiopia (Bernard et al., 2008). In recent years they are the major suppliers of improved seeds and chemical fertilizer for all farm households (Rashid et al., 2013; MoFED, 2010: Unpublished). While their role in agricultural inputs adoption for productivity growth is widely recognized (Abebaw and Haile, 2013; Spielman et al., 2011), the impact of technical efficiency gains among their members remain unproven. Whether cooperative members are technically more efficient than non-members is an open question. Agricultural cooperatives, as producer organizations, are mandated to supply inputs together with providing embedded support services and for facilitating farmer linkage with extension service providers; hence, members are expected to be technically more efficient.

This chapter aims to answer this question by comparing cooperative members and similar independent farmers within the same *kebeles* (in order to reduce potential differences in technology and agro-ecology in which this procedure tempers possible diffusion effects). This approach, which compares members and non-members within the same *kebeles* in which the agricultural cooperatives operate, enables us to precisely capture the efficiency gains from membership, since members receive benefits from dividends, information, and extension services that are embedded in new technolo-

gies and have prior access to inputs, which are directly linked with technical efficiency gains.

The study used the Stochastic Production Frontier (SPF) function model to measure the technical efficiency of sampled farm households, as it is effective in estimating the efficiency score of households that account for factors beyond the control of each individual producer (Coelli et al., 2005; Kumbhakar and Lovell, 2000). After estimating the technical efficiency score, Propensity Score Matching (PSM) technique is applied to estimate the impact of membership in agricultural cooperatives on technical efficiency, drawing on the approaches of Francesconi and Heerink (2010), Bernard et al. (2008), and Godtland et al. (2004). Rosenbaum bounds sensitivity analysis is conducted to understand the sensitivity of the results obtained from the matching estimates to possible unobservable covariates. Moreover, the estimation checked the robustness of the results following alternative estimation strategy that aimed at accounting potential bias that might arise in estimating technical efficiency scores.

The results consistently show a positive and statistically significant impact of membership in agricultural cooperatives on technical efficiency at the farm level. On average, the results found about a 5 percent difference in technical efficiency between cooperative members and non-members. The results suggest that member households are in a better position to obtain maximum possible outputs from a given set of inputs. The results are insensitive for a hidden bias that would double the odds of participation in cooperatives and they are consistent with the idea that agricultural cooperatives enhance members efficiency by providing easy access to inputs, information, and embedded support services.

The rest of the chapter is organized as follows: Section 2 presents the data source and descriptive statistics of the variables used in the analysis. Section 3 presents the research methodology, including discussion of the empirical strategy, estimation procedure of the propensity scores and estimation of household technical efficiency scores. Section 4 reports the results and section 5 concludes by discussing the main findings.

6.2 DATA AND DESCRIPTIVE ANALYSIS

The key variables used in this study include household characteristics; inputs used for production; production value and village level characteristics (such as population density and availability of farmer training centers). The data used are from the Ethiopia Agricultural Marketing Household Survey, jointly carried out by the Ethiopian Development Research Institute (EDRI), Ethiopian Institute of Agricultural Research (EIAR) and International Food Policy Research Institute (IFPRI) between June and August 2008. This survey provided data on all the variables of interest except village level variables, which were then obtained separately from the Central Statistical Authority (CSA).

The Ethiopia Agricultural Marketing Household Survey is focused on smallholders production and marketing patterns and covers the four most populated regions of Ethiopia (Amhara, Oromia, SNNP and Tigray). The sampling procedure employed was a three-stage stratified random sampling[1]. The original sample includes 1,707 households randomly drawn from 73 Peasant Associations (PAs). From the original sample the analysis dropped households with missing observation on variables of interest[2]. The resulting sample used in this study includes 1,638 farm households, from which the study drew a sub-sample (i.e., member and non-member farm households within cooperative *kebeles*) mainly used to address the research question.

Table 6.1 presents a summary of demographic characteristics of sample households used in the analysis. From the total sample households considered, 34 percent are members of agricultural cooperatives (i.e., treatment group) and the remaining (66 percent) is found to be independent farm households (i.e., comparison group). Farm households belonging to agricultural cooperatives are relatively more literate, older, more likely to have a male head and have higher household size both in numbers and adult equivalents. In addition, members are also more likely to own radios, televisions and mobile phones, as compared to the non-members.

As expected, members are using more productive inputs (i.e., fertilizer and improved seeds). This can be explained by ease of access, as agricultural cooperatives are the major last-mile distributors of fertilizers and seeds, and also by the fact that members need to compensate for relatively lower fertile land. Although not reported in the table to conserve space, the data indicates a mean difference within non-member farm households in input use by locations. Non-member farm households residing in cooperatives *kebeles* use a higher amount of fertilizer and improved seeds as compared to non-members living in a *kebele* without agricultural cooperatives. This suggests the potential presence of a spill-over effect in input use and the presence of similar technology among members and non-members to study efficiency gains in *kebeles* with agricultural cooperatives.

As shown in Table 6.2, farm households that belong to agricultural cooperatives are those located at comparatively accessible locations (closer to the nearest local markets, closer to the nearest all weather roads and woreda amenities). This can also suggest that most of the agricultural cooperatives in Ethiopia are found in locations that are relatively accessible. In terms of other village level characteristics, on average, members

1 In the first stage, the woredas from each region were selected randomly from a list arranged by degree of commercialization as measured by the woreda-level quantity of cereals marketed (i.e., the major focus of the survey). This ensured that that woredas were uniformly distributed across the range of level of marketed cereal outputs. In the second stage, farmers or peasants associations (FAs or PAs) were randomly selected from each woreda. For the third stage of selection, households were randomly selected from the list provided by the PA office.

2 For example, we dropped households that report production volume without amount of seed used or land cultivated.

Table 6.1: Demographic characteristics of sample households.

Indicators	Members (n = 564)		Non-members (n = 1074)		Pooled Sample (N = 1638)	
	Mean	STD	Mean	STD	Mean	STD
Household size	6.50	2.04	6.18	2.66	6.29	2.47
Sex of HH head	1.04	0.20	1.10	0.30	1.08	0.27
Age of HH head	45.76	12.28	44.09	13.35	44.67	12.99
HH head education level	0.45	0.49	0.25	0.43	0.32	0.46
Number of plots	6.37	2.81	5.14	2.72	5.56	2.81
Number of crops	2.75	1.04	2.34	1.04	2.48	1.06
Off-farm income	0.55	0.49	0.61	0.48	0.59	0.49
Radio and/or TV ownership	0.60	0.49	0.39	0.48	0.46	0.49
Phone ownership	0.01	0.13	0.006	0.08	0.01	0.10
Value of crop produced	3423.4	3149.9	2266.4	2437.8	26665.5	2758.8
Fertilizer used by HHs	96.39	136.32	22.41	49.61	47.88	96.13
Improved seed used by HHs	7.46	23.86	1.70	7.53	3.68	15.51
Cultivated land size	1.37	0.94	1.14	0.90	1.22	0.92
Labor (adult equivalent)	5.43	1.77	5.08	2.20	5.20	2.07
Oxen owned by HHs	1.71	1.11	1.19	1.07	1.37	1.11
TLU (excluding ox)	3.34	3.33	3.22	5.29	3.26	4.71

Note: Tropical Livestock Unit (TLU) is calculated based on conversion factors suggested by Asfaw et al. (2010), Chilonda and Otte (2006), and Jahnke et al. (1988).

Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

Table 6.2: Geographic characteristics of sample households.

Indicators	Members (n = 564)		Non-members (n = 1074)		Pooled Sample (N = 1638)	
	Mean	STD	Mean	STD	Mean	STD
Distance to all weather road	55.10	73.98	76.63	89.57	69.22	85.12
Distance to nearest market	67.21	69.5	75.63	72.71	72.73	71.71
Distance to woreda capital	141.60	111.86	154.74	111.48	150.22	11.75
Population density	183.2	114.6	187.4	144.4	185.9	134.8
Access to irrigation	0.10	0.30	0.09	0.28	0.09	0.29
Soil quality						
Fertile	0.19	0.39	0.34	0.47	0.29	0.45
Medium	0.65	0.47	0.49	0.50	0.55	0.49
Teuf	0.14	0.35)	0.15	0.36	0.15	0.35
Farmer training center	0.09	0.29	0.12	0.33	0.11	0.32

Note: Medium denotes that the land owned by the household in question is a combination of both fertile and infertile soil qualities.
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

and non-members are located in Peasant Associations (PAs) with similar population density and have comparable access to irrigation and Farmer Training Centers (FTC).

6.3 ANALYTICAL APPROACH

This chapter aims at measuring the average impact of membership in agricultural cooperatives on farm households technical efficiency. In other words, the study aims to estimate the Average Treatment Effect on the Treated (ATT)[3], where the treatment is membership in agricultural cooperatives and the treated are member farmers. In such types of casual inference, the estimation of treatment effects in the absence of information on the counter-factual poses an important empirical problem. In impact evaluation literature this is known as the problem of filling in missing data on the

3 See Becker and Ichino (2002), Dehejia and Wahba (2002), Heckman et al. (1997), Rosenbaum and Rubin (1983), Smith and Todd (2005), Todd (2006), and Chapter 4 of this dissertation for detailed methodological discussion on estimation of Average Treatment Effect on the Treated through matching procedures. We didn't include equations of ATT to conserve space.

counter-factual (Becker and Ichino, 2002; Dehejia and Wahba, 2002; Heckman et al., 1997; Rosenbaum and Rubin, 1985). As clearly described in Chapter 4 of this dissertation, the challenge is to find a suitable comparison group with similar covariates and whose outcomes provide a comparable estimate of outcomes in the absence of treatment.

The empirical approach in this chapter is twined to reduce three potential sources of biases in the selection of a comparison group of non-member or non-cooperative farmers. These potential biases are common in evaluations aimed at measuring *ex post* impact of projects that involve some degree of self-selection among participants. A point in case is given by this chapter, which aims to evaluate the impact of membership in agricultural cooperatives, given that participation is voluntary and based on the intrinsic preferences, ability and motivation of the farmers, as well as considering that no baseline (i.e., *ex ante*) observations are available to assess the performance of member-farmers before they joined a cooperative.

The first potential source of bias is given by selection on observables, which may arise due to sampling bias, meaning that the selection of cooperative location was not-random but determined by spatial fixed effects (e.g., village level characteristics) and farm households characteristics. To control for selection bias associated with the fact that participation in cooperatives was not random, the analysis draw from similar approaches by Francesconi and Heerink (2010), Bernard et al. (2008), and Godtland et al. (2004), and apply Propensity Score Matching (PSM) techniques to account for differences in observed covariates between members and non-members. Using PSM has a great importance in providing unbiased estimate through controlling for observable confounding factors and in reducing the dimensionality[4] of the matching problem (Becker and Ichino, 2002; Rosenbaum and Rubin, 1983).

With regards to placement bias, however, one can argue that Ethiopias past and current governance of cooperative organizations minimizes the importance of farmers free will and locations resource endowments, since every *kebele* is expected to have at least one cooperative and participation in cooperatives means access to agricultural inputs, as agricultural cooperatives are the major last-mile distributor of modern inputs in Ethiopia (Rashid et al., 2013). Hence, in most cases the establishment of agricultural cooperatives is more driven by location specificity (as evident in Chapter 5) than the characteristics of farm households. Further supporting this argument, Bernard et al. (2008) assume, as this study do, that the majority of the agricultural cooperatives are externally formed in its PSM analysis, and found that government and development agencies initiate 74 percent of cooperatives in Ethiopia. Thus, in Ethiopia cooperative placement based on households characteristics is rather negligible.

4 Propensity score methods solve the dimensionality or separateness problem through creating a single composite score from all observed covariates X, which will be used for matching (Becker and Ichino, 2002; Rosenbaum and Rubin, 1983; Steiner and Cook, 2012).

The second source of bias in selecting a comparison group is spill-over effects. In the presence of externalities, comparing members of cooperatives with non-members in the same *kebele* can increase the possibility of having spill-over effects that underestimate the cooperative impact. On the other hand, considering a comparison group from *kebele* without cooperatives can increase differences at the *kebele* level (i.e., difference in agro-ecological conditions, infrastructure and institutions) by increasing the likelihood of selection bias. In the empirical analysis the study tried to take care of both concerns. The estimation first considered a sample that includes members and non-members from the *kebeles* with cooperatives and then used the whole sample to match cooperative members with non-members from *kebeles* without cooperatives as well.

The third source of bias is selection on unobservable, which arises due to differences between members and non-members in the distribution of their unobserved characteristics (e.g., in their ability, desire, risk preference, aspiration etc.). Given the data available cannot control for selection on unobservable referring to farmers preferences, motivation or ability. Controlling for such biases requires a suitable instrument that explains the probability of participation in agricultural cooperatives but does not explain their outcome (see for detailed discussions on alternative estimators under the hypothesis of observables and unobservable in Chapter 4). In this case, however, since the study deployed matching and compared members and non-members whose propensity scores are sufficiently close or have the same distribution, one can assume that the distribution of unobservable characteristics is the same or at least not so different for both groups independent of membership to induce a bias (see Becker and Ichino, 2002, for a discussion). Rosenbaum bounds sensitivity analysis is used to test the sensitivity of the results to possible hidden biases due to unobservable household characteristics when this assumption is relaxed. Furthermore, the robustness of the results is checked using alternative estimation strategy that accounts for similar potential bias that might arise in technology selection. In this strategy the technical efficiency scores are estimated after obtaining a comparable treatment and control groups.

6.3.1 *Estimation of the propensity score (p-score) and matching*

As indicated in the previous section the study used propensity scoring to match members of agricultural cooperatives with similar independent farm households. Hence, the analysis first estimated the conditional probability of becoming a member in agricultural cooperatives (i.e., propensity score) given observed household characteristics using a flexible probit model, where membership status in cooperatives is the depen-

dent variable and covariates and their quadratic terms are introduced as independent variables[5].

Although the probability of participation needs to be estimated only for households living in a *kebele* with cooperatives for better identification of the variables that determine participation, the study also estimated the likelihood of participation for the whole sample to understand the existence of sufficient overlap of the covariates. At large, the coefficients and statistical significance of the covariates are similar, except for livestock ownership, telephone ownership and households that produce barley. The analysis mainly used the propensity scores based on the reduced sample to estimate the average treatment effect on the treated for two reasons. One, the opportunity to participate exists in the restricted sample; and two, the restricted sample is the primary focus of the analysis as it better controls local level differences that can potentially bias the impact, tempering possible spill-over effects that are found to be negligible.

The results from the probit estimation are summarized in Table 6.3. From the results it was evident that the propensity to become a member of agricultural cooperatives is high for households with large family size, experience in farming, number of farm plots, mobile ownership, wealth (i.e., number of ox and land), and crop types produced by household (i.e., *teff*, wheat and finger-melt). However, after certain threshold wealth, household size and age adversely affect probability of participation. On the other hand, farm households that have off-farm incomes, live closer to roads, and grow diverse crops are less likely to participate in agricultural cooperatives.

The results are more or less consistent with what has been found by Bernared et al. (2008) as predictors of participation in agricultural cooperatives. They suggest that poorer households without any resources (i.e., land, labor, oxen etc.) and households producing different crops than the common cereals marketed through agricultural cooperatives are less likely to become members. They also show that wealthy households with sufficient experience in farming and excess owned labor will not tend to be involved in collective action, which is consistent with theoretical predications.

The density distribution of propensity scores for members and non-members are presented in Figure 6.1[6]. In order to improve the robustness of the estimate, the matches are restricted to members and non-members who have a common support[7] in the distribution of the propensity score. As it can be seen in the figure, the distributions appear with sufficient common support region that allows for matching. Besides, the difference between members and non-members in their propensity score distribution

5 Quadratic terms are introduced in order to account for possible non-linear relationships and to maximize the predicting power of the model (see Godtland et al., 2004, for detailed discussion).

6 The reported density distribution is for the reduced sample that includes only members and non-members in a *kebele* with agricultural cooperatives.

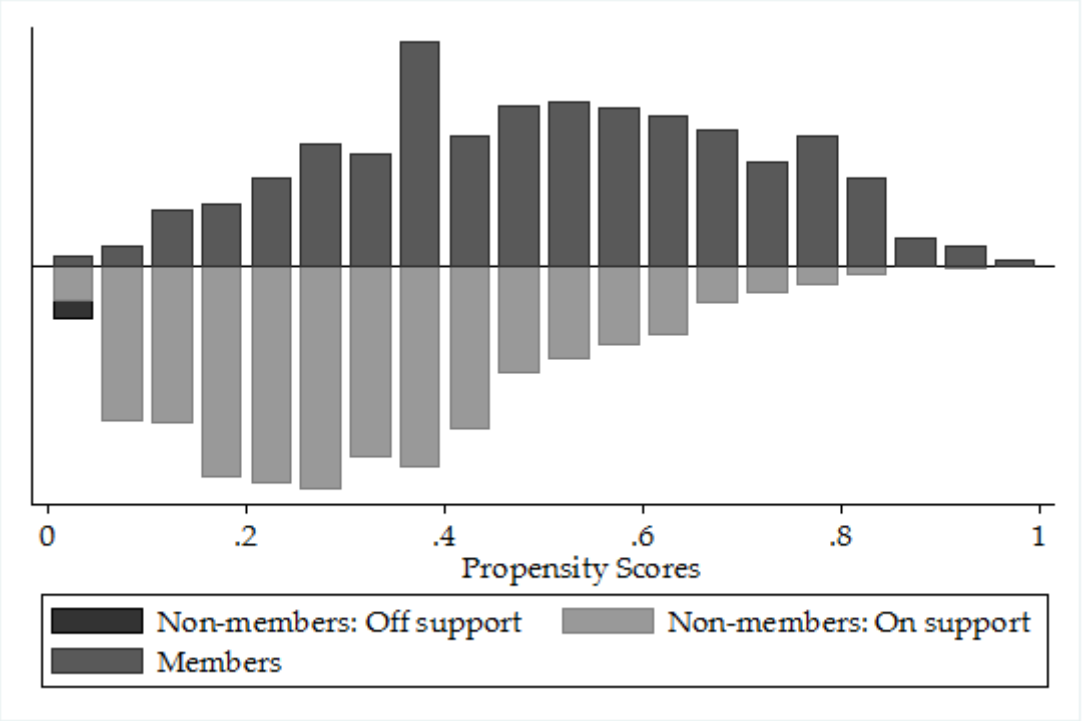
7 Common support refers to the values of the propensity scores where both treatment (i.e., members) and comparison groups (i.e., non-members) are found. 8 to 13 observations that are off-support are dropped (Table A3 and A4).

Table 6.3: determinants of participation in agricultural cooperatives.

Indicators	Members and non-members from cooperatives *Kebeles* (*reduced sample*)		Members and non-members from *Kebeles* with and without cooperatives (*whole sample*)	
	Coefficient	(Std. Err)	Coefficient	(Std. Err)
Household size	0.201	(0.067)***	0.206	(0.064)***
Household $size^2$	-0.013	(0.004)***	-0.014	(0.004)***
Gender of household head	-0.182	(0.153)	-0.161	(0.151)
Age of household head	0.034	(0.019)*	0.040	(0.018)**
Household head age^2	-0.001	(0.000)*	-0.001	(0.000)**
Household head literacy	0.408	(0.078)***	0.404	(0.077)***
Distance to the nearest road	-0.001	(0.000)***	-0.001	(0.000)***
Distance to the nearest market	0.001	(0.000)	0.001	(0.000)
Distance to woreda capital	-0.001	(0.000)	-0.001	(0.000)
Number of farm plots	0.027	(0.016)*	0.038	(0.016)***
Number of crops	-0.165	(0.109)	-0.197	(0.105)*
Household access to irrigation	-0.060	(0.126)	-0.085	(0.123)
HH receives off-farm income	-0.157	(0.075)**	-0.139	(0.073)**
Household owns telephone	0.987	(0.441)**	0.521	(0.342)
Number of ox owned	0.259	(0.073)***	0.252	(0.071)***
Number of ox $owned^2$	0.033	(0.015)**	-0.029	(0.015)*
Livestock, other than ox (in TLU)	-0.008	(0.011)	-0.017	(0.010)*
Hectare of land held	0.127	(0.041)***	0.162	(0.040)***
Hectare of land $held^2$	-0.004	(0.002)**	-0.006	(0.002)***
Household produces *Teff*	0.381	(0.136)***	0.444	(0.131)***
Household produces wheat	0.572	(0.140)***	0.662	(0.136)***
Household produces sorghum	-0.177	(0.147)	-0.180	(0.141)
Household produces barley	0.170	(0.135)	0.240	(0.131)*
Household produces maize	0.155	(0.138)	0.137	(0.135)
Household produces finger melt	0.643	(0.149)***	0.762	(0.145)***
Constant	-2.369	(0.488)***	-2.665	(0.477)***
Number of obs.	1455		1638	
Pseudo R^2	0.1464		0.1861	
Sensitivity (%)	50.00		48.58	
Specificity (%)	83.73		87.52	
Total correctly classified (%)	70.65		74.11	

Note: *** Significant at 1% , ** significant at 5%, and * significant at 10%.

Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.



Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

Figure 6.1: Distributions of the propensity scores for members (treated group) and non-members (comparison group).

validates the use of matching techniques to ensure comparability. From several matching techniques applicable in impact evaluation, the estimation used two extensively applied methods (i.e., non-parametric kernel based matching and five nearest neighbors matching).

The non-parametric kernel regression method is used to allow matching of members with the whole sample of non-members, since the technique uses the whole sample of the comparison with common support to construct a weighted average match for each treated (Heckman et al., 1998; Heckman et al., 1997). That is, the entire sample of non-members in the comparison group is used to construct a weighted average match to each member in the treatment group. On the other hand, the five nearest neighbors matching is used to match each member with the mean of the five non-members who have the closest propensity score. The imperative of the nearest neighbors matching is that it compares non-members with scores that are closer to the scores of the members.

What is more, the validity of the matching procedure relies on the extent to which these techniques sample or construct a comparison group that resembles the treatment

group. Besides, the balancing test within blocks that are satisfied in the estimation of the propensity score in case of both samples (see propensity score blocks in Table A.7), the study undertake a balancing test that compares a simple mean (i.e., mean equality test) of household characteristics within the treatment group to the corresponding comparison groups created by the matching techniques before and after matching as a complement.

As reported in Table 6.4[8], the unmatched sample fails to satisfy the balancing property. Although the groups are found to be comparable in terms of access to irrigation, age of household head and distance to market and district administration, it shows a systematic difference between members and non-members in the majority of their observed characteristics before matching. The balancing test results after matching that compares cooperative members to the sub-set of comparison non-members selected through five nearest neighbors matching and kernel-based matching shows no systematic or statistical difference in observed characteristics between the two groups. Hence, the results suggest that the comparison is valid from statistical point of view.

6.3.2 *Measuring technical efficiency*

The technical efficiency measure is intended to capture whether agricultural cooperatives enable their members in getting better access to productive inputs and services including training on better farming practices that enhance their productive efficiency. The stochastic frontier production model[9] is used to estimate the technical efficiency of sample households. It measures the ability of households to obtain maximum possible outputs from a given set of inputs (Coelli et al., 2005; Kumbhakar and Lovell, 2000; Farrell, 1957). Such a measure is of great importance in estimating the household efficiency score by accounting for factors beyond the control of each producer. Besides,

8 The reported balancing test is for the reduced sample (i.e., sample 1) that includes only members and non-members in a *kebele* with agricultural cooperatives. We did similar tests for the full sample and the balancing properties are satisfied.

9 Unlike the deterministic approach, it is a model that incorporates household-specific random shocks that represents statistical noises due to factors beyond the control of households, measurement errors and omission of relevant variables (Coelli et al., 2005; Kumbhakar and Lovell, 2000). In other words, in stochastic production frontier the error term is composed of the symmetric error component and the technical inefficiency component that measures shortfall of output from its maximum frontier or possible output. Hence, in this approach technical efficiency is measured as the ratio of observed output to maximum attainable output in a context characterized by household specific random shocks (i.e., $\exp\left\{V_j\right\}$): $TE_j = \frac{Y_j}{f(X_j,\beta).\exp\{V_j\}}$. Where, TE_j refers to the technical efficiency of the jth producer, Y_j is the observed output, $f\left(X_j,\beta\right)$ indicates the deterministic part that is common to all producers or households, $\exp\left\{V_j\right\}$ is a producers specific part that captures the effect of random noises or shocks on each producer. See Aigner et al. (1977), Coelli et al. (2005), Jondrow et al. (1982), Kumbhakar and Lovell (2000), and Meeusen and Ven den Broeck (1977) for detailed methodological discussions.

Table 6.4: Balancing test of matched sample.

Indicators	Unmatched samples			Five nearest neighbors matching			Kernel-based matching		
	M	N-M	Diff: P-value	M	N-M	Diff: P-value	M	N-M	Diff: P-value
Household size	6.50	6.03	**0.000**	6.50	6.45	0.676	6.50	6.46	0.775
Gender of HH head	1.04	1.10	**0.000**	1.04	1.04	0.834	1.04	1.03	0.799
HH head literacy	0.45	0.25	**0.000**	0.45	0.48	0.320	0.45	0.46	0.768
Age of HH head	45.76	44.80	0.169	45.81	44.95	0.239	45.81	45.41	0.585
Distance (minutes)									
To the road	55.10	72.11	**0.000**	55.20	57.51	0.590	55.20	57.7	0.562
To the market	67.21	68.26	0.783	67.16	71.43	0.357	67.16	69.95	0.523
To Woreda capital	141.6	148.5	0.249	142.2	140.7	0.828	142.2	143.5	0.837
Number of plots	6.37	5.38	**0.000**	6.35	6.33	0.942	6.35	6.21	0.432
No. of crops planted	2.75	2.42	**0.000**	2.74	2.76	0.764	2.74	2.72	0.741
Access to irrigation	0.10	0.08	0.367	0.10	0.08	0.328	0.10	0.09	0.481
Off-farm income	0.55	0.61	**0.014**	0.55	0.57	0.492	0.55	0.56	0.744
Own telephone	0.019	0.002	**0.001**	0.014	0.011	0.672	0.014	0.017	0.627
Number of ox	1.71	1.22	**0.000**	1.70	1.68	0.711	1.70	1.68	0.693
Livestock (in TLU)	3.34	2.80	**0.008**	3.32	3.14	0.972	3.32	3.43	0.631
Size of farm land	2.06	1.51	**0.000**	2.05	2.06	0.929	2.05	1.30	0.869

Note: M refers to members and N-M refers to non-members. Bold denotes that the p-value is statistically significance at lower than 10%. Livestock owned (TLU) refers to livestock other than ox owned by the household.
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

it helps to understand the factors that determine technical inefficiency of farm households, since some of the factors can be influenced by policies.

Following this approach the estimation first detected the presence of inefficiency in the production for sample households. Estimating the stochastic production frontier and conducting a likelihood-ratio test assuming the null hypothesis of no technical inefficiency on input-output data carried out the test. The result shows that the inefficiency component of the error term is significantly different from zero, which indicates the presence of a statistically significant inefficiency component (i.e., Ho: Sigma_u = 0 is rejected). The lambda (λ) value is also greater than one, indicating the significance of the inefficiency. Moreover, the value of gamma indicates that there is a 70 percent variation in output due to technical inefficiency. In other words, the technical inefficiency component is likely to have an important effect in explaining output among farm households in the sample.

Once the presence of technical inefficiency detected, the study estimate a one-stage simultaneous maximum likelihood estimate for the parameters of the Cobb-Douglas[10] stochastic frontier production function to predict households technical efficiency scores and to understand determinants of inefficiency. As expected, all conventional inputs (land, labor, fertilizer, seed and number of oxen owned) are found to be significant determinants of household production (Table 4.5). In particular, landholding size and number of oxen owned are found to be the major input variables that affect output considerably. Overall, the return to scale shows that farmers in the sample considered are operating under increasing return to scale, suggesting that size may matter in the efficiency of smallholder farmers. This result is expected in smallholder farms context and consistent with prior studies in Ethiopia by Asefa (2012) and Haji and Andersson (2008), among others.

The inefficiency model suggests that inefficiency of farm households is significantly linked with number of plots, diversification of crops, gender of household head and membership in agricultural cooperatives[11]. Overall, the above results are in line with the findings of Jaime and Salazar (2011), Alemu et al. (2009), and Idiong (2007) and comparable to the results obtained from the alternative strategy that estimate the technical efficiency scores using matched group of member and non-member farmers.

With regard to membership in agricultural cooperatives, the result indicates that membership reduces technical inefficiency by about 5 percent (Table 6.5). Concurrently, from the descriptive statistics it is understood that the mean technical efficiency of members is significantly higher than that of non-members (i.e., 71 and 62 percent, re-

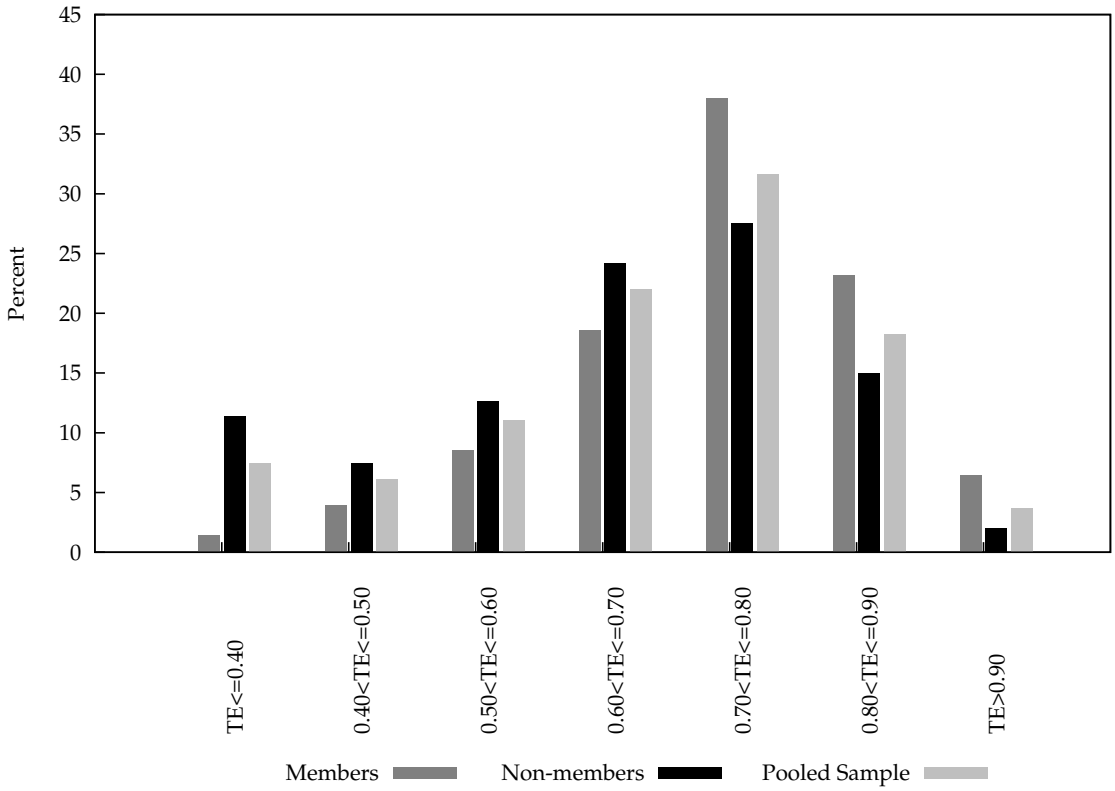
10 Cobb-Douglas stochastic frontiers are found to be adequate representations of the data as compared to the specifications of the translog stochastic frontiers.

11 The coefficient of membership in agricultural cooperatives obtained from the inefficiency model is comparable to the average impacts of cooperative membership on technical efficiency resulted from matching estimators.

Table 6.5: Maximum Likelihood (ML) estimates of the parameters for Stochastic Production Frontier (SPF) function and correlates of technical inefficiency.

Production function	Dependent variable: production value in *birr* (logged)	
	Coefficient	(Std. Err.)
ln (Land size held by household (ha))	1.174	(0.063)***
ln (Seed used (Kg))	0.071	(0.017)***
ln (Fertilizer used (Kg))	0.036	(0.009)***
ln (Labor (hired in number of days))	0.051	(0.014)***
ln (Number of oxen owned)	0.472	(0.042)***
Constant	6.327	(0.101)***
Return to scale (sum of elasticities)	1.804	
Technical inefficiency component		
Household size	0.023	(0.026)
Gender of household head	0.726	(0.204)***
Age of household head	-0.004	(0.004)
Household head read and write	-0.231	(0.148)
Distance to local market	0.001	(0.001)*
Number of plots held	0.106	(0.028)***
Number of crops planted	-0.620	(0.135)***
Household access to irrigation	-2.800	(1.219)**
Household receives off-farm income	0.152	(0.141)
Membership in cooperatives	-0.512	(0.176)***
Household access to institutional credit	0.053	(0.162)
Constant	-0.567	(0.439)
Diagnostic statistics		
Sigma_v	0.600	(0.032)***
Lambda	1.556	(0.091)***
Gamma ($\gamma = \lambda^2/(1+\lambda^2)$	0.707	
Number of obs.	1638	
Wald chi^2 (5)	1567.38	
Prob > chi^2	0.000	
Log likelihood function	-1871.810	
LR test of Sigma_u=0: $chibar^2(01)$	24.80	

Note: *** Significant at 1% , ** significant at 5%, and * significant at 10%.
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.



Note: TE refers to Technical Efficiency score of households.
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

Figure 6.2: Frequency distribution of technical efficiency scores by cooperative membership.

spectively) and the majority of the members are above the mean efficiency (i.e., 65 percent) of the pooled sample (Figure 6.2[12]). Besides, as is clear from Figure 6.2, the density of non-members is above that of the members on the distribution below the mean efficiency of the whole sample. However, one cannot draw any conclusion at this stage as this difference can be partially or totally due to original differences among households. Thus, as indicated above, the study used matching that computes the average difference in technical efficiency scores between members and non-members in the common support region using the techniques described above.

12 The reported frequency distribution is for the reduced sample (i.e., sample 1) that includes only members and non-members in a *kebele* with agricultural cooperatives.

6.4 RESULTS AND DISCUSSION

6.4.1 *Average impact of agricultural cooperatives on technical efficiency*

As described in the above sections, the average impact of cooperative membership on the technical efficiency of small farmers is analyzed using the reduced sample (i.e., sub-sample 1) that includes members and non-members from *kebeles* with agricultural cooperatives and the whole sample that aimed at accounting for possible spill-over effects (i.e., sample 2). The resulting non-parametric estimate of the Average Treatment Effect on the Treated (ATT), average impact of membership in agricultural cooperatives on the technical efficiency of smallholder farmers, based on the Propensity Score Matching (PSM) methods, is reported in Table 6.6.

The chapter mainly used the analysis based on the reduced sample as it accounts for differences in technology and agro-ecology that can affect efficiency estimation. On the other hand, the impact estimate based on the whole sample aimed at examining the extent of spill-over effects. As is clear from Table 6.6, the diffusion effect is found to be negligible. Meaning, the impact estimate based on the whole sample is lower[13] than the impact estimate based on the reduced sample where the possibility of diffusion effects exists.

Consistent with the results from the descriptive statistics and the inefficiency model of the stochastic frontier function, the study found that, on average, farmers belonging to agricultural cooperatives are more technically efficient than independent farmers. The results suggest that member households are in a better position to obtain maximum possible outputs from a given set of inputs used, by about 5 percentage points, in line with the expectation that agricultural cooperatives likely make productive technologies accessible and provide embedded support services (i.e., training, information and extension linkages). The impact estimates are robust across different estimation methods and samples considered. The estimation further checked the robustness of the estimates for a specific region (i.e., Amhara Region), where the size of the sample allows for using matching techniques. The results are comparable to the results from the reduced and the whole sample (i.e., about a 5.5 percent and 4.5 percentage points difference for kernel based and five neighbors matching, respectively).

Nonetheless, the above results rely heavily on the assumption of unconfoundeness or conditional independence[14] (i.e., once the factors affecting participation are taken into

13 Lower average impact from the whole sample that include non-cooperative *kebeles* can also indicate the presence of technology difference between cooperative and non-cooperative *kebeles*, strengthening our decision to focus on cooperative *kebeles* in order to reduce potential differences in technology, as it should be accounted to compare differences in technical efficiency due to cooperative membership.

14 Unconfoundedness in our case means that participation in agricultural cooperatives does not depend on households technical efficiency, after controlling for the variations in technical efficiency induced by

Table 6.6: Effect of cooperative membership on technical efficiency of smallholders.

Indicator	Kernel-based matching		Five nearest neighbors matching		Number of obs.
	ATT	Std. Err.	ATT	Std. Err.	
Reduced sample: (% Difference in TE)	5.64	(0.008)***	5.70	(0.010)***	1455
Whole sample: (% Difference in TE)	5.42	(0.009)***	4.55	(0.010)***	1638
Check for robustness: observations limited to Amhara region only					
Reduced sample	4.82	(0.012)***	4.11	(0.011)***	385
Whole sample	5.30	(0.010)***	4.02	(0.012)***	431

Note: Reduced sample includes members and non-members only from *kebeles* with agricultural cooperatives; Whole sample includes the whole sample (i.e., members and non-members from *kebeles* with and without agricultural cooperatives). TE refers to households Technical Efficiency score. Bootstrap with 100 replications is used to estimate the standard errors. *** Significant at 1%.

Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

account, the condition of randomization restored) and are not robust against hidden bias. If there are unobserved variables which affect participation in cooperatives and technical efficiency simultaneously, unobserved heterogeneity affecting the robustness of the estimates might arise (Keele, 2010; Becker and Caliendo, 2007; Rosenbaum, 2002; Rosenbaum and Rubin, 1983).

The study assessed the presence of this problem using Rosenbaum bounds sensitivity analysis when the key assumption is relaxed by a quantifiable increase in uncertainty. As reported in Table 6.7, the results are found to be insensitive to a bias that would double the odds of participation (self-selection) in agricultural cooperatives but sensitive to bias that would triple the odds. The magnitude of hidden bias, which would make the finding of a positive and significant effect of membership in agricultural cooperatives on technical efficiency questionable or spurious, should be higher than =2.5 and =2.6 for the reduced sub-sample and whole sub-sample, respectively. Hence, the study deduce that the strength of the hidden bias should be sufficiently high to undermine the conclusion of positive and significant impact of membership in agricultural cooperatives on technical efficiency based on the matching analysis.

6.4.2 *Robustness check*

Besides the Rosenbaum bounds sensitivity analysis for hidden bias presented in Table 6.7, the estimation checked the robustness of the results following alternative estimation strategy used by Crespo-Cebada et al. (2013) and Mayen et al. (2010) to address the same problem of correcting potential selection bias in measuring technical efficiency difference between two groups using PSM. In this approach the stochastic frontier model is estimated on sub-samples of cooperative non-members and members that are obtained from PSM. The strategy is aimed at addressing potential bias that may arise in estimating technical efficiency scores using unmatched samples, as the technology use can be affected by the same selection bias like that of membership in agricultural cooperatives.

Thus, before estimating the technical efficiency scores, the analysis constructed statistically comparable non-members using PSM. Single-nearest-neighbor matching technique is used to pair each cooperative member with a non-member that has the closest propensity score[15]. Figure 6.3 shows the distribution of the propensity score for sub-sample members and non-members obtained from the matching. As expected, the propensity score distribution of the PSM sub-sample of non-members closely resem-

differences in observable covariates. It is a strong assumption that implies that participation is based on observable characteristics and that variables simultaneously influencing participation and technical efficiency are observable.

15 Similar probability model and specification presented in section 4.1 and Table 3 is used to estimate the propensity scores.

Table 6.7: Rosenbaum bounds sensitivity analysis for hidden bias.

Critical Value of Hidden Bias (Γ)	TE (Sample 1) Sig+ (max)	TE (Sample 2) Sig+ (max)
1	<0.0000001	<0.0000001
1.10	<0.0000001	<0.000001
1.20	<0.000001	<0.000001
1.30	<0.000001	<0.000001
1.40	<0.000001	<0.000001
1.50	<0.000001	<0.000001
1.60	<0.000001	<0.000001
1.70	<0.000001	<0.000001
1.80	0.000011	<0.000001
1.90	0.000085	0.000012
2	0.000489	0.000084
2.10	0.002134	0.000443
2.20	0.007333	0.001824
2.30	0.020519	0.006039
2.40	0.048091	0.016554
2.50	**0.09674**	0.038524
2.60	0.170595	**0.077759**
2.70	0.268689	0.1387
2.80	0.384324	0.222264
2.90	0.506814	0.32474
3	0.624664	0.43839

Note: Reduced sample includes members and non-members only from *kebeles* with agricultural cooperatives; Whole sample includes the whole sample (i.e., members and non-members from *kebeles* with and without agricultural cooperatives). TE refers to households technical efficiency score. The sensitivity analysis is for one-sided significance levels. Γ measures the degree of departure from random assignment of treatment or a study free of bias (i.e., Γ=1).

Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

Table 6.8: Means and standard deviations of technical efficiency: PSM sub-sample.

	Members		Non-members		Difference in Means
	Mean	Std. Err.	Mean	Std. Err.	
Reduced sample	68.37	0.58	61.08	0.74	7.29***
Whole sample	67.17	0.60	62.03	0.73	5.13***

Note: Reduced sample includes members and non-members only from *kebeles* with agricultural cooperatives; Whole sample includes the whole sample (i.e., members and non-members from *kebeles* with and without agricultural cooperatives). *** Significant at 1%.

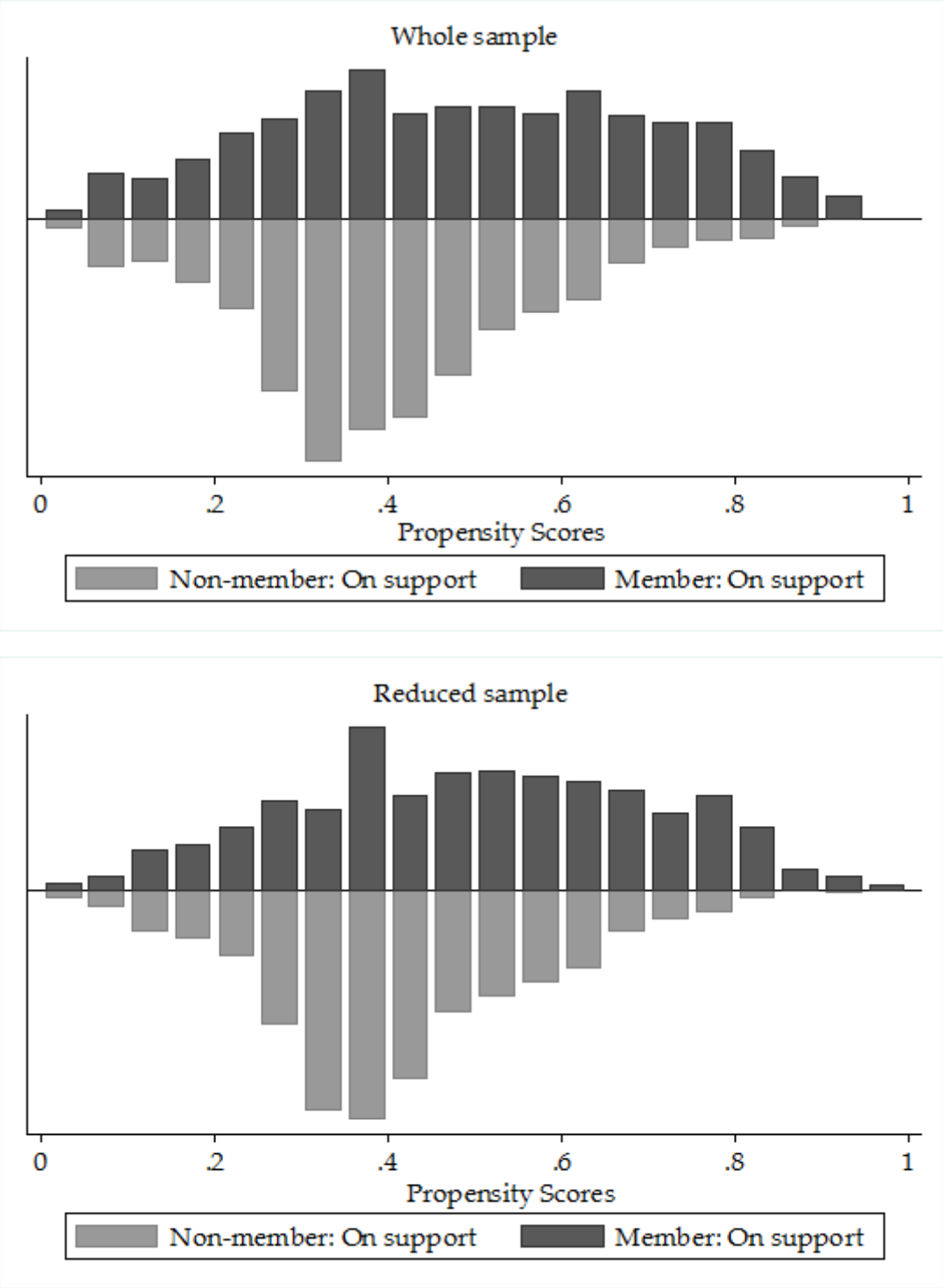
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

bles that of members in terms of their propensity to membership, compared to the distribution in Figure 6.1. Furthermore, as it is a matched sub-sample, there are no farm households that are off-support in either of the groups (Figure 6.3).

Next the analysis estimated the technical efficiency scores of the farm households using stochastic frontier model on the two different sub-samples obtained from PSM (i.e., PSM sub-sample that include members and non-members in cooperative *kebeles* and PSM sub-sample that also include non-members in non-cooperative *kebeles*). The results from the stochastic frontier analysis are presented in Table 6.8[16]. For the whole sample the analysis found the technical efficiency of cooperative members to be 67.17, which is 5.13 percentage points higher than for non-members. When the study account for potential technology differences across locations by restricting the sample to farm households only living in cooperative *kebeles*, the it found that cooperative members are 7.29 percent more efficient compared to non-members. Overall, the 5 to 7 percentage points efficiency gap found from alternative estimation strategy is comparable with the results obtained from ATT reported in Table 6.6.

In all, although the magnitude or economic significance is not as high as expected, the results obtained from the two alternative estimation strategies suggested that participation in agricultural cooperatives resulted in technical efficiency gains among smallholder farmers. This efficiency difference can be due to greater benefit of agricultural cooperatives in farm technology/inputs adoption by lowering costs and improving members access to productive inputs and services (Abebaw and Haile, 2013; Getnet and Tsegaye, 2012). As presented in Table A.8, the study also found considerable impact of cooperatives membership in use of farm inputs (i.e., fertilizer and improved

16 As indicated in section 4.2 the coefficients of the production parameters, inefficiency correlates and diagnostic statistics obtained from the SPF estimation using the matched sample are more or less similar to the one resulted from the estimation based on the whole unmatched sample.



Note: Reduced sample includes members and non-members only from *kebeles* with agricultural cooperatives; Whole sample includes members and non-members from *kebeles* with and without agricultural cooperatives.
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

Figure 6.3: Distributions of the propensity scores for members and non-members: PSM subsample.

seeds). Moreover, benefits of cooperatives in linking smallholders to extension services can be also the sources of this efficiency gap between members and non-members, as recent study by Rodrigo (2012) found a positive effect of agricultural cooperatives in increasing farmers involvement in agricultural extension programs in Ethiopia that results in productivity growth among members.

6.4.3 *Impact heterogeneity*

The above results obtained from the alternative estimation strategies assume a homogenous treatment effects among cooperative member households. However, treatment impacts can vary within cooperative members, as households are distinct in their socio-economic realities. In order to understand potential impact heterogeneity within members, the distribution of cooperatives impact on members level of technical efficiency is plotted using the results obtained from Kernel matching estimates (i.e., the difference between actual observed technical efficiency and corresponding matched values obtained from the estimation of ATT).

While the impacts are normally distributed, one can observe some variations of membership impact on technical efficiency within members across the two samples (Figure A6.1). For large proportion of members, involvement in cooperatives results in about 5-15 percent efficiency gains as compared to non-members. For the remaining few member households is shows both efficiency gains and losses ranging from 20-40 percent as compared to their counterparts. The analysis further regress technical efficiency gains due to membership in cooperatives obtained from Kernel matching estimates by household characteristics, with the purpose of understanding the determinants or correlates of observed impact variations within members.

The results from the regression suggests that the impact of membership in cooperatives on technical efficiency significantly increases with cultivated land size, application of improved seeds and access to irrigation and farmer training center and decreases with distance to market, off-farm income and sex of household head (Table A.9). It implies that technical efficiency gains from cooperative membership is better responsive for member households with large and irrigated land holding and resides in villages with farmer training centers. The lower impact of cooperatives membership for members away from local market on the other hand can be due to higher costs of accessing the services provided by the cooperatives, as most of the cooperatives in Ethiopia are located closer to nearest markets (Bernard et al, 2013). Conversely the results indicate that household head literacy, access to media, as measured by radio ownership and application of fertilizer does not explain variations in efficiency gains within members.

6.5 CONCLUSIONS

Over the past decade and a half, agricultural cooperatives in Ethiopia have strongly promoted as instrument to transform subsistence agriculture by preserving market options and increasing farmers income, as they are believed to be efficient in internalizing transaction costs, reducing the variability of farmers income through risk pooling and countervailing opportunistic behaviors (Hogeland, 2006; Staatz, 1987). Though many variations in the agricultural cooperatives model can be distinguished, typical agricultural cooperatives in Ethiopia combine both agricultural supply and marketing activities. Currently, agricultural cooperatives market more than 10 percent of farmers produce and supply farm inputs for all farm households irrespective of membership. Although their share in input and output marketing shows how vibrant the cooperatives are in supporting agricultural transformation, empirical studies on their efficiency and productivity impacts are very limited.

Using household data drawn from the Ethiopia Agricultural Marketing Household Survey in 2008, this chapter aims to understand the impact of membership in agricultural cooperatives on technical efficiency in a context where membership incentives can result in efficiency gains. The study assume that the establishment of cooperatives in Ethiopia has been independent of household level characteristics due to negative experiences in the past and current policies on cooperative formation (i.e., one cooperative for each *kebele*). Moreover, the study assume that difference in technology between members and non-members is insignificant, as agricultural cooperatives in Ethiopia are required to supply basic farm inputs for all farm households. In addition, the role of spill-over effects cannot be underestimated. With these assumptions, Propensity Score Matching (PSM) technique is used to compare the average technical efficiency difference between cooperative member households and independent farm households living within the same *kebele* in which agricultural cooperatives operate.

The results consistently indicate a positive and significant impact of agricultural cooperatives on members levels of technical efficiency. On average members are better situated to get maximum possible output from a given set of inputs used, by at least 5 percent. These results are in line with the predicted role of agricultural cooperatives in improving efficiency by providing easy access to productive inputs and embedded support services such as training, information, and extension on input application. The robustness of the findings is demonstrated by similar results obtained from different approaches and techniques. However, as compared to the results of the descriptive statistics, the impact based on the average treatment effect is lower, which indicates the existence of variation or heterogeneity across households within members.

In general, the efficiency gains from membership in agricultural cooperatives emerged from the analysis has important policy implications. It suggests that besides their progressive role in input and output marketing, agricultural cooperatives in Ethiopia

are effective in providing embedded supportive services, significantly contributing to members technical efficiency. Therefore, promoting agricultural cooperatives as complementary institutions to public extensions services should further enhance smallholders technical efficiency.

7

CONCLUSIONS AND DISCUSSIONS

7.1 INTRODUCTION

Microfinance institutions that aim at providing financial services to the unbanked poor and agricultural cooperatives which often arise to ameliorate problems related to market-failures in (smallholder) agriculture are the two prominent pro-poor development institutions advanced by scholars and policy makers over the last three-to-four decades across developing countries. This dissertation mainly focuses on understanding the driving forces and efficiency and impact of these two institutions in the Ethiopian context - it examines the impact and business viability of microfinance institutions in serving the poor and the drivers of agricultural cooperatives incidence and its economic imperatives in two separate parts. The first part specifically addresses whether microfinance providers can achieve financial sustainability together with serving the poor and estimates the actual impact of access to microfinance credit on farmers agricultural technology adoption and intensity of use. The analysis distinguished the efficiency and impact of microfinance institutions by ownership form. The second part of the dissertation investigates the drivers of agricultural cooperative presence and farmers membership and patronage decisions. It also examines the effect of agricultural cooperatives membership on farmers level of technical efficiency.

This chapter presents a summary of the main results from the preceding five chapters that are organized in these two thematic parts. It also discuss on how the main empirical results are related to theoretical and empirical evidences. The rest of this concluding chapter is organized as follow. The next section recapitulates the main results with some general remarks. Section 7.3 locates the general conclusions in the broader theoretical and empirical literature of microfinance and agricultural cooperatives. The last section presents potential areas of future research.

7.2 SUMMARY OF MAIN RESULTS

Whether microfinance providers can be financially self-sufficient in serving the poor and have impact on borrowers agricultural investment are the main issues addressed in the first part of the dissertation . The estimates on outreach-financial performance

trade-offs show distinct results by microfinance ownership form. For microfinance institutions that are owned by agents other than their clients (i.e., NBFIs), financial self-sufficiency and outreach to the poor are found to be challenging objectives to achieve altogether and can be conflicting. The results indicate that NBFIs that serve small size loans and more to women borrowers are less financially sustainable. While NBFIs with relatively lower cost per unit of currency lent are financially self-sufficient, those which serve small size loans face higher loan costs that significantly undermine their financial sustainability. On the other hand, the results indicate a complementary relationship between outreach and financial performance for microfinance providers that are owned by their clients (i.e., financial cooperatives). There exist financial cooperatives that serve small loans and more to women borrowers in cost-covering basis. Overall financial cooperatives face about 30 percent lower costs per unit of currency lent compared to NBFIs. These results are plausible, as microfinance providers that are owned by their clients can better dispense with information and enforcement problems and reduce or internalize high market contract costs in micro-lending.

Additional results that examine the relation between interest rates and financial performance confirm to theoretical expectations. The profitability or financial self-sufficiency of NBFIs, in particular, increases with interest rate charges, but up to a point. It became evident that charging high enough interest rate (i.e., 25 percent per annum) adversely affects their financial performance. This can be due to the problems of adverse selection and moral hazards and fall of demands, as higher interest rates can drive worthy clients out of the market and only risky borrowers would find it in their interest to borrow (Armendàriz de Aghion and Morduch, 2010; stigltiz, 1990). Although financial cooperatives charge significantly lower interest rates compared to NBFIs, for financial cooperatives as well, relatively higher interest charges are negatively related with financial performance.

Following the results that point to cost containment as potential avenue for microfinance institutions towards achieving financial viability in serving the poor, chapter three further examines whether microfinance providers in Ethiopia are reasonably cost-efficient or their costs include significant avoidable expenses. The results from stochastic cost frontier estimation indicate that operating at the efficient cost frontier is an objective not yet achieved by the majority of microfinance providers in Ethiopia. The predicted cost-efficiency scores suggest that most of the microfinance institutions in the sample could have reduced their costs by half had they been efficient in using and/or allocating the available resources. The estimates specifically show a 58.7 percent efficiency gap between the average microfinance providers and microfinance operating at the frontier. The inefficiency model simultaneously estimated with the cost function identified outreach variables as one among the sources of cost-inefficiency, corroborating the trade-offs between outreach and financial performance. It indicated that microfinance providers with relatively small average loan sizes and cater more to

women borrowers are less cost-efficient. Moreover, consistent to the regression results above, financial cooperatives are found to be more cost-efficient compared to NBFIs.

Besides the institutional analysis that examines the ability of microfinance institutions to dispense with information and enforcement costs in serving poor clients, part one of this dissertation evaluates the actual impact of microfinance credit on farmers agricultural technology adoption and application rates, indicators directly related to the main purposes of microfinance credit for farmers in Ethiopia. The analysis used carefully stratified samples and Propensity Score Matching (PSM) method that systematically restore the counterfactual scenario in the absence of experimental comparison group in impact evaluation. The results across the three matching techniques deployed indicate a significant positive impact of access to microfinance credit on adoption and application rates of the two main divisible agricultural technologies in Ethiopia (i.e., fertilizer and improved seeds). However, impacts disaggregated by subrogate variables such as farm size and ownership structure of the microfinance institution reveals considerable heterogeneity concealed by mean estimates. While access to microfinance credit significantly improves fertilizer use and application rates among all sizes of farmers, it doesn't have significant effect on use of improved seeds among small farmers with less than 2 ha of farm land. On the other hand, the results distinguished by microfinance ownership form found a strong impact of credit on technology use only among farmers who are users/clienteles financial cooperatives.

In general, the main results from part one indicates: (1) the difficulty microfinance institutions face while trying to serve the unbanked poor clients in cost covering basis and the need to engage in experimentation and innovations that aimed at reducing costs of lending other than relying heavily on simplistic assumptions that assert transfer of higher costs of lending to poor clients onto the clients themselves. (2) the need for efficient assignment of ownership rights in microfinance organization. Consistent to theoretical predictions the results suggest that assigning ownership right to clients significantly lower costs per unit of currency lent and enables microfinance institutions to fulfill their full promises - serving small loans and more to women borrowers together with financial sustainability. (3) the crucial roles of access to institutional financial services like credit in stimulating adoption and use of technological innovations in smallholder agriculture. The results also indicate the need for targeting by farm size and supply of complementary financial products like insurance, which can reduce (perceived) adoption risks among small farmers who have limited scale for experimentation.

Understanding the drivers of agricultural cooperative incidence, its impact, and farmers membership and patronage decisions are of particular interests of the second part of the dissertation. In Ethiopia, like anywhere in the world, agricultural cooperatives are a prominent farmers' integrating and bargaining agency. They serve both as a source of modern inputs and market outlets for farmers' produces. However, despite

their economic imperatives agricultural cooperatives are not ubiquitous (equally distributed) and empirical evidences on the drivers of their presence are scarce. Most of the existing works are more of theoretical. Using indicators that are related to the environment where agricultural cooperatives actually exist (i.e., local market structure and geographic isolation) this dissertation made effort to empirically test two theoretical propositions (i.e., market power vs., transaction cost arguments) often used to justify the presence of agricultural cooperatives. The results found support the market power hypothesis that view agricultural cooperatives as a defensive response by farmers to effect price and service adjustments in the face of trading partners opportunistic behavior. Most of the agricultural cooperatives in the sample are found to be located at advanced locations with markets/traders and closer to major roads than in remote locations where information and transaction costs are likely to be higher.

The analysis in chapter five further examines the drivers of farmer membership and patronage decisions, as in places where cooperatives exist all farmers are not members and all members are not necessarily users of the services agricultural cooperatives provide. The results from seemingly unrelated probit model that estimated double discrete choices indicate that the two decisions are related - farmers who choose to become a member more likely patronize their cooperatives. Joint significance tests identified location, asset and relational specificity as major drivers of farmers membership and patronage decisions. While farmers with access to local markets, reside in advanced locations, specialized in grain production and affiliated to other network/-group tend to become a member, only small scale farmers that produce grain and reside in places with no regular local markets more likely make use or deliver to agricultural cooperatives. Moreover, the specialization of the agricultural cooperative itself and its integration downstream significantly affect farmer-cooperative relation. Farmers more likely become members and users of agricultural cooperatives if the cooperative is specialized in modern input supply (other than commercialization) and affiliated to secondary level cooperative unions.

The second part of this dissertation also made effort to fill a research gap on the actual impact of agricultural cooperative membership on household outcomes. After decades of agricultural cooperatives revival in Ethiopia, there are only few empirical studies that evaluate the impact of agricultural cooperatives on smallholder commercialization, technology use and livelihood improvements. Despite its roles in modern input supply and extension linkages, its effect on efficiency improvements is an open question. The last chapter of this dissertation estimated technical efficiency gains from membership in agricultural cooperatives. The results indicate a positive impact of agricultural cooperatives on farmers' technical efficiency - farm households that belong to agricultural cooperatives produce relatively higher outputs from a given set of inputs used compared to non-members, at least by five percentage points. This result is in line with the expected role of agricultural cooperatives in improving efficiency by

providing easy access to productive inputs and embedded support services such as training, information and extension linkages.

7.3 DISCUSSIONS

Microfinance institutions and producer organizations are prominent pro-poor economic organizations that are playing a crucial role in filling missing market or services across low income communities in developing countries. The ability of microfinance institutions to serve poor households whom banks would spurn with remarkable success in loan repayment rates has specially attracted worldwide attention, which led to redirecting of resources from traditional poverty reduction programs to microfinance institutions by governments, donors and non-governmental organizations (Morduch, 1999). Despite greater common interest in microfinance as a tool to triumph poverty, policy debates or schism exist over its role, goals and methods of service delivery (Robinson, 2001; Morduch, 2000; Woller et al., 1999; Rhyne, 1998). At the center of the debate is difference over the scope of potential trade-offs between outreach to the poor and financial sustainability. Contentions between two camps are emanate (advocates of financial development vs., social impact).

On the one hand, the financial system approach asserts pursuing profitability by microfinance institutions as the surest way to perpetually serve the poor at large scale (Frank, 2008; Rhyne and Otero, 2006; Christen, 2001). The supporters of this approach argue that poor clients demand access to credit not cheap credit and hence microfinance should operate in full cost-recovery basis by simply transferring the higher costs of lending to poor clients onto the clients themselves without compromising outreach. The advocates of the poverty approach, on the other hand, claim that the strife for full cost-recovery would only force microfinance providers to crowed-out poor clients, as they are costly to service and cannot repay at the higher interest charges that should be paid for full cost-recovery (Hashemi and Rosenberg, 2006; Weiss and Montgomery, 2005; Woller and Schreiner, 2002; Hulme and Mosley, 1996).

Empirically examining the nature and scope of trade-offs between outreach and financial performance of microfinance providers in Ethiopia along with their actual impact are of particular interest of the first part of this dissertation. The general conclusions from chapter two and three that analyze potential trade-offs between outreach, financial self-sufficiency and cost-efficiency implies that outreach to the poor and financial sustainability are not inherently conflicting objectives difficult to achieve altogether. It was evident that the ability of microfinance providers to contain their costs or avoid unnecessary costs matters most to achieve financial self-sufficiency in serving the poor. Microfinance providers that spent lower costs per unit of currency lent are found to be self-sufficient in serving the poor and more to women borrowers. Although lowering costs mean lower interest charges, higher credit demand, better repayment and finan-

cial performance subsequently, microfinance in Ethiopia are on average cost-inefficient. Cost-efficiency estimates show that microfinance providers in the sample could have reduced their costs by half had they been efficient in resource use and allocation.

One potential path to reduce cost of services in microfinance, which was found across the analysis, is efficient assignment of ownership rights (i.e., the right to control and appropriate earnings). The results in chapter two and three clearly indicate that assigning ownership rights to clients is cost-efficient and can enable microfinance providers to be financially sustainable in serving the poor. Microfinance providers in the sample that are owned by their clients (i.e., financial cooperatives) are found to be relatively cost-efficient and able to serve the poor in cost-covering basis with significantly lower interest charges compared to NBFIs that are owned by patrons other than their clients. This result is consistent with the economic theory of ownership that asserts assigning ownership of a firm to patrons who will be most affected or born most of the costs of market contracts and ownership as cost-efficient (Hansmann, 1996). In microfinance clients shoulder costs of services/lending - all costs are transferred onto the clients through interest following an assumption that asserts that poor borrowers demand access to credit not to cheap credit (Rosenberg et al., 2013; Dehejia et al., 2012; Morduch, 2000). For instance, recent studies on microfinance cost structure indicate transfer of high cost of lending onto borrowers through charging higher interest rates, of which about 62 percent emanated from exorbitant operating costs (Cull et al., 2009; Gonzalez, 2007; Rosenberg, 2007). Hence, in markets with pervasive imperfection, putting the clients on both sides of the transaction (possibly both as a provider of the demand for and the supply of loanable funds) can generate creditable individual incentives which can significantly curb costs of market contracts in microfinance (i.e., costs of screening, monitoring and enforcement).

The results on the actual impact of access to microfinance credit on farmers adoption of agricultural technologies also substantiate the importance of ownership form in microfinance. While access to microfinance credit significantly improved farm households adoption and application rates of divisible modern inputs overall, its impact is found to be higher or strong among the borrowers of financial cooperatives. Given that microfinance credit in Ethiopia are mainly provided to stimulate the use of agricultural inputs among farmers by both types of lenders in the sample (Amha and Peck, 2010), this result implies that the tendency to use or redirect credits for purposes/projects other than the one approved by the lender is relatively lower among clients of financial cooperatives compared to users of NBFIs. This can be due to the nature and scope of follow-up and monitoring incentives in place. In financial cooperatives the dual role of clients both as provider of the demand for and the supply of loanable funds can generate follow-up incentives for each individual client. Its embeddedness in small communities can also make monitoring easier.

The impact estimates disaggregated by farm size also revealed additional interesting results. The results indicate a heterogeneous effect of access to microfinance credit on technology adoption by landholding sizes. While microfinance credit improves the use of fertilizer among all size of farmers, its impact on adoption and application rates of improved seeds among small farmers (with less than 2 ha of land) is not statistically distinguishable from zero. The result is in line with theoretical studies of adoption behaviors using safety-first type of model (Roumasset, 1976; Bell, 1972). The argument is that, in rain-fed crops, the level of risk is much higher to small farmers than those of large farmers, forcing them to refrain from adopting improved seed varieties which may not increase yield if the weather is poor. The result in general implies that access to institutional credit *per se* may not stimulate use of risky technologies among small farmers who generally are risk averse and have a limited scale for experimentation. Providing insurance products along with credit can reduce (perceived) risks of adoption and encourage the use of yield enhancing modern inputs by smallholders (Dercon and Christiaensen, 2011).

The second part of this dissertation discusses on agricultural cooperatives, a prominent farmers economic organization that serve as source of inputs and market outlets for farmers produce in rural Ethiopia. The focus is on understanding the drivers of the presence of agricultural cooperatives and farmers membership and patronage decisions. Most of the existing works that closely studied agricultural cooperative focus on theoretical explanation of when transacting via cooperatives will be a preferred governance system over the price mechanism (Sykuta and Cook, 2001; Cook, 1995; Sexton and Iskow, 1993; Sexton, 1990; Bonus, 1986; LeVay, 1983). These studies explain the incidence of agricultural cooperatives and farmers participation through their ability to countervail market power and reduce information and transaction costs. The mixed oligopoly literature view agricultural cooperatives as a defensive response by farmers to avoid opportunistic behavior of trading partners (Sexton and Iskow, 1993; Sexton, 1990; LeVay, 1983). The new institutional (transaction cost) economics theories, on the other hand, characterize cooperatives as a hybrid governance mechanism that arise to internalize or reduce transaction costs (Sykuta and Cook, 2001; Bonus, 1986; Cook, 1995).

Chapter five of this dissertation empirically test these two related propositions on the incidence of agricultural cooperatives in the Ethiopian context based on their working environment (i.e., geographic isolation and local market structure) and assuming that reduction in information and physical transaction costs and improving bargaining power are main advantages of agricultural cooperatives in remote and advanced locations, respectively. The results indicate that most of the agricultural cooperatives are found in advanced locations that are connected to major roads and with alternative service providers (i.e., traders and financial institutions), supporting the market power argument. Their incidence in advanced location, instead of on remote areas, implies

that agricultural cooperatives in Ethiopia mainly exist to bargain for better terms of trades and effect price and service adjustments in the market place.

The results on farmers-agricultural cooperatives relation clearly show the importance of location, asset and relational specificity on the choice of cooperative transaction mechanism by farmers. It was evident that farmers residing in places with local market, specialized in grain production, relatively large scale, and affiliated to other networks are more likely to become members of agricultural cooperatives. However, these categories of farmers less likely make use of the services their agricultural cooperatives provide. Only small farmers specialized in grain production and with no regular local market are strong users of cooperative services. This implies that relatively large scale farmers with access to markets found and join agricultural cooperatives to induce competition and once competitive price prevails they tend to use the market mechanism either to avoid costs of specific use or delivery requirements by cooperatives (Karantininis and Zago, 2001; LeVay, 1983) or due to lower benefits from reduction in physical transaction costs from aggregation. Small farmers with no regular local market, on the other hand, tend to avoid ownership and control costs and accrue benefits from using the services agricultural cooperatives provide.

Moreover, the size, specialization and vertical integration of the agricultural cooperatives itself affects farmers' membership and patronage decisions. Farmers more likely become members and users of agricultural cooperatives if the cooperatives are affiliated to business consortium and are specialized on input and credit provision. The link between integrated cooperatives and farmers' choice to join and patronize their cooperatives is in line with theoretical expectations. In theory, vertical integration through consortium can enable agricultural cooperatives to coordinate complex tasks and accrue most of the value of the products to farmers (Valentinov, 2007; Stenfanson and Fulton, 1997). Integrated cooperatives can attain strong members, since it also gives farmers the assurance that they will have reliable market outlets for their produces (Rhodes, 1983). Regarding the link between specialization and farmers membership and patronage decisions, two factors can be at play. One, limited commercialization impact of agricultural cooperatives in Ethiopia (Bernard et al., 2008). Two, limited access to alternative input and credit suppliers, as agricultural cooperatives are the major last-mile providers of such services (Rashid et al., 2013).

Size of agricultural cooperatives (as measured by number of members) attract membership but not use of services - large size agricultural cooperatives attract more farmers, but farmers less likely use the services agricultural cooperatives provide if the members are numerous. This result corresponds to the problems of open membership in traditional agricultural cooperatives. Farmers tend to join cooperatives mainly because the socio-political conditions require them to join. However, they less likely use the services provided by the cooperatives, seeing that the problems of ill-defined property right in cooperatives increases with size (Sykuta and Cook, 2001; Cook and

Iliopoulos, 2000; Cook, 1995). In general, the results from the double discrete choices by farmers (i.e., membership and patronage) indicates that strong participation in agricultural cooperatives depends not only on farm household characteristics, but also on the services the agricultural cooperatives provide and its ability to control the flow of products down and upstream.

Besides the drivers of agricultural cooperative presence and farmers membership and patronage decisions, the second part of this dissertation contributes to the missing agricultural cooperatives impact evidence on farmers productivity/efficiency. The existing few studies on agricultural cooperatives focus on measuring its impact on commercialization (Francesconi and Heerink, 2010; Bernard et al., 2008), technology use (Abebaw and Haile, 2013), and livelihood improvements (Getnet and Tsegaye, 2012). Chapter six estimates the impact of membership in agricultural cooperatives on farmers technical efficiency using two alternative estimation strategies that aimed at reducing potential selection problems both in membership and choice of technology. The results from both of the strategies indicate a positive impact of membership in cooperatives on farmers technical efficiency, by at least five percentage points. Easy and prior access to inputs and embedded support services by agricultural cooperatives to their members can be the reason for such efficiency gaps. The role agricultural cooperatives are playing in increasing farmers' involvement in agricultural extension programs can also be the source of efficiency gains among cooperative members (Rodrigo, 2012).

To conclude, this dissertation overall touches the institutional features and impacts of two prominent organizations that arise to ameliorate financial, input and output markets in rural Ethiopia, viz., microfinance institutions and agricultural cooperatives. It systematically examines their incidence, efficiency, and impact and discusses challenge they need to address to perpetually serve the demands of the rural poor without compromising their institutional sustainability.

7.4 FUTURE RESEARCH

The existing researches on microfinance are mostly theoretical with a greater focus on micro-banking/finance problems (e.g., Armendàriz de Aghion and Szafarz, 2009; Guttman, 2008; Ghatak, 2000; Besley and Coate, 1995; Smith et al., 1981). Empirical studies on its efficiency, lending methods, and impact are far behind theoretical guidances. This section presents potential future research areas relating to the topics discussed in this dissertation .

The analysis on outreach-financial performance trade-offs in chapter two and three examined whether serving small loan sizes and more to women borrowers and financial self-sufficiency are conflicting objectives to each other. However, using the available data it wasn't empirically possible to firmly conclude about the incidence of mission

drift. For example, it was evident that NBFIs with higher average loan sizes are financially self-sufficient and *vice versa*. Nonetheless, in the presence of progressive lending (i.e., increasing loan sizes with the passage of time based on repayment records), high average loan size may not necessarily indicate that the microfinance shifts its focus to the unbanked wealthier clients. Hence, further investigation on the trade-offs between the two bottom-lines of microfinance over a long span of time can contribute to the missing empirical evidence on the effect of the growing microfinance commercialization and competition on their social mission.

Following the economic theory of ownership, the analysis in the first part of this dissertation are disaggregated by microfinance ownership form (i.e., financial cooperatives vs., shareholder owned NBFIs). The question was whether the relation between the clients and microfinance institutions affects the lenders' ability to dispense with information and enforcement costs - that is, which form of ownership better generates credible screening, monitoring and enforcement incentives for individual clients. Lending or contractual term is another source of variation that might affect market contract costs and participation (demand) in microfinance. For instance, Berhane (2009) indicates that joint liability or group lending can limit participation (depress credit demand) in microfinance, as it increases (perceived) risks. Investigating the effects of lending terms (i.e., individual, group, solidarity, etc.) on service costs or the ability of microfinance providers to serve the poor on full cost-recovery basis is an interesting area of future research. Relating to ownership form, examining the effects of the dual roles of clients in financial cooperatives as a provider of both the demand for and the supply of loanable funds in reducing/overcoming micro-banking problems can be potential area for theoretical research. Moreover, the analysis in chapter three indicates that microfinance providers in Ethiopia are not cost-efficient - their cost includes significant avoidable expenses. Applied researches on microfinance cost-structure and the effects of each cost components on efficiency can have a practical value in terms of indicating potential avenues of cost containment.

With regard to microfinance impact, there is progress in understanding its role on poverty reduction (e.g., Berhane and Gardebroek, 2011; Khandker, 2005; Morduch and Heley, 2002; Pitt and Khandker, 1998). In Ethiopia, for instance, Berhane and Gardebroek (2011) systematically measure the impact of microfinance on borrowers consumption and housing improvement over long span of time. However, most of the existing impact studies assume homogenous impact across borrowers of all types of lending contracts and microfinance providers. Although the analysis is not over long period, chapter four checked potential heterogeneity using relevant subrogate variables (like ownership form and farm size). For example, the assumption with ownership is that efficient assignment of ownership rights to patrons who will be the most affected is efficient - reduce cost of services and interest charges to borrowers and increase impact subsequently. Similar arguments can be made on lending terms. While joint liability lending reduces repayment risks for lenders, it may increase indi-

vidual borrowers risks (e.g., partner failure and denial of future access) and adversely affects impact (Berhane and Gardebroek, 2011). Thus, disaggregated impact estimates by ownership and lending terms over long span of time can be important for optimal organizational and product design, respectively.

Like that of microfinance, most of the researches closely studied agricultural cooperatives are theoretical (e.g., Hendrikse and Bijman, 2002; Sykuta and Cook, 2001; Cotteril, 1987; Sexton and Sexton, 1987; Bonus, 1986; Rhodes, 1986). The analysis in chapter five empirically tested two closely related theoretical propositions on the economic rationale of agricultural cooperative presence (i.e., market power vs., transaction cost arguments). The results shade light that the advantage of agricultural cooperatives in Ethiopia is more through the bargaining power offered - that is, through effecting price and service adjustments in the market place. More empirical studies in this direction can contribute to our understanding on the roles of cooperative firms on market economy. For instance, empirically investigating theoretical arguments which claim that the entry of cooperatives in a market beneficially regulates market performances is an interesting future research agenda for applied research.

The analysis on the drivers of farmers membership and patronage decisions, on the other hand, distinguished four types of membership, of which the two (i.e., shadow and soft membership) indicates the presence of farmers who use the services agricultural cooperatives provide without membership commitment and members who are not users of cooperatives services. Investigating membership commitment (e.g., what differentiate members from non-members in open membership agricultural cooperatives) can be imperative in terms of understanding the efficiency and viability of cooperatives and how cooperatives are able to differentiate itself from other transaction governance mechanisms.

Part III

APPENDIX

A

APPENDIX

The following pages present supplementary tables and figures for all chapters.

Table A.1: Correlations of major variables considered in the financial performance outreach estimations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Financial self-sufficiency	1												
(2) Operational self-sufficiency	0.88*	1											
(3) Return on assets	0.21*	0.15	1										
(4) Average loan size	0.12	0.14	-0.16*	1									
(5) % of women borrowers	-0.07	-0.00	0.06	-0.20*	1								
(6) Age	0.13	0.22*	-0.05	0.46*	-0.04	1							
(7) Size	0.01	0.05	0.23*	0.15*	0.20*	0.42	1						
(8) Financial coops	0.28*	0.28*	-0.33*	0.27*	-0.35*	0.04	-0.63*	1					
(9) Yield	-0.23*	-0.25*	0.50*	-0.28*	0.20*	-0.14	0.45*	-0.76*	1				
(10) Capital costs to assets	-0.37*	-0.40*	0.40*	-0.17*	0.14	-0.09	0.08	-0.40*	0.42*	1			
(11) Labor costs to assets	-0.46*	-0.50*	0.34*	-0.28*	0.19*	-0.26*	0.05	-0.46*	0.42*	0.55*	1		
(12) Loan to assets	-0.08	-0.08	0.35*	-0.02	-0.13	-0.07	-0.08	0.03	0.13	0.56*	0.29*	1	
(13) Donation to loan portfolio	-0.10	-0.06	0.06	-0.15	0.41*	-0.12	0.06	-0.20*	0.20*	0.01	0.18*	-0.04	1
(14) Length of client r/ships	0.21*	0.31*	-0.07	0.41*	-0.15	0.78*	0.07	0.35*	-0.36*	-0.20*	-0.28*	0.00	-0.19*

Note: * significant at below 10%.

Source: Author's calculations, based on primary data collected between April and June 2012.

Table A.2: Correlations of major variables considered in the cost-efficiency outreach estimations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Total costs	1												
(2) Salary	0.25*	1											
(3) Interest paid	0.01	0.18*	1										
(4) Gross loan portfolio	0.91*	0.18*	-0.03	1									
(5) Equity over assets	-0.04	-0.23*	-0.92*	0.01	1								
(6) LLR over GLP	0.00	0.19*	0.13	-0.03	-0.18*	1							
(7) Loan loss expenses	0.76*	0.29*	0.10	0.77*	-0.16*	0.37*	1						
(8) Depreciation	0.85*	0.29*	0.03	0.87*	-0.08	0.04	0.67*	1					
(9) Financial coops	-0.40*	-0.60*	-0.24*	-0.34*	0.31*	-0.22*	-0.44*	-0.45*	1				
(10) Average loan size	-0.08	0.05	-0.07	-0.06	0.07	-0.02	-0.09	-0.11	0.24*	1			
(11) % Of women clients	-0.00	0.26*	0.15	-0.02*	-0.16	0.15	-0.03	0.04	0.35*	-0.20*	1		
(12) % Of rural clients	0.11	-0.02	0.08	0.08	-0.11	-0.02	0.12	0.12	-0.09	-0.37*	-0.18*	1	
(13) Age of the institution	0.14	0.07	-0.05	0.15	0.03	0.04	0.11	0.14	0.04	0.47*	-0.04	-0.26	1
(14) Size of the institution	0.37*	0.67*	0.13	0.32*	-0.23*	0.25*	0.41*	0.42*	-0.634*	0.18*	0.20*	-0.16*	0.42*

Note: LLR refers to Loan Loss Reserve and GLP refers to Gross Loan Portfolio. * significant at below 10%.

Source: Author's calculations, based on primary data collected between April and June 2012.

Table A.3: Alternative gambles, payoffs and corresponding risk classification.

Options	Expected gain (E)	Standard Deviation (SD)	Approximate partial risk aversion coefficient ()	Risk classification 1	Risk classification 2
Option 1: 2.5 *birr*, 2.5 *birr*	2.5	0	to 7.51	Extreme	*Extreme to sever*
Option 2: 2.25 *birr*, 4.75 *birr*	3.5	1.25	7.51 to 1.74	Sever	
Option 3: 2 *birr*, 6 *birr*	4	2	1.74 to 0.81	Intermediate	
Option 4: 1.75 *birr*, 6.25 *birr*	4	2.25		Inefficient	*Moderate*
Option 5: 1.5 *birr*, 7.5 *birr*	4.5	3	0.81 to 0.32	Moderate	
Option 6: 1 *birr*, 8 *birr*	4.5	3.5		Inefficient	
Option 7: 0.5 *birr*, 9.5 *birr*	5	4.5	0.32 to 0	Slight-to-neutral	*Risk preferring to neutral*
Option 8: 0 *birr*, 10 *birr*	5	5	0 to -	Neutral	

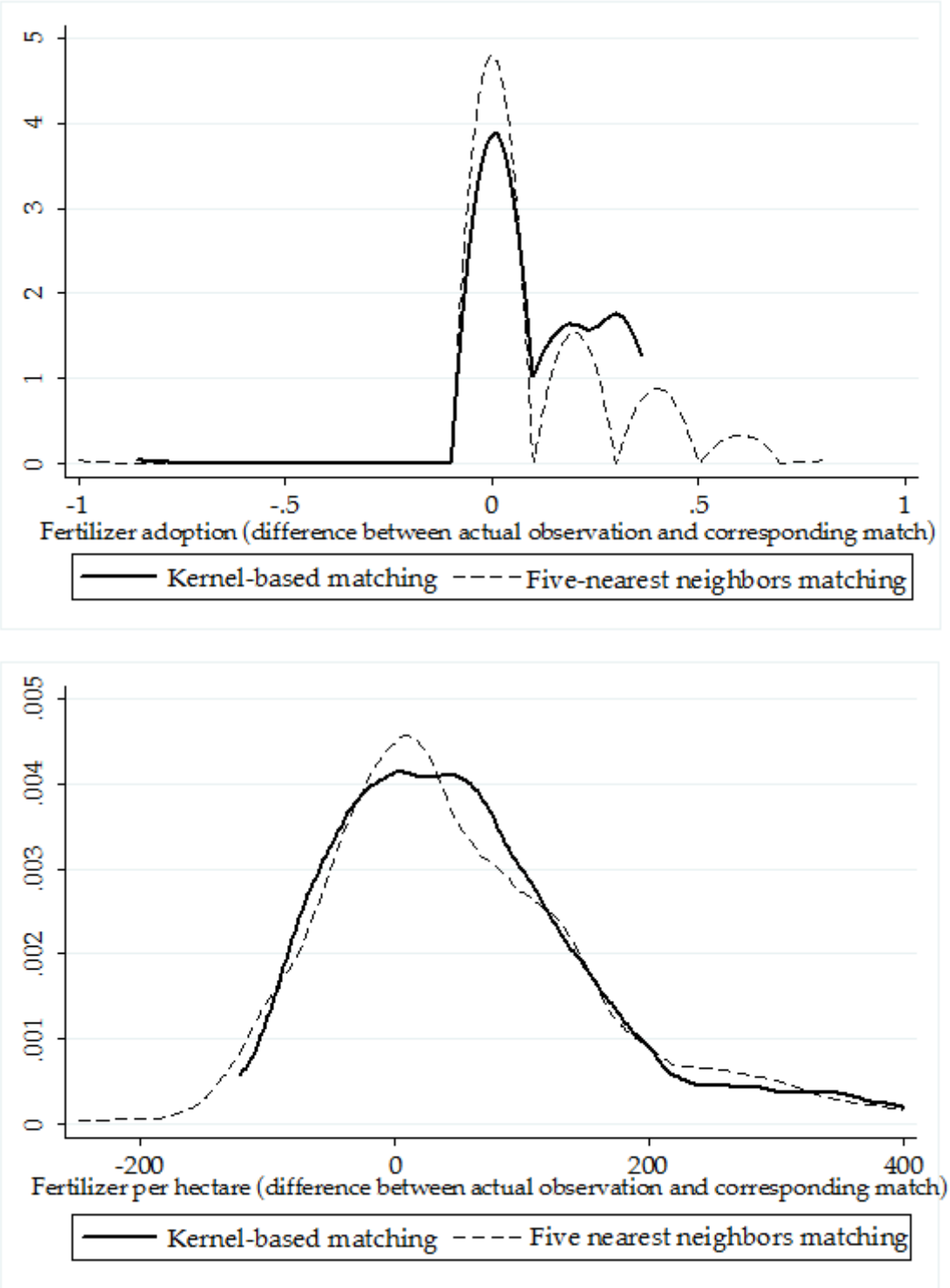
Note: Farm households level of risk aversion is directly measure via gambling experiment with a real payoff following Binswanger and Sillers (1983). Risk classification 2 is used in the analysis for analytical simplicity.

Source: Author's calculations, based on primary data collected between April and June, 2012.

Table A.4: Number of users and non-users of institutional finance in each blocks of the propensity scores (inferior bound of *p-score*).

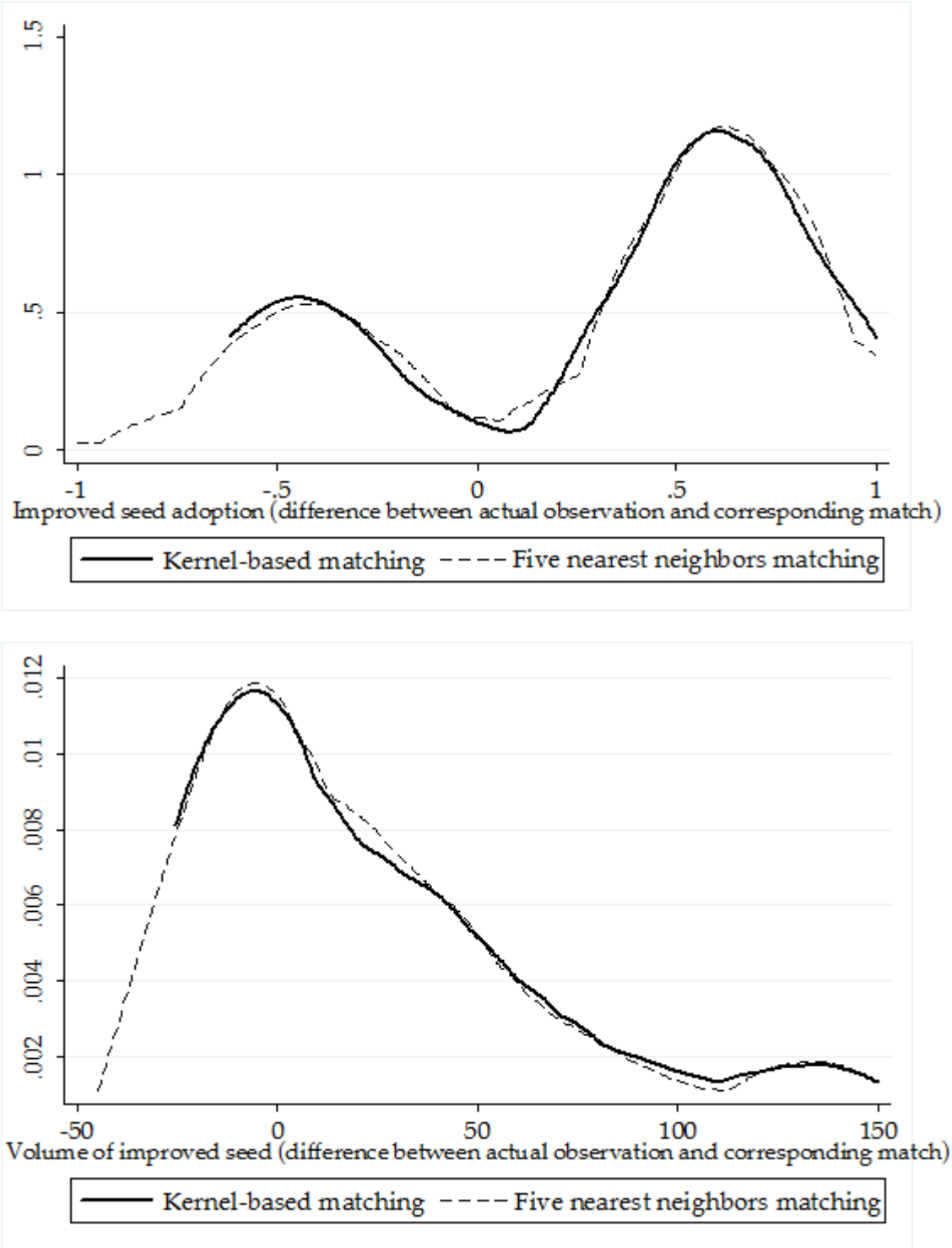
Block of pscore	Users	Non-users	Total
0.126	32	2	34
0.2	98	44	142
0.4	68	104	172
0.6	47	142	189
0.8	27	84	111
Total	272	376	648

Note: The common support condition is imposed.
Source: Author's calculations, based on primary data collected between April and June, 2012.



Source: Author's calculations, based on primary data collected between April and June, 2012.

Figure A.1: Distribution of access to institutional finance impacts across user households (*Fertilizer*).



Source: Author's calculations, based on primary data collected between April and June, 2012.

Figure A.2: Distribution of access to institutional finance impacts across user households (*Improved Seeds*).

Table A.5: Commercial and private banks loan composition by economic sectors (in percent), 2011.

Economic sector	CBE	BOA	Awash	NIB	United	Bunna	OIB	LIB	Birhan	AdIB	Dashen
Agriculture	10,5	0,2	2,2	4,5	0	0	2,2	3	0,5	0,7	2
Industry/Manufacturing	11,5	9,3	5,8	25,7	16,7	3,3	4,7	2,6	10,2	11,1	22,8
Domestic trade	4,5	35	26,4	19,4	21	32,4	51,1	56	30,1	13,7	31,8
International trade	13,9	29	35,3	28,1	36,2	27,1	19,4	29	27,1	39,9	14,9
Import	-	14	14,2	13,9	21,1	19,3	4	24,7	19,3	12,4	8,8
Export	-	15	21,1	14,2	15,1	7,8	15,4	4,3	7,8	27,5	6,1
Others	59,6	26,5	30,3	22,3	26,1	37,2	22,6	9,4	32,1	34,6	28,5

Note: others include government deficit financing, hotel and truism, mine, power and water resource, and personal and interbank lending. CBE=Commercial Bank of Ethiopia, BOA=Bank of Abyssinia, NIB=Nib International Bank, OIB=Oromia International Bank, LIB=Lion International Bank, AdIB=Addis International Bank.

Source: Deribie (2012) and annual reports of respective banks.

Table A.6: Correlation of selected variables used in the analysis of the impact of access to institutional finance on smallholders technology adoption.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Access to finance	1														
(2) Fertilizer adoption	0.35*	1													
(3) Fertilizer per hectare	0.32*	0.51*	1												
(4) Seed adoption	0.20*	0.40*	0.40*	1											
(5) Seed (volume)	0.24*	0.27*	0.35*	0.66*	1										
(6) Pesticide adoption	0.08*	0.39*	0.20*	0.19*	0.27*	1									
(7) Literacy	0.16*	0.17*	0.23*	0.18*	0.15*	0.03	1								
(8) Family size	-0.04	0.12*	0.08*	0.22*	0.21*	0.04	0.00	1							
(9) Distance to FCs/MFIs	0.05*	0.12*	-0.18*	-0.20*	-0.18*	-0.04	-0.13*	-0.03	1						
(10) Off-farm income	0.12*	0.05*	0.06*	0.09*	0.04	-0.11*	0.21*	-0.06*	-0.01	1					
(11) Land holding size	0.03	0.31*	-0.08*	0.29*	0.29*	0.28*	0.07*	0.41*	0.01	-0.03	1				
(12) TLU	-0.02	0.29*	0.19*	0.30*	0.36*	0.22*	0.10*	0.49*	-000	0.00	0.57*	1			
(13) Safety net	-0.13*	-0.33*	-0.17*	-0.17*	-0.11*	-0.19*	-0.05	-0.01	-0.05	0.16*	-0.13*	-0.12*	1		
(14) Extension	0.03	0.20*	0.15*	0.29*	0.22*	0.22*	0.04	0.20*	0.05	0.00	0.15*	0.20*	0.04	1	
(15) Moderate risk averse	0.01	0.04	0.05*	-0.02	0.02	0.15*	0.02	-0.05	-0.07*	0.04	0.01	0.02	-0.04	-0.10*	1
(16) Risk neutral	-0.01	0.02	-0.02	0.05	0.01	-0.03	0.01	0.00	0.00	-0.09*	0.03	-0.04	-0.00	0.08*	-0.74*

Note: * indicates differences significant at a 10% level or lower.
Source: Author's calculations, based on primary data collected between April and June, 2012.

Table A.7: Propensity scores blocks for members and non-members of agricultural cooperatives (*reduced and whole sample*).

Block of Pscore (*reduced sample*)	Members	Non-members	Total
0.026	43	248	291
0.2	60	196	256
0.3	96	174	270
0.4	37	73	110
0.45	46	47	93
0.5	92	76	168
0.6	82	46	128
0.7	67	19	86
0.8	41	4	45
Total	564	883	1447

Block of Pscore (*whole sample*)	Members	Non-members	Total
0.015	54	448	502
0.2	65	206	271
0.3	97	153	250
0.4	76	120	196
0.5	76	68	144
0.6	149	58	207
0.8	47	8	55
Total	564	1061	1625

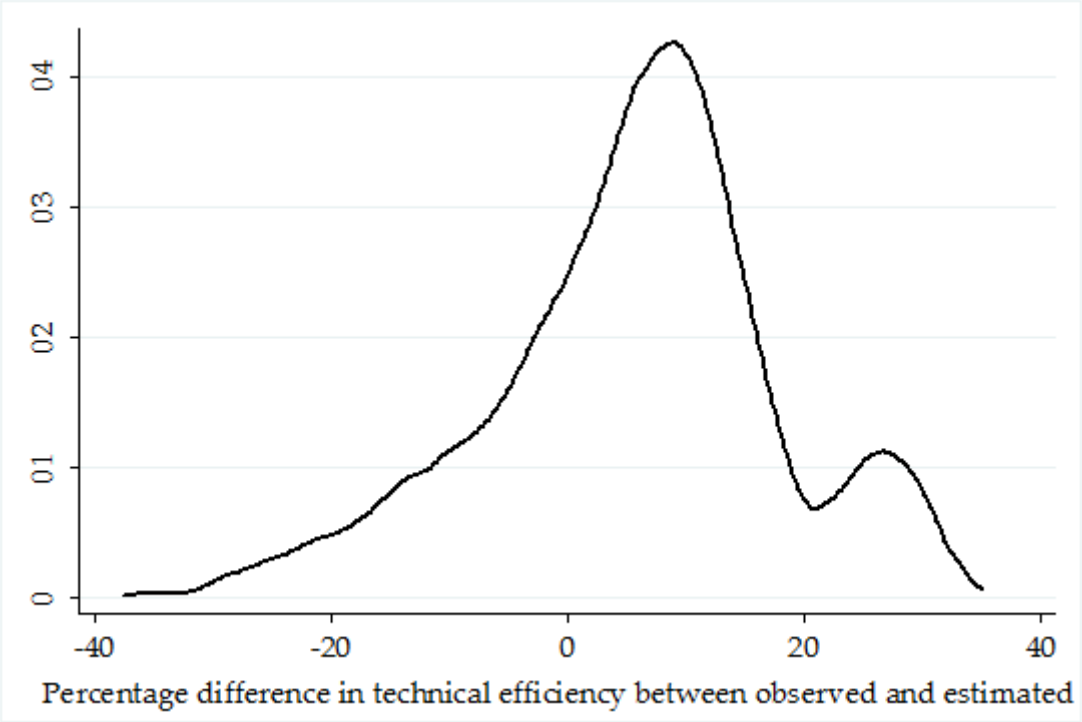
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

Table A.8: Average impact of cooperative membership on agricultural input adoptions.

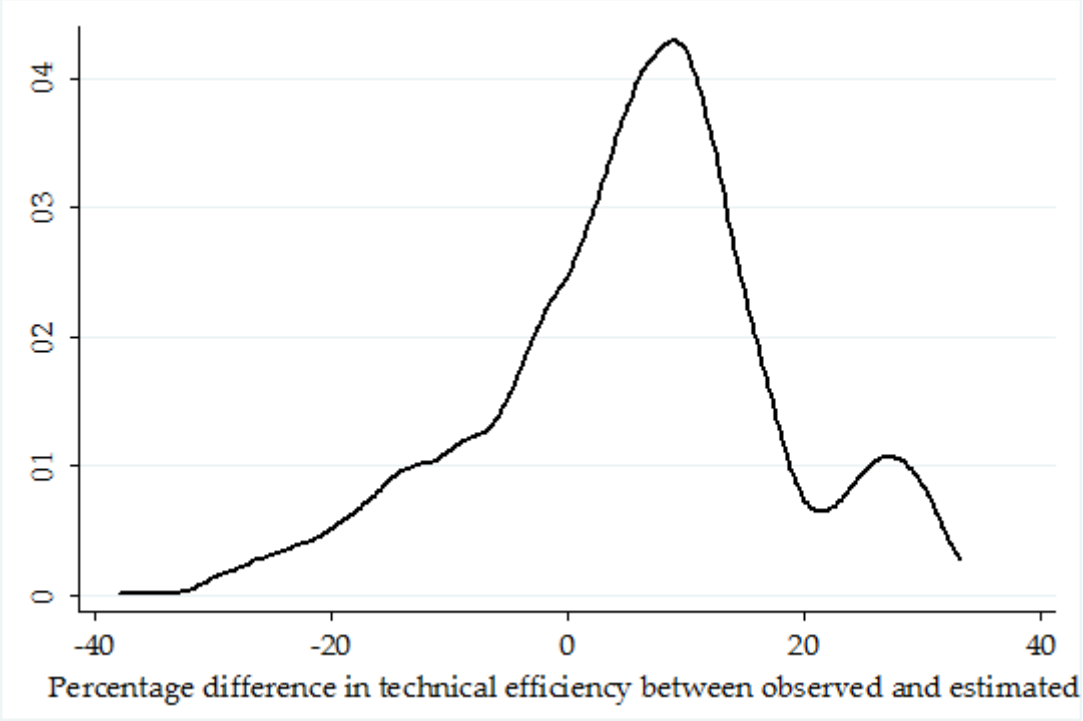
Indicator	Kernel-based matching		Five nearest neighbors matching		Number of Obs.
	ATT	SE	ATT	SE	
Reduced sample					
Fertilizer (total amount in kg)	48.66	(6.74)***	49.55	(7.73)***	1455
Fertilizer (kg/ha)	31.32	(4.88)***	32.78	(5.49)***	1455
Improved seed (total amount in kg)	4.45	(1.22)***	4.40	(1.39)***	1455
Whole sample					
Fertilizer (total amount in kg)	46.13	(6.81)***	44.06	(7.46)***	1638
Fertilizer (kg/ha)	30.42	(4.66)***	29.67	(6.26)***	1638
Improved seed (total amount in kg)	4.52	(1.18)***	4.48	(1.29)***	1638

Note: Reduced sample includes members and non-members only from Kebeles with agricultural cooperatives; Whole sample includes the whole sample (i.e., members and non-members from Kebeles with and without agricultural cooperatives). Bootstrap with 100 replications is used to estimate the standard errors. *** Significant at 1% level.
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

(a) Reduced sample: members and non-members only from Kebeles with agricultural cooperatives.



(b) Whole sample: members and non-members from Kebeles with and without agricultural cooperatives



Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

Figure A.3: Distribution of cooperative membership impacts based on the results from Kernel matching estimates.

Table A.9: Correlates of variations in impact of cooperative membership on technical efficiency within members.

Indicator	Dependent variable: Technical efficiency gain from membership	
	Reduced sample	Whole sample
HH head age	0.000	0.000
	(0.76)	(0.46)
HH head gender	-0.047	-0.055
	(2.19)**	(2.58)**
HH head literacy	-0.002	0.004
	(0.27)	(0.42)
Distance to market (Minutes)	-0.000	-0.000
	(1.68)*	(1.51)
Access to irrigation	0.231	0.238
	25.18)***	(27.47)***
Receives off-farm income	-0.033	-0.035
	(4.01)***	(4.21)***
Radio ownership	0.012	0.012
	(1.26)	(1.25)
Land cultivated (ha)	0.015	0.015
	(2.86)***	(2.92)***
Number of plots	-0.003	-0.003
	(1.56)	(1.42)
Number of Oxen	-0.006	-0.004
	(1.24)	(0.90)
Reside in village with FTC	0.037	0.042
	(2.66)***	(2.86)***
Improved seed	0.000	0.000
	(1.95)*	(1.88)*
Fertilizer	-0.000	-0.000
	(0.14)	(0.26)
Constant	0.095	0.099
	(2.77)***	(2.86)***
Number of Obs.	559	549
R-Squared	0.37	0.39

Note: *** Significant at 1% level, ** significant at 5% level and * significant at 10% level. t-statistics in parenthesis.
Source: Author's calculations, based on data from Ethiopia Agricultural Marketing Household Survey, 2008.

Table A.10: Outreach and financial performance (*after omitting the four big semipublic NBFIs*).

Indicator	Average loan size over GNP per capita	Percentage of women borrowers	Percentage of rural borrowers	Time between install-ment
Financial self-sufficiency	0.298	-0.355	0.163	0.364
	(0.291)	(0.095)***	(0.255)	(0.705)***
Financial self-sufficiency (coops)	-0.413	0.430	-0.158	0.848
	(0.353)	(0.105)***	(0.268)	(1.06)
Financial coops	-0.682	-0.654	0.637	4.494
	(0.446)	(0.103)***	(0.257)**	(1.45)***
Age of the institution	-0.037	-0.012	0.056	0.033
	(0.023)	(0.005)	(0.015)***	(0.054)
Age (coops)	0.099	0.005	-0.061	0.034
	(0.046)**	(0.007)	(0.018)***	(0.118)
Institutional size	0.236	-0.030	-0.255	-0.098
	(0.186)	(0.060)	(0.138)*	(0.399)
Institutional size (coops)	0.523	0.068	-0.028	-1.260
	(0.277)*	(0.074)	(0.165)	(1.15)
Length of client relationship	-0.049	-0.001	-0.006	-0.410
	(0.046)	(0.009)	(0.019)	(0.154)***
Donation over loan portfolio	0.104	0.226	-0.016	0.512
	(0.210)	(0.061)***	(0.153)	(1.45)
Number of source of capital	-0.560	0.124	0.118	0.324
	(0.218)	(0.040)***	(0.094)	(0.793)
Individual/investor owned	0.203	0.045	-0.135	0.023
	(0.202)	(0.093)	(0.158)	(0.434)
NGO owned	0.186	0.026	0.245	0.737
	(0.275)	(0.109)	(0.230)	(0.891)
Constant	1.384	0.597	0.190	1.703
	(0.526)***	(0.151)***	(0.325)	(1.49)
R-squared	0.46	0.45	0.29	0.30
Number of Obs.	103	103	103	103

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