IGAE
29th | Milan Italy 2015
UNIVERSITÀ DEGLI STUDI DI MILANO AUGUST 8 - 14
AGRICULTURE IN AN INTERCONNECTED WORLD

Who benefits from collective action? Determinants and economic impacts of coffee farmer cooperatives in Ethiopia

Dagne Mojo[a,b,], Christian Fischer[a] and Terefe Degefa[c]*

[a]*Free University of Bozen/Bolzano, Faculty of Science and Technology, Universitätsplatz 5 - piazza Università, 5, 39100, Bozen-Bolzano, Italy*

[b]*Ethiopian Institute of Agricultural Research, Holetta Center, P.O. Box 2003, Addis Ababa, Ethiopia*

[c]*Addis Ababa University, College of Development Studies, P.O. Box 150325, Addis Ababa, Ethiopia*

**Corresponding author's Tel.: +39 0471 017819; Fax: +39 0471 017009; E-mail address: dagnemojo.yadate@natec.unibz.it*

Abstract

Using household survey data gathered from 305 Ethiopian coffee farmers, the determinants and impacts of cooperative membership are explored. A logit model results reveal that the probability of farmers' membership decision increases with age, education level, family size, and land property. Employing propensity score matching (PSM), no unique membership impact on members' economic performance and output are found. However, cooperatives have a positive economic benefit to the whole community (members and nonmembers), regardless of membership. The results suggest a need for a mechanism to improve members' benefits to make cooperatives more meaningful, attractive and sustainable.

Keywords: Coffee, Cooperative, Ethiopia, impact evaluation, Propensity score matching, Sustainability

JEL: Q12, Q13, Q18

1 Introduction

Cooperatives have been playing significant socioeconomic roles by reducing transaction costs and by improving the bargaining power of individuals in all sectors including agriculture (Staatz, 1986; Bonin et al., 1993; Francesconi and Ruben, 2012). Agricultural cooperatives in particular are recognized as major tools to fight poverty especially in rural areas where more than 70 percent of the world's poor live (Deriada, 2005; FAO, 2012). However, in previous studies, inconsistent findings about the performance and benefits of agricultural cooperatives have been reported, partially due to the indicators used and congruent with the varying nature of cooperatives. For instance, studies on Ethiopian coffee cooperatives have been addressing the benefits (mainly the socioeconomic benefits) of cooperatives to their members through ensuring fair trade, linking them to the markets, or by improving value chains (Kodama, 2007; Bacon et al., 2008; Emana, 2009; Getnet and Anullo, 2012). In other cases, Abate et al. (2014) pointed out that agricultural cooperatives improved members' technical efficiency because of better access to productive inputs and services as compared to nonmembers.

Notwithstanding the above, many cases of poor performance of agricultural cooperatives have been reported in the context of developing countries (Chibanda et al., 2009; Nkhoma and Conforte, 2011). In some occasions, the majority of members have also been reported to sell their coffee to private traders, which may affect the economic impact of cooperatives on their members. In a study of market outlet choice of coffee farmers, Anteneh et al. (2011) reported that only 42% of members sell their coffee to their respective cooperatives due to several reasons. The implication is that there might be no unique economic benefits of cooperatives to their members. However, as long as Ethiopian cooperatives are guided by International Cooperative Alliance (ICA) principles, they should be economically viable and profitable, socially equitable and environmentally sustainable, while benefiting members who own and control them.

Due to the limited studies and somewhat inconsistent results on the benefits and performances of agricultural cooperatives as a whole, there still exist a knowledge gap. In particular, the full impacts of cooperatives on members have not been conclusively investigated in Ethiopia. Thus, this article attempts to contribute to the literature by exploring the example of coffee farmers

cooperatives[1] in Ethiopia. Specifically, we aim to answer two questions: what are the factors affecting farmers' likelihood of participation in cooperatives? And, does cooperative membership has an impact on members' level of economic performance? The analysis is based on a household survey of 305 coffee farmers located in Jimma Zone of Oromia regional state, Ethiopia. A logit model is used to analyze the factors affecting participation and propensity score matching (PSM) to estimate the impact of membership by controlling for selection bias.

The reminder of this article is organized as follows. Section two briefly reviews the theories, benefits and problems of agricultural cooperatives and that of family farms. Section three recounts the notion of Ethiopian cooperative development and coffee cooperatives, and section four deals with the major hypotheses. While section five presents sampling, data collection and analytical procedures, section six describes the findings. Finally, section seven discusses the results and concludes.

2 Theoretical background

The International Cooperative Alliance (ICA, 2014) defines a conventional cooperative as "an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly owned and democratically controlled enterprise." A cooperative shall also be guided by seven internationally recognized cooperative principles: voluntary and open membership; democratic member control; member economic participation; autonomy and independence; provision of education, training and information; cooperation among cooperatives; and concern for the community. Following the arguments that cooperatives cannot implement all these principles, usually three principles: user-owned, user-controlled and user-benefiting principles are adopted as basic principles in cooperative study (Ortmann and King, 2007).

Historically, the development of cooperative enterprises has been studied from several different perspectives (see Staatz, 1987; Sexton, 1995). The studies show that cooperatives were first formally modeled in the early 1940s. However, much of the debates in cooperative theory until the early 1960s focused on whether to analyze a cooperative using a vertical integration

[1] Coffee farmer cooperatives are formally referred to as farmers' multipurpose cooperatives in the study area since they are involved in many other activities such as the distribution of agricultural inputs in addition to coffee processing and marketing.

framework (as simple aggregation of member firms) or treating it as an organization (similar to an investor-owned firm). Later on, the work of Helmberger and Hoos, who analyzed how the presence of cooperatives would affect marketing outcomes in different marketing structures, was considered as landmark in the theory of cooperatives (Sexton, 1995). Due to the increased heterogeneity, rapid changes in the business environment, and subsequent structural changes in cooperatives to adapt to the new situation, there has also been enormous advancement in theories of farmers' cooperatives, most of which are the extensions of economic theories of investor owned firms (Staatz, 1987; Ortmann and King, 2007; Nilsson et al., 2012).

2.1. Advantages and problems of cooperatives

The institutional advantages of agricultural cooperatives have been mainly addressed based on transaction cost economics theory, and we recapitulate some of these benefits, which are discussed in Staatz (1986) and Valentinov (2007). According to these authors, farmers can create a countervailing power (market power) via collective action. This helps to avoid the opportunistic behavior of trading partners; increases the bargaining power of farmers; ensures fair distribution of income in the market chain; and also leads to more equitable and efficient markets. Cooperatives can also encourage the development of new technologies and farming techniques[2] and internalize transaction costs through contingency pricing[3].

The conventional cooperative organizational form has been also plagued by a number of problems that create disadvantages for members (Vitaliano, 1983; Royer, 1999; Ortmann and King, 2007; Valentinov, 2007; Tortia et al., 2013). While some of these problems are grouped as investment-related incentive such as common property (free rider), horizon and portfolio problems, the others are grouped as decision-related incentive that include influence-cost and control/monitoring problems (Nilsson, 2001). Usually, the investment-related incentive problems lead to under-investment (members are not willing to invest) in a cooperative, whereas decision-related problems increase transaction costs that affect cooperatives competitiveness. Generally, the studies show that while the main problems of cooperatives are related to the vaguely defined

[2] The investor owned firms usually do not engage in such activities.

[3] Cooperatives might help farmers to economize on transaction costs caused by agricultural production risks. In fact, farmers do not form cooperatives simply to reduce transaction costs alone and an additional motivation may be to try to redistribute rights in the farmers' favor and property rights in society (Staatz, 1986).

property right (VDPR), they have remarkable advantages in economizing on transaction costs and in developing countervailing power.

2.2. Advantages and disadvantages of family farms

The advantage of family farms has been explained with respect to the low feasibility of cooperatives in agricultural production due to supervision and monitoring difficulties (Tortia et al., 2013). Ownership, monitoring and decision costs are low in family farms since farmers can effectively monitor their own farms with nearly homogenous interest among the family members arising from affectional relationships, equivalent claims on the family's resources, and symmetrically distributed information (Pollak, 1985 cited by Valentinov, 2007).

On the other hand, family farms have two basic organizational disadvantages that are the motive for the creation of agricultural cooperatives (Tortia et al., 2013). First, family farms are unable to realize the external economies of scale, which represent a real source of cutting production costs and improving access to markets. Second, individual farmers have weak market power compared with their upstream and downstream trading partners; they may also be confronted with information asymmetries. Thus, these farmers have a lower ability to combat opportunistic behavior on the part of these firms (Valentinov, 2007; Tortia et al., 2013).

2.3. The new (hybrid) cooperative models

The disadvantages of family farms and the growing gap between the sizes of family farms and their upstream and downstream trading partners enhance the potential role that cooperatives can still play in agriculture (Tortia et al., 2013). Conventional cooperatives have also undergone structural changes (to overcome the incentive problems that hinder their capital growth and competitiveness), which resulted in the emergence of new cooperative models (Chaddad and Cook, 2004). Royer (1999), also earlier noted that due to their inherent weaknesses, the conventional cooperatives would have to exit or reorganize as the market evolves. Consequently, development economics research has shifted from the classic contrast between markets and hierarchies to the study of a broad set of hybrid organizational arrangements (Menard, 2004).

New cooperative models emerged as a result of competitive strategies pursued by different agricultural cooperatives (particularly in western countries) in response to the evolving

institutional environment and structural changes (see Chaddad and Cook, 2004 for details). According to Chaddad and Cook, several cooperatives have undergone structural changes in order to acquire necessary capital to implement the growth of related strategies and to remain competitive in the market. New cooperative models introduced various types of modifications to the basic scheme, which is usually deemed to induce investment and collective decision-making inefficiencies.

Generally, since cooperative models have been changing and are not stable compared with the investor owned firms, further structural adjustments and new cooperative models may also be expected. As Cook (1995) postulated a five-stage cooperative life cycle that seeks to explain the formation, growth, and eventual decline (leading to structural changes or demies), cooperatives in developing countries like Ethiopia may naturally face the same situations.

3 Coffee and other agricultural cooperatives in Ethiopian

Agricultural cooperatives (specifically those for coffee and other cash crops) were introduced to Ethiopia in the early 1960s, i.e., during the imperial regime (1932 – 1974; Bernard et al., 2010). Although the subsequent military *Derg* regime (1974 – 1991) was also in favor of cooperatives, it abolished almost all former cooperatives and established new ones (Kodama, 2007). Being influenced by the governments varying political ideologies, cooperatives at that time didn't develop well. The imperial regime was a monarchy (feudal) system and the prime purpose of establishing cooperatives was not to benefit farmers; membership consisted of farmers with large landholdings, which tended to exclude smallholders. *Derg* was following the socialist ideology and its cooperatives were based on Marxist principles aiming at ending the exploitation of the peasantry by the feudal system (Kodama, 2007; Bernard et al., 2010). However, the regime used cooperatives as a tool to politically and economically control rural communities. In either case, the cooperatives of that time were not based on the conventional cooperative principles and values.

Unlike the past two regimes, the current Ethiopian government (1991 onwards), which favored free markets, adopted the international cooperative principles and values, and different cooperative societies were willingly re-initiated after 1994 based on the establishment of enabling legal frameworks (Holmberg, 2011). Consequently, the size of cooperatives in Ethiopia

has been fast increasing since the beginning of the new millennium. Recently, more than 48,124 registered primary cooperatives of all types with more than 6.63 million members exist in the country (FCA, 2013).

Of all agricultural cooperatives, those of coffee farmers are the most active because of different opportunities related to coffee production and marketing (Emana, 2012). First, coffee is among the most important cash crops produced in Ethiopia and in the world. It is the second most traded commodity after oil in the world (Ponte, 2002); it generates more than 25% of foreign exchange earnings and supports the livelihoods of an estimated 15 million smallholder Ethiopian farmers (USAID, 2010). Coffee cooperatives (Unions) can also directly export coffee to the world market (bypassing the central auction market) that might have helped increase farmers' earnings (Dempsey, 2006).

On the other hand, due to the nature of the commodity in world markets (short-term price instability and declining terms of trade in the long run), coffee producers are usually exposed to problems of low returns and high-risk investments (Petit, 2007). Typically, the Ethiopian coffee supply chain is very long as a result of involving numerous participants, and the farm gate price is low (Bacon, 2005). Given the importance of the commodity in the world market and the absolute dependence of producers on it, the benefits of vertical integration (collective action) discussed by transaction cost economics (such as in Staatz, 1986,) are also applicable, and arguably more relevant under Ethiopian conditions where rural infrastructure remains poor and information asymmetries predominate. Accordingly, coffee cooperatives can improve farmers' income by increasing their bargaining power, by shortening supply chain and by setting fair coffee prices.

The second opportunity that made coffee cooperatives active is that they are the first in Ethiopia to start benefiting from different eco-certification programs such as Fair Trade, Organic, UTZ Kapeh, and Rainforest Alliance. These certifications are granted for commodities produced and marketed, taking into account one or more aspects of sustainability (Lentijo and Hostetler, 2011). Usually, certificates in Ethiopia are granted for qualified primary cooperatives after evaluation by the third party (certifying organization), and the certified cooperatives earn fair trade or other premiums that would encourage members to produce more in a healthy environment (Lentijo and Hostetler, 2011; Jena et al., 2012).

The current study focuses on four primary agricultural cooperatives (coffee marketing being their mainstay), which are found in the Jimma Zone where an estimated 30 - 40 % of the population depend on coffee (Jena et al., 2012). Out of the four cooperatives under study, three (Kenteri, Ilbu, and Garuke-Mazoriya) were established in 1977 by the socialist government and restructured in 1998 under the new proclamation (No. 147/1998)[4]. The fourth cooperative (Yachi-Kachise cooperative) was established in 1998 through Technoserve (an NGO) initiative. While all the cooperatives are managed by an elected chairman and the board, Kenteri and Garuke-Mazoriya have additional hired managers. Election follows the democratic principle of one person - one vote, open membership with registration fee (3 - 20 ETB[5]), and with at least one share (67 - 100 ETB) - almost all members own only one share at present. The variation in fees and the amount of shares is between cooperatives, not within. About half of the coffee farmers in the area are cooperative members.

Though the extent of their involvement may differ, these cooperatives accomplish the following activities. (1) Coffee marketing: buying coffee from farmers, processing (wet or dry) and selling it to the Oromia Coffee Farmers Cooperative Union that pay back a dividend. According to an Ethiopian cooperative proclamation, a union shall maintain 30% of its profit and pays back 70% to the primary cooperatives. Similarly, the later shall pay back 70% of the profits to their members keeping 30% for their use and for investing in public goods. Cooperatives also sell the rest of the coffee at the ECX[6]. (2) Distributing (selling) fertilizers and other inputs to farmers. (3) Stabilizing coffee prices by setting a minimum threshold. Additionally, Kenter cooperative has been involved in honey processing and marketing; and in the provision of saving and credit services through its women's credit and saving association.

[4] This was formulated based on international cooperative principles.

[5] Ethiopian Birr (ETB) is Ethiopian currency, and 1 USD is approximately equal to 20 ETB.

[6] The Ethiopia Commodity Exchange (ECX) is a newly established, well-structured organization/organized marketplace, where buyers and sellers come together to trade, assured of quality, quantity, payment, and delivery. The closest center to our study area is found in Jimma town.

4 Hypotheses and variables

4.1. Determinants of memberships

Farmers' decision to join cooperatives may be conditioned by several demographic, socioeconomic and physical characteristics of the households. Based on theories and similar previous empirical literature (Bernard et al., 2008; Bernard and Spielman, 2009; Francesconi and Heerink, 2010; Fischer and Qaim, 2012; Abebaw and Haile, 2013), the following proxy variables that may affect the propensity of farmers to join cooperatives were identified. These variables include age, education level, marital status, family size, land size, membership in *Idir* (a traditional (burial) association) and village dummies.

The age of the household head seems an important factor positively affecting the likelihood of farmer's decision to join a cooperative (Bernard et al., 2008; Bernard and Spielman, 2009; Francesconi and Ruben, 2012; Abebaw and Haile, 2013; Abate et al., 2014). In this study, a similar influence of this variable (age) is expected on the likelihood of cooperative membership. However, there are mixed results for most of the other variables. For instance, some studies reported a positive association between a decision to join a cooperative and educational level (Bernard and Spielman, 2009; Abate et al., 2014) while other studies (Abebaw and Haile, 2013; Francesconi and Ruben, 2012) show no association between membership and the education level of the head. Likewise, mixed results were reported for family size and land holding. According to Bernard et al. (2008), Fischer and Qaim (2012) and Abebaw and Haile (2013), family size has no effect on the likelihood of farmers' decision to participate, but, has a positive effect in Abate et al. (2014). Similarly, Abebaw and Haile (2013) found no association between land holding and membership but Abate et al. (2014) found a positive association. Generally, we leave those variables with mixed results without assigning any prior sign expectation.

H_1: *Household's demographic, socioeconomic and physical characteristics and the nature of cooperatives significantly affect the likelihood of farmer's decision to join a cooperative.*

4.2. Impact of membership on households' economic performance

According to transaction cost economics, one of the most important farmers' motives of vertical integration via a cooperative is to reduce their production and transaction costs and thereby

increase their income. Among the limited cooperative evaluation studies in Ethiopia, Kindie and Anullo (2012) attempted to assess the economic impact of other agricultural cooperatives. Their findings show a positive impact of cooperatives on farmers' income, saving and in reducing input costs, but have mixed results on members' asset accumulation. Perhaps agricultural cooperatives may have a wide range of impacts on the members and may also spillover to a wider community.

H_2: *Coffee farmers cooperatives create positive economic effects (e.g., on total real income, perceived economic performance, household assets) for the members as compared to nonmembers.*

4.3. Impact of the membership on coffee production

Lack of competitiveness due to low coffee quality and growing productivity is among the important challenges of Ethiopian coffee farmers. Studies show that the national average, plantation, garden and forest coffee yields (kg/ha) are about 650, 800, 450 and 250, respectively (Kebede, 2012). However, cooperatives may benefit their members because they facilitate input supply, and provide training and other coffee management and improvement activities that can increase farmers' return. To see the effect of cooperative membership on members' coffee output, the amount of coffee that each farmer produce in one year was considered.

H_3: *Coffee farmer cooperatives have positive impacts on the amount of coffee that members produce as compared to nonmembers.*

5 Methods

5.1. Sampling and data collection

A household survey was conducted in the Jimma Zone of Oromia regional state, Ethiopia between March and April 2014. The Jimma Zone is among the largest coffee growing zones where Arabica coffee *(Coffea arabica L.)* was also originally discovered. The zone has about 18 districts among which we purposefully selected Mana and Goma based on their coffee production potentials and geographic accessibility. The two districts are adjacent to one another. Mana is found at about 20 km, while Goma at 50 km to the West of Jimma town, 340 km from

Addis Ababa. The districts are similar in terms of agro-ecology and the history of growing coffee. The majority of the rural residents are entirely based on coffee production and marketing.

Observation units were selected using a multistage sampling procedure. Ensuing purposeful selection of the two districts (Mana and Goma), a total of four primary cooperatives were randomly selected, two cooperatives (one fair trade certified and another uncertified) from each district. By obtaining the lists of registered primary (multipurpose) cooperatives from each district's cooperative promotion offices, Kenteri (certified) and Garuke-Mazoria (uncertified) cooperatives were randomly selected from Mana district; and Ilbu (certified) and Yachi-Kachise (uncertified) from Goma district. Finally, by getting the complete list of households at each village that each primary cooperative overlays, representative households (members and nonmembers together) were randomly selected using Excel random numbers, and total of 305 were interviewed and considered for empirical analysis. Generally, prior stratification was not done by membership or other household characteristics such as gender, marital status, head's education level or assets and income in sampling procedure, which is believed to have ensured equal chances of selection for cooperative members and nonmembers.

Data were collected through face-to-face interviews with household heads using a semi-structured questionnaire. Prior to the interviews, we translated the questionnaire into local language (Afan Oromo), trained the interviewers, and conducted a pre-test. In addition to the household survey, cooperative managers/chairmen were interviewed to get information about the overall characteristics of the cooperatives. Furthermore, a total of four group discussions (one for each cooperatives), each consisting of 8 – 12 farmers, were held with the group of random farmers who were not selected for the household survey. Participants were asked about the overall economic performance of the majority of farmers in their area, the contribution of the cooperatives in these regards, and about the benefits of the cooperatives to the individuals and to the whole community. Essentially, the responses of the group participants were used to substantiate the household survey results.

5.2. Data description

Data on the households' demographic and socioeconomic characteristics, and perceived and actual economic performance were collected using the survey questionnaire. Households were

classified into two groups: the treatment and the comparison. The treatment group is made up of the cooperative members, and a treatment variable is membership status (1 for members, and 0 for nonmembers). Table 1 shows, out of the total 305 sample households, 139 (46%) are cooperative members and 166 (54%) are nonmembers. Members and nonmembers appear similar in their education level and in membership status in *Idir*. But, they have significant mean differences along other several covariates. For example, cooperative members are more likely to have married and older household heads than nonmembers. The average age of members is about 48 years, whereas only 40 years for nonmembers. Members are more likely to have a larger family with more adult literate family members. They own more land (1.6 ha) than nonmembers (1.1 ha), and land allocated for coffee production. Members are also more likely to possess a radio, a TV or a mobile phone than nonmembers.

[Table 1]

Table 2 shows the summary of the economic performance and impact indicators by membership. The performance indicators considered consists of (i) total income (annual farm and nonfarm income in ETB), (ii) household assets, i.e., estimated current values of selected household items in ETB (A.1), and (iii) perceived (self-evaluated) economic performance. The self-evaluated performance indicator are addressed by inquiring the farmers' perceptions using a five-point rating scale ranging from 1=much decreasing to 5=much increasing. Farmers were asked to rate (changes over last three years, 2011-2013): their overall revenue growth from all farm activities, nonfarm revenue growth, revenue growth from coffee sales alone, profitability of coffee farming, and amount of coffee they produce. Averaging each farmer's response to these questions, the average scale for perceived economic performance for each individual were generated, then further transformed to binary outcomes, i.e., 1 if household perceived increases (average scale > 3), 0 otherwise.

Generally, the data show that members have significantly higher incomes, assets, and amounts of coffee produced than nonmembers. However, since the confounding factors should be controlled, this result cannot be used for inference regarding the impact of cooperative membership on members' performance. Hence, further analysis is conducted for more reliable results using a matching technique.

[Table 2]

5.3. Analytical approaches

5.3.1 Determinants of cooperative membership: a binary outcome estimation model

The household decision to become a cooperative member can be analyzed using a random utility framework as discussed in Fischer and Qaim (2012), and in Abebaw and Haile (2013). The framework states that a given household chooses to be a cooperative member if the utility gain from being a member is larger than being a nonmember, even though the actual level of utility of cooperative membership to each household is unknown. The utility gain of membership can be expressed as a function of observed covariates (X)[7] in the latent variable model as follows:

$$U_i^* = BX_i + e_i \quad (1)$$

Where, U_i^* is an indicator of the latent cooperative membership and e_i is the disturbance term that explain unobserved utility. On the other hand, the observed dependent variable, i.e., cooperative membership status (U_i), where $U_i = 1$ for cooperative members and $U_i = 0$ for nonmembers is related to U_i^* as follows:

$$U_i = \begin{cases} 1 \; if \quad U_i^* > 0 \\ 0 \quad \text{otherwise} \end{cases} \quad (2)$$

Hence, any binary outcome estimation models can be used to analyze the participation in the cooperatives. We used the logit[8] model to evaluate the association of the observed characteristics with the probability of being a member.

5.3.2 Average treatment effect: an impact evaluation framework

The counterfactual model of causality assumes that each unit has two potential outcomes: the observed and unobserved (Heckman, 2008). For instance, in the case of a binary treatment, the treatment indicator equals 1 if an individual receives treatment and 0 otherwise. The individual that receives treatment has Y_1 outcome (observed) and Y_0 outcome (unobserved - what would have happened to the individual if the same individual had not received the treatment). In

[7] Observed characteristics are pretreatment variables that are not affected by the fact that individuals are the members of a cooperative (Getnet and Anullo, 2012), but they may affect the likelihoods of membership.

[8] For binary treatment variables, logit and probit models usually yield similar results and are preferred to the linear probability model (Heinrich et. al., 2010).

principle, the treatment effect is the difference between Y_1 and Y_0. However, the fundamental evaluation problem or missing data problem arises because only one of the potential outcomes is observed for each individual (Holland, 1986). The unobserved outcome is called counterfactual outcome, and is common for both experimental and non-experimental studies (Caliendo and Kopeinig, 2008). This problem can be overcome by shifting the inferential goal of estimating the individual treatment effect to average treatment effects (Steiner and Cook, 2012).

In randomized experiments, the average impact of the treatment can be obtained by computing the differences of mean values of outcome variables for treatment and control groups. However, impact analysis in observational (non-experimental) studies is difficult since the causal effect obtained by comparing treatment groups with non-experimental control groups could be biased due to a self-selection (nonrandom assignment) of the treatment. To overcome the selection biases in such observational studies, matching has become a useful tool (Getnet and Anullo, 2012). Getnet and Anullo cited that matching involves pairing treatment and control groups that are similar in terms of their observable covariates. If the relevant differences between any two units are captured in the observable covariates, matching methods can yield an unbiased estimate of the treatment impact. However, when there is a dimensionality problem as a result of the differences in the nature of the covariates (including measurement scales), matching on covariates is difficult. In this case, Rosenbaum and Rubin (1983) suggest the use of balancing scores on the covariates, and a propensity score (PS) is one such possible balancing score.

5.3.3 Propensity Score Matching (PSM)

Since a PS reduces the dimension of the covariate to a scalar and balances the observables between treated and control groups, we applied Propensity Score Matching (PSM) to estimate the average impact of membership on farmers' levels of economic performance. As underlined in several studies such as in Rosenbaum and Rubin (1985), Heckman et al. (1997), Caliendo and Kopeinig (2008) and Heinrich et al. (2010), PSM works under the following assumptions. (1) Conditional independence assumption (CIA) or unconfoundedness: assumes that after controlling for the observable covariates (X) the potential outcomes are independent of the treatment assignment. CIA is a strong assumption that implies participation is based on observable characteristics, and variables that simultaneously influence participation and performance indicators are also observable. (2) The common support or overlap condition:

assumes that units (farmers) with the same X values have a positive probability of being both treated and untreated. The probability of treatment assignment is bounded away from zero and one (treatment assignment is not perfectly predicted). Additionally, PSM requires the fulfillment of the balancing property, i.e., the covariates means between members and nonmembers should be similar after matching. The objective of this property is to verify that treatment is independent of unit characteristics after conditioning on the observed covariates (Heinrich et al., 2010).

Considering these assumptions and based on previous studies in Ethiopia and elsewhere (Getnet and Anullo, 2012; Abebaw and Haile, 2013; Francesconi and Ruben, 2012; Heinrich et al., 2010), we follow certain steps in implementing PSM. First, we estimate the PS, i.e., the predicted probability of membership in cooperatives using a logit model on observed covariates. Second, we choose matching algorithms (radius, kernel, and nearest neighbor matching methods). These algorithms differ in the way neighborhood for each treated individual is defined; how the common support is handled; and how the weights are assigned to these neighbors. Discussions about several matching algorithms are available in the literature (Becker and Ichino, 2002; Caliendo and Kopeinig, 2008; Heinrich et al., 2010). In principle, a good matching estimator does not eliminate too many original observations from the final analysis (Abebaw and Haile, 2013). Normally, all matching estimators compare the outcome of a treated with that of a comparison group. Thirdly, we check for common support conditions to verify the presence of enough overlap in the propensity score distribution of the treatment and comparison groups. At the same time, we also test for the balancing property of the PS, i.e., test whether there is similarity between the covariates of the two groups. Finally, according to the PSM model, once cooperative members are matched with similar nonmembers, the average treatment effect(s) can be computed. Meanwhile, the matches should be restricted to the households with propensity scores that fall in the area of common support.

Based on the same logit model described earlier, the estimated propensity scores of our data vary between 0.06101 and 0.98551 for the treated and between 0.01726 and 0.89076 for comparison samples. From this, the common support region for the treated and comparison sample is between 0.06101 and 0.98551. PS of observations out of this region are dropped from the sample on which matching is executed. Hence, the final sample size becomes 285 (139 member and 146 nonmembers) on which the ATT is estimated. The average impact of membership on

performance of the members, referred to as the average treatment effect on treated (ATT), is estimated as follows:

$$ATT = E(Y_1 - Y_0 / U_i = 1) = E(Y_1 / U_i = 1) - E(Y_0 / U_i = 1) \quad (3)$$

Where, Y_1 is the outcome in the treated condition; Y_0 is the outcome in the control condition; and the U_i indicator variable (treatment status) denoting membership in a cooperative. Generally, matching is a good method to estimate the average treatment effect in observational studies when there is no baseline observation. However, it has some limitations such as: inability to address the bias created by unobservable characteristics, being a non-parametric method, and requirement for large amounts of data to maximize estimation efficiency (Bernard et al., 2010).

6 Results

6.1. Determinants of participation in cooperatives

Logistic regression model results, in which treatment status was regressed on baseline characteristics, are shown in Table 3. The model indicates that 76.41% of sample observations are correctly classified and the model generally shows a highly significant (Prob. > chi2 = 0.000) association of membership with households' demographic and socioeconomic characteristics. Additionally, the pseudo R^2 (0.237) shows good model fit as pseudo R^2 between 0.2 and 0.4 are considered to indicate good model fit (Louviere et al., 2000; Elder et al., 2012).

As shown in Table 3, most of the covariates have expected signs and match with the findings of previous studies. For instance, the probability of being a member in a cooperative significantly increases with household age, up to a certain level. But, contrary to expectation, the participation in cooperatives was not related to household experience in a traditional association (*Idir*). An increased probability of participation with head's education level was also found; that is, a household with a higher education level has 7.4% higher probability of participation in a cooperative.

As expected, farmers with a bigger family and larger land holdings are more likely to join a cooperative. Among household wealth, land is a basic resource particularly for subsistent farmers. Apparently, farmers with large land holding are more likely to join the cooperatives. The finding shows that farmers who have a unit higher land size have about 35% higher

probability of participation in a cooperative. We also learned during group discussions that farmers with more land size and hence more coffee production benefit more from a price stabilizing role of a cooperative and the dividend paid by cooperatives, which is based on the amount of coffee that farmers sell to the cooperative. Besides, village dummies indicate that farmers' geographic locations have effects on participation decisions with respect to a reference village (Yachi Kachise), which is the farthest from the Jimma town. Generally, these findings confirm H_1, i.e., household's demographic, socioeconomic and physical characteristics significantly affect the likelihood of farmers' decisions to join cooperatives.

[Table 3]

6.2. Average treatment effect for treated (ATT)

6.2.1 Impact of membership on farmers' economic performance

As indicated earlier, economic performance indicators considered consist of (i) total income, (ii) household assets and (iii) perceived (self-evaluated) economic performance. Table 4 reveals the presence of a positive, but statistically insignificant impact of membership on members' economic performance. Additionally, cooperative membership has no significant impact on the non-financial asset accumulation of the members. The findings reject H_2; Ethiopian coffee farmers' cooperatives have no significant economic impact on its members. However, from the group discussions held with the randomly selected farmers, they clearly testified that cooperatives have an important economic impact on each of them and on the entire community. Particularly, the remarkable cooperative's benefit mentioned was its price-stabilizing role. A participant during a group discussion narrated: "…the most important reason we like cooperatives is that they give us a fair price; when the cooperatives start buying coffee, all the coffee traders raise the coffee price to equal or sometimes to better level to win the emerging competition, which benefits all producers. If there were no cooperatives, we could have been all out of production due to the very low prices the traders and the middlemen offer to our coffee." The group participants also reported that the certified cooperatives have been delivering better services to the community through investing premiums on schools, health and clean water development, among others.

[Table 4]

On the other hand, there are a number of issues related to cooperatives that came up from the group discussions and from the interviews with cooperative chairmen/managers. First, members and nonmembers obtain similar services from the cooperatives in the study area irrespective of the cooperative principles and bylaws. According to the information from the group discussion, cooperatives actually buy coffee from both members and nonmembers at equal prices (members also sell their coffee to other traders), and thus the members cannot get better incomes because of their membership. Additionally, being multipurpose in nature, cooperatives also render different services to both members and nonmembers at similar prices (e.g. supply of agricultural inputs). Second, the only reported unique benefit to the members is the dividend (second payment) that cooperatives supposed to pay (from the profit they made) to members in proportion to the amount of coffee the members supply. However, some farmers were even complaining that they didn't get a dividend for some years or only a very small one and the impact on income is low. Third, cooperatives usually don't start buying the coffee early in the coffee season due to ambiguous bureaucratic and financial issues. Apparently, some members explained that the district cooperative promotion office has problems of endorsing credit to the cooperatives that they use to buy coffee from their members. On the other hand, the district cooperative promotion offices clarified that if the cooperatives fulfill all the requirements, they do not waste time to endorse the requested credit, and added that the committees need to be effective to submit their request for credit in advance. The cooperatives usually get the loan from Oromia Cooperative Bank after fulfilling the requirements.

Generally, the results from the group discussions reveal the presence of ineffective management and ill implementation of cooperative principles and rules. This directly points to the inefficiency of the committee that could also be the result of the state interference, timely unavailability of credit services and farmers' low education levels.

6.2.2 Impact on coffee production

Considering the amount of coffee that each farmer sells in one year, cooperative membership seems to have mixed effect on the amount of coffee that a member produces and supplies to the market. That is, membership has no impact on the amount of dry processed coffee that a farmer

supplied to the market. Nevertheless, the amount of wet coffee supplied is positively associated to membership (Table 4). Information from the group discussions show that the cooperatives buy most of the coffee for wet processing since this kind of coffee has quality and hence higher price than dry processed counterpart in world markets.

6.3. Robustness and validity of matching estimates

The validity of the matching estimates discussed earlier depends on the fulfillment of the common support conditions, balancing requirement of the propensity scores, and the conditional independency assumption (CIA). Following previous studies (Becker and Ichino, 2002; Heinrich et al., 2010; Getnet and Anullo, 2012), we verify these assumptions using different tests. First, we visually inspect and validate the quality of the common support using the graphical distribution of the propensity score for treated and comparison groups. Figure 1, shows the presence of sufficient overlap between the two groups. Second, as shown in Table 5, the kernel-based test verifies that all the covariates are similar for both treated and untreated groups after matching. In other words, a *t*-test shows the covariate means of the two groups are not significantly different after application of matching. Hence, our PSM satisfies the balancing property. Additionally, the standardized bias differences for mean values of all covariates between members and nonmembers are below 10%. Apparently, our matching is successful since matching is considered as successful if the bias is less than 20% (Rosenbaum and Rubin, 1985).

The third assumption to be justified is CIA. Since PSM can only account for selection bias due to observable characteristics, the assumption is violated if unobserved characteristics also determine treatment assignment. Unfortunately, the CIA is not directly testable but requires justification (Heinrich et al., 2010). Accordingly, first we specified the logit model as discussed earlier. Second, following Godtland et al. (2004) and Fischer and Qaim (2012) we test the robustness of estimated ATT results using alternative variations in the logit model. We run two additional logit models by including more covariates. In the base model, the variables expected to affect the likelihoods of participation are included. In the second model, we included some more endogenous variables such as coffee farm size, radio ownership, adult education (number of adult (age > 15) household members who can read and write). In the third model, we even added more covariates including cooperative dummy, membership status in other traditional association (*debo*), self-evaluated poverty level, and coffee-farm-to-total-farm ratio. A.2 shows

that the results of tests for the robustness of estimated ATTs using alternative participation models are robust to the alternative participation models. The perceived economic performance, total income, assets and coffee output are consistently insignificant across all the participation models and across matching algorithms. In general, even if some estimation results are sensitive to model specifications indicating the presence of some unobserved factors affecting treatment assignment, those unobserved factors seem not strong enough to invalidate our finding.

[Figure 1]

6.4. Impact heterogeneity

The PSM results assume a homogeneous membership effect among cooperative members. However, there could be a variation in treatment impacts within cooperative members due to their demographic and socioeconomic differences. Ordinary regression analyses were run for outcome variables including household income, assets and coffee production (as dependent variables) to understand potential impact heterogeneity within members (i.e., nonmembers excluded).

The regression models (A.3) generally suggest that the impact of membership on member economic performance significantly varies with households' education level, land holdings and village dummies. For instance, the impact of membership on household income increases with head education level, family size and village dummies ($p < 0.1$).

[Table 5]

7 Discussion and conclusions

The benefits and the impacts of any cooperative on the livelihoods of members and the community could be both tangible and intangible. This study was conducted to understand the determinants of cooperative membership and the impact of membership on the economic performance of coffee farmers in Jimma Zone of Oromia regional state, Ethiopia. A logit model was employed to investigate the determinants of participation and PSM is utilized to assess the impacts of the membership. The validity and robustness of estimation results were also tested and the major findings are reliable and are not sensitive to the estimation methods used. The

sensitivity analysis (bounding approach) also reveals that the result is not sensitive to hidden biases. Furthermore, we conducted group discussions that helped us capture the overall situation of the study area and the impact of cooperatives on the coffee farmers' livelihoods.

The results from the logit regression model reveal that household demographic and socioeconomic characteristics (age of the household head, education level of the head, family size and land holding) significantly increase the likelihood of farmers' decisions to join cooperatives. The strong association of age with the probability of participation can be justified by farming experience that correlates with the age of the farmer. However, the wide age gap between the two groups indicates a lack of interest among younger generations or a possible presence of barriers to become a member. This age difference between the two groups is consistent with findings of other studies (Bernard et al., 2008; Bernard and Spielman, 2009; Abebaw and Haile, 2013; Abate et al., 2014; Francesconi and Ruben, 2012). The large family size could also be related to age and also to the labor input for coffee production. Formal education also seems to be another important factor in farmers' decision, probably because more educated household heads are more aware of the benefits of cooperatives. Abate et al. (2014) also reported similar results. Apparently, information about the benefits of cooperatives is among the most important factors associated with farmers' decisions to participate in cooperatives. This is because, farmers in the villages closer to a Jimma town where there is more access to information have a higher probability of joining cooperatives compared to those located very far away from the town. Generally, consistent with Fischer and Qaim (2012), the better-off farmers (in terms of wealth and access to information) are more likely to join agricultural cooperatives.

Regardless of considerable economic benefits to the whole community, the PSM shows that cooperative membership has no significant impact on members' economic performance (including perceived, actual income and household asset accumulation). The perceived economic impact of cooperatives and real household income is consistent, and the results are robust across matching algorithms. The insignificant impact of cooperatives on household assets complies with the findings of Getnet and Anullo (2012). Nevertheless, Getnet and Anullo reported that members are better than nonmembers in terms of their income, though their study was for agricultural cooperatives from annual crops growing areas. The insignificant economic impact on members in our case could be justifiable. (i) Members and nonmembers obtain similar services (both input and output marketing at similar price) even if cooperatives are in principle to serve

the members. (ii) Although the unique benefit for members is dividend (second payment from the profit of cooperatives), it is either too small or not paid timely and hence has little impact. These two points can be strong justifications for the insignificant difference between members and nonmembers in their economic performance. (iii) Since we drew our sample from the same community where members live intermingling with nonmembers, there could be a spillover effect and hence the impact of membership may be underestimated. In fact, from the group discussion we confirmed that cooperatives have important economic benefits to the whole community, regardless of membership. Thus, the findings indicate that the insignificant impact of membership is not due to the absence of the potential (real) impact of cooperatives, but due to management related problems.

In conclusion, in addition to basic household characteristics, village dummy, related to access to information about the benefit of cooperatives, is an important factor affecting the likelihood of households' decision to participate in a cooperative. Although cooperatives are reported to considerably benefit all coffee farmers and the community at large, membership has no significant impact in improving members' economic performance compared with nonmembers. In other words, since cooperatives are serving both members and nonmembers in a similar way, membership has no unique economic benefit to the members. This could be due to a vaguely defined property right problem discussed earlier. So, as long as nonmembers are getting similar economic benefit, there is no point that farmers may further join the cooperatives. However, since the cost of joining a cooperative is small (excluding the time commuted), it may survive due to its potential benefits to the whole community. In fact, the insignificant economic benefits to the members could put the sustainability of cooperatives under question in the long term. Therefore, policy makers, the cooperative promotion office, the cooperative general assembly and its managing committee need to work on the mechanisms that may help to maximize the benefits of cooperative members, or further actions such as revising cooperative structure may be needed.

References

Abate, G. T., Francesconi, G. N., Getnet, K., 2014. Impact of agricultural cooperatives on smallholders' technical efficiency: empirical evidence from Ethiopia. *Ann. Public Coop. Econ.*, 85, 257-286.

Abebaw, D., Haile, M. G., 2013. The impact of cooperatives on agricultural technology adoption: Empirical evidence from Ethiopia. *Food Pol.*, 38, 82-91.

Anteneh, A., Muradian R., Ruben R., 2011. *Factors Affecting Coffee Farmers Market Outlet Choice. The Case of Sidama Zone, Ethiopia*. EMNet Conference paper, https://emnet.univie.ac.at/uploads/media/Anteneh_et_al..docx(accessed 13 August 2014).

Bacon, C., 2005. Confronting the coffee crisis: can fair trade, organic and specialty coffees reduce small-scale farmer vulnerability in northern Nicaragua? *World Devel., 33*, 497-511.

Bacon, C. M., Méndez, V. E., Gómez, M. E. F., Stuart, D., Flores, S. R. D., 2008. Are sustainable coffee certifications enough to secure farmer livelihoods? The millennium development goals and Nicaragua's Fair Trade cooperatives. *Globalizations*, 5*,* 259-274.

Becker, S., Ichino, A., 2002. Estimation of average treatment effects based on propensity score. *The Stata J*., 2, 358-377.

Bernard, T., Spielman, D., 2009. Reaching the rural poor through rural producer organizations: A study of agricultural marketing cooperatives in Ethiopia. *Food Pol*., 34, 60-69.

Bernard, T., Spielman, D., Taffesse, A. S., Gabre-Madhin, E., 2010. *Cooperatives for Staple Crop Marketing: Evidence from Ethiopia.* Report No.166. IFPRI, Washington, DC.

Bernard, T., Taffesse, A. S., Gebre-Medhin, E. Z., 2008. Impact of cooperatives on smallholders' commercialization behavior: evidence from Ethiopia. *Agri. Econ*., 39, 147-161.

Bonin, J. P., Jones, D. C., Putterman, L., 1993. Theoretical and empirical studies of producer cooperatives: Will ever the twain meet? *J. Econ. Lit*., XXXI, 1290-1320.

Caliendo, M., Kopeinig, S., 2008. Some practical guidance for the implementation of propensity score matching. *J. Econ. Surveys*, 22, 31-72.

Chaddad, F. R., Cook, M. L., 2004. Understanding new cooperative models: An ownership–control rights typology. *Appl. Econ. Perspect. Pol*., 26, 348-360.

Chibanda, M., Ortmann, G., Lyne, M., 2009. Institutional and governance factors influencing the performance of selected smallholder agricultural cooperatives in Kwazulu-Natal. *Agrekon*., 48, 293-315.

Cook, M. L., 1995. The future of US agricultural cooperatives: A neo-institutional approach. *Amer. J. Agr. Econ*., 77, 1153-1159.

Dempsey, J., 2006. *A case study of institution building and value chain strengthening to link*

Ethiopian cooperative coffee producers to international markets. ACDI/Voca, Addis Ababa.

Deriada, A. L., 2005. Assessment of cooperative movement in a developing country: The Philippine experience. *Forum of International Development Studies*, 28, 81-101.

Elder, S. D., Zerriffi, H., & Billon, P. L. E., 2012. Effects of fair trade certification on social capital: the case of Rwandan coffee producers. *World Devel*., 40, 2355-2367.

Emana, B., 2009. *Cooperatives: A path to economic and social empowerment in Ethiopia*. ILO, Dar es Salaam.

Emana, B., 2012. *Cooperative Movement in Ethiopia. A paper presented at Workshop on Perspectives for Cooperatives in Eastern Africa*. October 2-3, 2012, Uganda.

Federal Cooperative Agency (FCA), 2013. *Unpublished data*, Addis Ababa, Ethiopia.

Fischer, E., Qaim, M., 2012. Linking smallholders to markets: Determinants and impacts of farmer collective action in Kenya. *World Devel*., 40, 1255-1268.

Food and Agriculture Organization (FAO) of the United Nations, 2012. *Agricultural cooperatives: Key to feeding the world.* World Food Day leaflet. FAO, Rome, Italy.

Francesconi, G. N., Heerinck, N., 2010. Ethiopian agricultural cooperatives in an era of global commodity exchange: Does organization form matter? *J. Afr. Econ*., 20, 153-177.

Francesconi, G. N., Ruben, R., 2012. The hidden impact of cooperative membership on quality management: A case study from the dairy belt of Addis Ababa. *JEOD*, 1, 85-103.

Getnet, K., Anullo, T., 2012. Agricultural cooperatives and rural livelihoods: Evidence from Ethiopia. *Ann. Public Coop. Econ*., 83, 181-198.

Godtland, E.M., Sadoulet, E., de Janvry, A., Murgai, R., Ortiz, O., 2004. The impact of farmer field-schools on knowledge and productivity: A study of potato farmers in the Peruvian Andes. *Econ. Devel. Cult. Change*, 53, 63-92.

Heckman, J., 2008. Econometric causality. *Int. Statistical Rev., 76*, 1-27.

Heckman, J., Ichimura, H., Smith, J., Todd, P., 1997. Matching as econometric evaluation estimator: Evidence from evaluating a job-training program. *Rev. Econ. Stud*., 64, 605-654.

Heinrich C., Maffioli, A., Vázquez, G., 2010. *A Primer for Applying Propensity-Score Matching: Impact-Evaluation Guidelines.* No.TN-161, Inter-American Development Bank.

Helmberger, P. G., Hoos, S., 1962. Cooperative enterprise and organization theory. *J. Farm Econ.*, 44, 275-290.

Holland, P. W., 1986. Statistics and causal inference. *J. of the Amer. Statistical Assoc.*, 81,945-6.

Holmberg, S. R., 2011. *Solving the Coffee Paradox: Understanding Ethiopia's coffee. cooperatives through Elinor Ostrom's theory of the commons.* Dissertations. Paper 379.

ICA, 2014. http://ica.coop/en/whats-co-op/co-operative-identity-values-principles (accessed 10 October 2014).

Jena, P. R., Chichaibelu, B. B., Stellmacher, T., Grote, U., 2012. The impact of coffee certification on small-scale producers' livelihoods: A case study from the Jimma Zone, Ethiopia. *Agri. Econ*., 43, 429-440.

Kebede, T., 2012. *Coffee quality and productivity as basic factors for sustainability in Ethiopia*. A presentation at 2st African Coffee Sustainability Forum, February 15th, 2012, UNCC-AA, Addis Ababa, Ethiopia.

Kodama, Y., 2007. New role of cooperatives in Ethiopia: The case of Ethiopian coffee farmers' cooperatives. *African Study Monographs*, 35, 87-108.

Lentijo, G. M., Hostetler, M., 2011. *Evaluating Certified Coffee Programs*. WEC306 http://edis.ifas.ufl.edu/uw351 (accessed 3 September, 2014).

Louviere, J. J., Hensher, D. A., Swait, J. D., 2000. *Stated choice methods: Analysis and applications*. Cambridge University Press. Cambridge, UK.

Menard, C., 2004. The economics of hybrid organizations. *J. Inst. Theoretical Econ. /Zeitschrift für die gesamte Staatswissenschaft*, 345-376.

Nilsson, J., 2001. Organizational principles for cooperative firms. *Scandinavian Journal of Management*, 17, 329-356.

Nilsson, J., Svendsen, G. L., Svendsen, G. T., 2012. Are large and complex agricultural cooperatives losing their social capital? *Agribusiness*, 28, 187-204.

Nkhoma, A., Conforte, D., 2011. *Unsustainable cooperatives: Lessons from Malawi*. IFAMA Symposium, Frankfurt.

Ortmann, G., King, R., 2007. Agricultural Cooperatives: History, Theory and Problems. *Agrekon,* 46, 40-68.

Petit, N., 2007. Ethiopia's coffee sector: A bitter or better future? *J. Agrarian Change*, 7, 225-263.

Ponte, S., 2002. The 'latte revolution'? Regulation, markets and consumption in the global coffee chain. *World Devel*., 30, 1099-1122.

Rosenbaum, P. R., Rubin, D. B., 1983. The central role of the propensity score in observational studies for causal effects. *Biometrika,* 70, 41-55.

Rosenbaum, P., Rubin, D., 1985. Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *Am. Stat.*, 39, 33-38.

Rosenbaum, P.R., 2002. Observational Studies, Second Ed. New York.

Royer, J. S., 1999. Cooperative organizational strategies: a neo-institutional approach. *J. Cooperatives*, 14, 44-67.

Sexton, R. J., 1995. A Perspective on Helmberger and Hoos' Theory of Cooperatives. *J. Cooperatives*, 10, 92-99.

Staatz, J. M., 1986. Farmers' Incentives to Tare Collective Action via Cooperatives: A Transaction Cost Approach (http://www.rurdev.usda.gov/rbs/pub/sr18/incentve.pdf)

Staatz, J. M., 1987. Recent developments in the theory of agricultural cooperation. *J. Agri. Cooperation*, 2, 74-95.

Steiner, P. M., Cook, D., 2012. *Matching and propensity scores*. The Oxford.

Tortia, E. C., Valentinov, V. L., Iliopoulos, C., 2013. Agricultural cooperatives. *JEOD.*, 2, 23-36.

USAID (United States Agency for International Development), 2010. *Ethiopian coffee industry value chain analysis: profiling the actors, their interactions, costs, constraints and opportunities*. Chemonics International Inc.

Valentinov, V., 2007. Why are cooperatives important in agriculture? An organizational economics perspective. *J. Inst. Econ.*, 3, 55-69.

Tables and Figure

Table 1. Descriptive statistics of sample households by cooperative membership status

Variable	Members (N = 139)		Nonmembers (N = 166)		t - values	Mean differences	
	Mean	Std. Dev.	Mean	Std. Dev.			
Idir (1 = member, 0 otherwise)	0.96	0.19	0.94	0.24	0.97	0.02	
Sex (1 = male, 0 otherwise)	0.92	0.27	0.96	0.20	1.36	-0.04	
Marital status (1=married, 0 otherwise)	0.84	0.37	0.92	0.28	-2.00	-0.08	**
Age (years)	48.42	12.69	40.17	12.93	5.60	8.25	***
Age sq.	2504.80	1356.92	1779.82	1246.01	4.86	724.98	***
Head education level (years of schooling)	3.85	2.75	3.72	2.91	0.41	0.13	
Head education sq.	22.31	27.90	22.21	27.84	0.030	0.1	
Adult education (number of literate adult)	2.60	1.69	1.55	1.34	6.01	1.05	***
Family size (number of family members)	6.58	2.11	5.43	2.00	4.86	1.15	***
Land size (ha)	1.58	1.20	1.13	0.78	3.98	0.45	***
Log land size	0.87	0.38	0.70	0.33	4.20	0.17	***
Coffee farm size squared (sq. ha)	0.87	0.68	0.65	0.51	2.43	0.22	**
Crop diversity (number of crops grown)	2.19	1.17	2.27	1.12	-0.56	-0.08	
Mobile (1= own mobile, 0 otherwise)	0.84	0.37	0.75	0.43	1.91	0.09	*
Radio (1 = own radio, 0 otherwise)	0.85	0.36	0.77	0.42	1.72	0.08	*
TV (1 = own TV, 0 otherwise)	0.17	0.37	0.05	0.23	3.20	0.12	***
Distance to ECX (km)	28.30	18.25	32.86	19.78	-2.07	-4.56	**
Certification (1 = certified, 0 otherwise)	0.63	0.48	0.00	0.00	2.03	0.63	**
Kenteri[d] (dummy)	0.36	0.48	0.25	0.44	-2.03	0.11	**
Garuke[d] (dummy)	0.31	0.46	0.29	0.45	-0.38	0.02	
Ilbu[d] (dummy)	0.27	0.45	0.27	0.44	-0.16	0.00	
Kachise[d] (dummy)	0.06	0.23	0.19	0.40	3.54	-0.13	***

[d] A cooperative dummy, 1= if the household is a member of the cooperative, 0 otherwise

***, **, * denote significance at 1%, 5% and 10% significance level, respectively.

Table 2. Mean differences between members and nonmembers along performance indicators (before matching)

Variable	Mean		
	Members (N = 139)	Nonmembers (N = 166)	t-value
Economic performance (1= increase perceived, 0 otherwise)	0.885	0.910	-0.71
Total income (ETB)	16246.00	10177.00	3.75***
Asset (ETB)	16385.00	10182.00	3.98***
Wet coffee supplied (kg)	806.74	476.80	2.61***
Dry coffee supplied (kg)	386.60	299.63	1.39

*** denote significance at 10% significance level

Table 3. Logit model results of factors determining cooperative membership

Variables	Coef.		Std. Err.	Marginal effect[m]		Std. Err.
Membership status in *Idir*[b]	0.286		0.736	0.069		0.173
Sex[b]	-1.075		0.670	-0.259	*	0.146
Marital status[b]	-0.957	*	0.492	-0.234	**	0.113
Age	0.172	***	0.059	0.042	***	0.015
Age sq.	-0.001	**	0.001	0.000	**	0.000
Head education level	0.299	**	0.144	0.074	**	0.036
Head education sq.	-0.024	*	0.014	-0.006	*	0.003
Family size	0.281	***	0.075	0.069	***	0.018
Log land size	1.410	***	0.446	0.348	***	0.110
Crop diversity	-0.198		0.154	-0.049		0.038
Kenteri[b]	1.943	***	0.531	0.449	***	0.103
Garuke[b]	1.904	***	0.537	0.441	***	0.105
Ilbu[b]	1.463	***	0.550	0.349	***	0.119
Constant	-8.290	***	1.813			
Pseudo R^2	0.2374					
LR chi^2 (13)	98.63					
Prob > chi^2	0.000					
% Correctly predicted	76.41%					
Number of observations	301					

[b] = binary outcomes indicating discrete changes from 0 to 1
***, **, * denote significance at 1%, 5% and 10% significance level, respectively.
[m] marginal effect calculated using the "mfx" command in STATA after the logistic regression estimation.

Table 4. Average impact of membership on performances of members: estimation results of ATT

Outcomes	Matching algorithms+		
	Nearest neighbor (3)	Kernel (0.06)	Radius (0.05)
Economic performance (1= if an increase	0.018	0.007	0.005
perceived, 0 otherwise)	(0.074)	(0.055)	(0.052)
Total income (ETB)	2537.643	2729.896	2806.599
	(2672.849)	(2056.003)	(1882.023)
Asset (ETB)	2766.563	2640.675	2717.599
	(2213.932)	(2434.038)	(2173.732)
Dry coffee (kg)	-90.609	-83.420	-83.532
	(112.507)	(113.650)	(123.659)
Wet coffee (kg)++	277.883*	273.571*	268.633*
	(158.565)	(148.975)	(141.302)

*Significance at 10% significance level

+ATT estimates of 3 Nearest neighbors, Kernel (band width = 0.06) and Radius (caliper = 0.05) based matching are estimated using the "psmatch2" command in STATA. The standard errors (in parentheses) are estimated using bootstrap with 100 replications. With the matching estimators, a common support condition is imposed and the matched sample includes 139 members and 146 nonmembers.

++To check the sensitivity of the result to hidden biases, Rosenbaum sensitivity analysis (Rosenbaum, 2002) was calculated and the results are not sensitive. It is meaningless to run sensitivity analysis for other outcome variables with statistically insignificant results.

Table 5. Test of matching quality (balancing property) means, % bias and *p*-values for percent differences between means of treated and comparison groups after a kernel matching

Variable	Mean		% Bias	% Reduction	*t*-test	
	Comparison	Treated		|bias|	*t*	$p > \|t\|$
Traditional association (*Idir*)	0.961	0.942	9.3	1.1	0.72	0.474
Sex	0.930	0.915	6.1	59.4	0.43	0.664
Marital status	0.875	0.898	-7.2	67.5	-0.59	0.557
Age	47.945	47.973	-0.2	99.7	-0.02	0.987
Age sq.	2456.000	2493.400	-2.9	95	-0.21	0.836
Head education	3.781	3.898	-4.1	-30.4	-0.34	0.735
Head education level sq.	21.438	23.238	-6.4	-736.1	-0.50	0.615
Family size	6.398	6.508	-5.4	90.2	-0.45	0.656
Log land size	0.827	0.825	0.7	98.5	0.06	0.951
No. of crop types grown	2.164	2.249	-7.5	-61.8	-0.60	0.547
Kenteri	0.336	0.380	-9.6	56	-0.73	0.463
Garuke	0.305	0.308	-0.8	81.1	-0.06	0.950
Ilbu	0.297	0.258	8.8	-391	0.70	0.487

	Before matching	After Matching
Pseudo R^2	0.236	0.015
LR chi^2	98.00	5.15
$p > chi^2$	0.000	0.972
Mean Bias	23.9	5.3
Media Bias	15.0	6.1
%Var	23	8

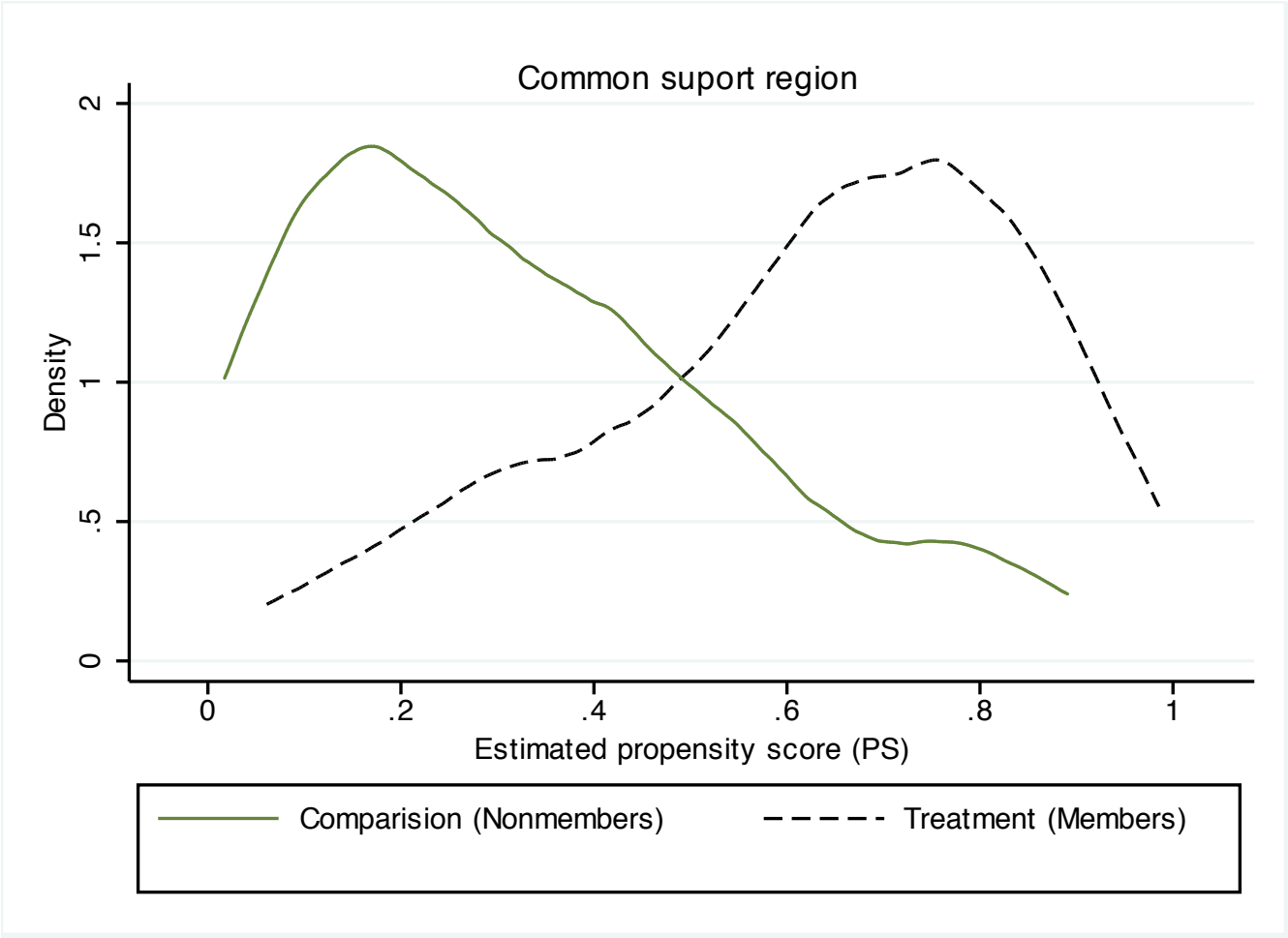

Figure 1 Density distribution of propensity scores for treated and comparison groups

Appendices

A.1. Summary statistics for proxy asset indicators and corresponding current values (in ETB), by membership

	Members (*N* = 139)		Nonmembers (*N* =166)		Pooled sample (*N*= 305)	
Household assets	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Oxen	5802.88	5837.97	3970.48	4898.34	4805.57	5415.71
Other cattle	4976.62	5755.02	3393.37	4938.71	4114.92	5375.60
Sheep	628.78	1172.94	314.16	834.43	457.54	1013.45
Goat	117.27	328.63	65.06	281.96	88.85	304.72
Horse/donkey	755.76	2109.78	426.20	1424.50	576.39	1774.54
Warehouse	1474.46	5799.07	461.75	1697.98	923.28	4133.52
Radio	368.67	348.61	281.24	282.17	321.09	316.68
TV	871.94	2194.63	176.20	791.66	493.28	1626.96
Mobile phone	992.73	942.50	702.34	724.48	834.69	842.09
Others assets	395.68	3614.82	270.18	2417.87	327.38	3018.06

A.2. Robustness of the results of average treatment effect on treated (ATT)

	Matching algorithms (Base model)			Matching algorithms (extended model_1)			Matching algorithms (extended model_2)		
Outcome variables	3 nearest	Kernel	Radius	3 nearest	Kernel	Radius	3 nearest	Kernel	Radius
Economic performance (1= increase perceived, 0 otherwise)	0.018	0.007	0.005	0.098	0.033	0.031	0.033	-0.015	-0.020
Total income (ETB)	2537.643	2729.896	2806.599	2600.79	1832.08	1612.08	1553.03	49.05	-107.50
Assets (ETB)	2766.563	2640.675	2717.599	1215.84	1058.91	1172.78	523.66	-27.72	227.86
Dry coffee (kg)	-90.609	-83.420	-83.532	-143.21	-124.87	-126.43	-279.31*	-259.31	-273.95
Wet coffee (kg)	277.883*	273.571*	268.633*	158.75	193.07	197.65	194.71	273.18	281.03**

**, * denote significance at 5% and 10% significance level, respectively.

A.3. Variations in the impact of cooperative membership on economic performances of farmers within cooperative members: Ordinary regression estimation results.

	Outcome (dependent) variables							
	Annual income (ETB)		Household asset (ETB)		Dry coffee (kg)		Wet coffee (kg)	
Independent variables	Coef.	Std.Err	Coef.	Std.Err	Coef.	Std.Err	Coef.	Std.Err
Idir	3528.51	7599.38	-9464.31	6973.37	-496.03	279.04 *	455.63	529.92
Sex	-10473.08	6534.11	-3820.34	5995.85	-251.98	239.93	-582.78	455.63
Marital status	6457.77	4547.67	-20.61	4173.04	233.28	166.99	-186.07	317.12
Age	-36.09	134.72	-60.22	123.63	-1.38	4.95	2.93	9.39
Head education level	1130.67	594.35 *	851.00	545.39	28.45	21.82	94.18	41.44 **
Family size	1422.06	737.63 *	-516.92	676.87	15.63	27.09	43.49	51.44
Log land size	2391.55	4230.92	14231.77	3882.39 ***	521.12	155.35 ***	-252.87	295.03
Number of crops grown	1438.16	1595.69	1262.45	1464.24	-79.76	58.59	14.33	111.27
Garuke	-6319.98	3533.63 *	-385.34	3242.54	-284.49	129.75 **	-244.21	246.41
Ilbu	-7098.01	3928.49 *	-4764.85	3604.88	-228.06	144.25	-706.31	273.94 **
No. years of membership	-17.68	127.64	-153.13	117.12	-3.68	4.69	3.34	8.90
Constant	4062.63	12375.74	20879.46	11356.27 *	685.36	454.42	678.80	862.98
Number of observations	138		138		138		138	
F (11, 126)	2.16		3.67		3.06		1.59	
Prob > *F*	0.0203		0.0002		0.0012		0.1099	
R-squared	0.1589		0.2425		0.2107		0.1217	
Adj R-squared	0.0855		0.1764		0.1418		0.0451	

***, **, * denote significance at 1%, 5% and 10% significance level, respectively.