Do coffee cooperatives benefit farmers? An exploration of heterogeneous impact of coffee cooperative membership in Southwest Ethiopia

RESEARCH ARTICLE

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Abstract

Smallholder farmers' participation in agricultural cooperatives is often promoted as a promising strategy for overcoming market imperfections and to increase farmers' productivity and income. In recognition of this potential, in recent years, Ethiopia has shown renewed interest in promoting cooperatives. However, there is lack of empirical evidence of the impact that cooperatives have on farmers' performance in Ethiopia. Using a matching technique, we evaluate the impact of coffee cooperatives on the performance of their member households in terms of income and coffee production. We use data from coffee farmers in south-west Ethiopia. The overall results suggest that members of cooperatives are not faring much better than non-members. The treatment effects we measured were not statistically significant from zero. Yet, the aggregate figures mask differences between cooperatives and amongst individual cooperative members. Average treatment effects on members differ between cooperatives, in general older members, those who have benefitted from more education and those with larger coffee plantations seem to benefit more from membership. Our analysis sheds light on the heterogeneity in the impact that membership of a cooperative can have: this differs by cooperative and by members within cooperatives, a finding that has important policy implications.

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1. Introduction

It is widely recognized that by participating more in markets smallholder farmers can increase their productivity levels and incomes, thereby improving their food security and experiencing less poverty. A thriving agricultural sector contributes to overall economic growth (World Bank, 2007). At the same time, changing economic, environmental and socio-political conditions around the world pose serious challenges to agricultural production and particularly to small-scale production. Today, as in the past, African smallholder producers face problems in accessing rewarding markets. Market liberalization, mainly in markets for traditional export products – such as coffee, and globalization have brought new opportunities and challenges to farmers (World Bank, 2007) who have had to start to deal with the quasi-monopsonistic powers of intermediaries with whom they have to make deals on spot markets or negotiate contracts with (Markelova and Mwangi, 2010). If unprotected or insufficiently supported, smallholder farmers are often disadvantaged and lack the bargaining power to secure fair trade conditions (Mujawamariya, 2013).

Horizontal coordination among farms, in the form of cooperatives or producer groups is often promoted as a way to overcome market imperfections and constraints (World Bank, 2007; Verhofstadt and Maertens, 2015). These collective organizations can facilitate and leverage market linkages for small scale producers, help them to exploit the economies of scale that farmers are unable to achieve individually, improve their bargaining power and provide access to inputs, transport and market information that can enable farmers to engage with and benefit from existing value chains (Verhofstadt and Maertens, 2015; World Bank, 2007). Over recent decades, donors and governments have been supportive of producer cooperatives (Berdegué, 2001; Bernard *et al.,* 2008; Collion and Rondot, 2001; World Bank, 2003, 2007) even though studies reveal that, in Ethiopia and elsewhere, they achieve different levels of success. Our study shows that cooperative membership brings mixed results and that this is partly due to differences between cooperatives (some cooperatives perform well while others fail to create impact for their members) and partly because some members benefit from membership more than others).

Fisher and Qaim (2012), Ito *et al.* (2012) and Vandeplas *et al.* (2013) have all shown the positive and significant impact of cooperative membership on farm income and profits. By contrast, Bernard *et al.* (2008) and Francisconi and Heerink (2011) show that cooperatives have a limited influence on their members' commercialization behavior. Barham and Chitemi (2009) examined the extent to which certain characteristics and asset endowments of smallholder farmer groups facilitate collective actions that can improve group marketing performance. Their findings suggest that more mature groups with stronger internal institutions, functioning group activities and a good base of natural capital are more likely to improve their members' market situation. Markelova and Mwangi (2010) indicated the need to consider different types of markets and products, the characteristics of user groups, institutional arrangements, and external environment to determine the effectiveness and sustainability of collective marketing for smallholders. Cazuffi and Moradi (2012) found a net positive effect of group size on cooperative performance probably resulting from economies of scale.

However, the average impact of cooperative membership on members' performance seems to hide considerable heterogeneity between members. The World Bank (2007) expressed concerns about this trend, which was confirmed by Bernard *et al.* (2008) who found a positive and significant impact of cooperative membership on the degree of commercialization for large farms, yet a sometimes negative impact for some very small farms. Similarly, Verhofstadt and Maertens (2015) show that cooperative membership is more beneficial for larger farms and members in remote areas in Rwanda. Fisher and Qaim (2012) show that the effects of membership, in terms of commercialization, technology adoption and farm income, of banana cooperatives in Kenya are more noticeable for the smallest farms. Ito *et al.* (2012) conclude that the income effect of cooperative membership for watermelon farmers in China is twice as large for small farms than for larger farms. Abebaw and Haile (2013) assess the impact of cooperative membership on the likelihood of fertilizer adoption among farmers in Ethiopia and find that there is a significant positive effect for less educated farmers and an inverse U-shaped effect of distance to the market. Yet, none of these studies examined coffee cooperatives, despite the relevance of coffee for income generation and the mainly smallholder nature of its production.

Studying variance in treatment effects across cooperatives and members is useful in that it can help policy makers and researchers anticipate problems that could endanger the sustainability of cooperatives, and can also play an important role in improving program targeting. If only the top-performing farmers join a cooperative, the net benefit of membership could decrease if economies of scale are not increased significantly. The difference the cooperative makes for these top-performers would be small compared to when they would operate individually and the transaction costs involved in cooperating could be larger than benefits in economies of scale. On the other hand, attracting top-performers to join a cooperative which also has less successful or less qualified farmers as members, could increase the net impact, especially for those members who faced difficulties before joining the cooperative (Djebbari and Smith, 2008; Verhofstadt and Maertens, 2015; Xie *et al.,* 2012). In short, supporting cooperatives may contribute to uplifting some members out of poverty but the average effect could be larger for less-well performing farmers.

In this paper, we explore both the overall and the heterogeneous impact of membership of coffee cooperatives in Ethiopia. Our general hypothesis is that coffee farmers in south-west Ethiopia benefit from cooperative membership in terms of increasing income via improving the supply, the price they receive and the margins obtained (H_1). We assume that this impact will differ among the different socioeconomic groups of member households (H_2), and across cooperatives (H_3).

We collected data amongst coffee farmers in south-west Ethiopia and used propensity score matching to estimate the average treatment effect of cooperative membership. We analyzed how the estimated treatment effect differs with various household and farm characteristics. We find that in general cooperative membership does not have a significant impact on the selected performance indicators, including income, the volume of supply, the price and net margins. Nonetheless, significant differences on the estimated average treatment effects were observed between cooperatives and individual members. Older members, those who have better education and those who own large farms were found to benefit more. The result also indicated that different coffee cooperatives have different impacts on performance. Hence, although the average effect of cooperative membership is not significantly different from zero, this does not mean that cooperatives are ineffective: some are and some aren't and members of some cooperatives fair better than non-members, while some members fair better than others.

2. Background and data collection

Despite the tempestuous history of cooperatives under Ethiopia's socialist regime (1974-1991), the present government of the Federal Democratic Republic of Ethiopia (FDRE) has expressed renewed interest in collective action to improve smallholders' market involvement (Abate *et al.,* 2014; FDRE, 1994, 1998). This renewed interest in cooperatives was also inscribed in the Sustainable development and poverty reduction program (FDRE, 2002 cited in Abate *et al.,* 2014) as well as the Plan for accelerated and sustained development to end poverty (FDRE, 2005 cited in Abate *et al.,* 2014), in which cooperatives are central to the country's rural development strategy. Agricultural cooperatives are also recognized as privileged institutions by the recently established Agricultural transformation agency (Abate *et al.,* 2014). As a result, cooperatives are widespread throughout the country and a substantial number of public improvement programs and private initiatives are directed through them in an attempt to reduce the exorbitant transaction and coordination costs that individual farmers face (Pingali *et al.,* 2005).

In this study, we focused on coffee cooperatives from the Jimma and Kaffa zones of south-west Ethiopia (Supplementary Figure S1). Jimma is one of the twelve zones in the Oromia region which has about 2.5 million inhabitants, most (88%) of who are Oromo, and manly speak Oromiffa and Amharic. Muslim is the dominant religion in the region, followed by orthodox Christianity and Protestantism. At an altitude of around 1,700 m.a.s.l., and with average temperatures that range from 8 to 28 °C, coffee (Arabica) thrives in the region and is the most important crop in terms of contributing to peoples' livelihoods. Cereals, such as maize, and fruits, such as avocado and mango, are also widely produced in the region (personal communication, Jimma Zone Bureau of Agriculture 2012-2013). Kaffa is part of the Southern Region of Ethiopia and it contains a

population of about one million people. The primary language in the area is Kaffa and the major religion is orthodox Christianity (80%). Temperatures are around 18-21 °C and the altitude ranges from 500 m.a.s.l in the south to 3,000 m.a.s.l in the north and central highlands. Due to the favorable altitude and weather condition, much coffee (Arabica) is produced in the zone and provides the main source of income for farmers. Agricultural production, livestock rearing and collection of non-timber forest products are other important sources of livelihood in the zone (Personal communication, Kaffa Zone Bureau of Agriculture 2012-2013).

Coffee cooperatives in the region are multi-purpose. Other than marketing coffee, they also process coffee and are involved in the sale of other crops. They also provide inputs (e.g. improved coffee seedlings, improved seed and fertilizer for other crops, etc.) and consumables, such as sugar and oil. Member farmers also receive at least one training session a year and a dividend (between 2 and 4 birr/kg of coffee cold[1]) from their cooperative. Cooperatives are organized by Kebeles or Peasant Associations, with each cooperative named after its location. Our preliminary study estimated that there are sixty-three (eight certified and fifty-five uncertified) cooperatives in Jimma supplying coffee to the export market and twenty-seven (eighteen certified and nine uncertified) in Kaffa (personal communication, zonal cooperative agencies 2012-2013).

Data collected from a survey of coffee farm households in 2012-2013 have been used for this study. In the first stage, three weredas (districts) from each zone were purposively selected on the basis of coffee production and the concentration of cooperatives. In the second stage, two Kebeles from each wereda were purposively selected using accessibility and existence of a relatively equal proportion of members and non-members as criteria. In our context, inaccessible cooperatives are cooperatives which require three to four hour walk on foot to reach due to the absence of any type of road for vehicle. But in order to avoid biases, we considered cooperatives which have similar performance with those of the inaccessible ones in our sample selection procedure. In the third stage, the households were stratified on the basis of their membership status. A random selection of 132 members and 124 non-member coffee producing households (the control group) were made across from twelve cooperative Kebeles with the help of experts from the Bureau of Agriculture and development agents. Despite the relevance of stratifying the sample on gender basis for a better understanding on determinants of cooperative membership, it was impossible to consider it due to the limited number of female headed households in the area. Most of the cooperative women are wives in the male member headed households.

Respondents were interviewed by twelve trained enumerators using a structured questionnaire with different sections on household characteristics, farm characteristics, the volumes of coffee produced and supplied, prices received and costs incurred and cooperative membership. The household data were supplemented with information obtained from key informant interviews, focus group discussions with selected farmers and surveys among the twelve cooperatives (both certified and uncertified) that the sample of farmers belong to.

3. Analytical framework

A particular challenge in assessing the effect of cooperative membership on performance is the need for a counterfactual; a control group of farmers who are not members of a cooperative (Heckman *et al.,* 1997). We used the well-known propensity score matching (PSM) technique (Becker and Ichino, 2002; Dehejia and Wahba, 2002; Heckman *et al.,* 1997; Rosenbaum and Rubin, 1985) to test our general hypothesis that coffee cooperatives have a substantial impact in improving the income of their members through increasing supply, price received and margins obtained (H_1). In this technique the farmers in both treated and control samples are matched based on their observable characteristics. The impact is measured by the difference in performance between pairs of treated and control farmers. This allows us to partially control for non-random selection of cooperative members (Caliendo and Kopeinig, 2008; Imbens, 2004). Members are matched with non-members in order to search for differences in performance or the average treatment effect on the treated (ATT) in terms of supply volume, income levels, price received and margins obtained.

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[1] 10 birr = 0.45 USD, calculated on the basis of the exchange rate on October 11, 2016.

It should be noted that the PSM mimics the effects of a counterfactual and attempts to control for any bias caused by non-random selection. Yet it does not take into account any possible spillover effects of cooperative membership. In addition, members may side-sell some or all of their coffee outside the cooperatives (cf. Mujawamariya *et al.,* 2014) and this also cannot be captured by PSM.

As a first step the probability of being member of the cooperative was estimated as a function of observable pre-treatment covariates, using a logit model that included different sets of confounding variables that may explain the non-random distribution of cooperative membership among the population. Next, the predicted values of the logit model generated propensity scores for all treatment and control units. Mathematically, this is written as:

$$PS = Prob\ (Z=1|X) \tag{1}$$

Where the PS is the propensity score obtained through a logit regression of observable covariates on cooperative membership, Z is the probability of sample farmers being members of cooperatives and the variables considered in vector X (age, years of schooling, number of family members in the productive age range, land planted with coffee, off-farm income, risk of price volatility on coffee income, location). These variables were inspired by previous research (see next section).

The propensity scores were used to restrict the samples and ensure common support or overlap. The common support assumption requires balancing the covariate distribution between treated and untreated observations, so that treatment observations will have a comparable control observation close-by in the PS distribution. Once sufficient overlap is found, treated and control units with similar propensity scores are matched using the Kernel matching method and the ATT can be calculated.

The estimation of ATT is given by:

$$ATT = E[Y\ (1) - Y\ (0)\ |Z=1] = E[Y\ (1)\ |Z=1] - E[Y\ (0)\ |Z=1] \tag{2}$$

Where E[Y (1) |Z=1] is the mean value of the outcome variable in the treatment group, and E[Y (0) |Z=1] is the mean value of the outcome variable in the matched control group.

A good matching estimator does not eliminate too many of the original observations from the analysis and should still, at the same time, yield statistically equal covariate means for households in the treatment and control groups (Caliendo and Kopeinig, 2008). In this regard, the use of kernel matching is helpful since it uses more information to construct the counterfactual outcome by using a weighted average of all the individuals in the control group with weights that are inversely proportional to the propensity score distance between the treated and control units, which reduces variance (Caliendo and Kopeinig, 2008). As PSM results are sensitive to matching methods (Caliendo and Kopeinig, 2008; Imbens, 2004), neighborhood matching was estimated as a check for robustness. Bootstrap standard errors were used to test the statistical significance of the estimated ATT in order to account for the variation caused by the matching process. Finally, the balancing of the covariates was checked by testing that the means of each covariate between the treated and control groups did not differ after matching.

Next, the ATT was explored against the farms' characteristics to test whether there is impact difference among the different groups of member households (H_2). Inspired by similar work (Abebaw and Haile, 2013; Bernard *et al.,* 2008; Mutuc *et al.*, 2013; Verhofstadt and Maertens, 2015), the estimated ATT of each outcome variable was used as a dependent variable in a linear regression model to investigate how the cooperative effect may vary for different household and farm characteristics. Graphic assessment of the impact of heterogeneity was also made by plotting the ATT over the distribution of the propensity scores, household and farm characteristics are presented in Supplementary Figures S2 to S8. Finally, anova-post

hoc test was applied to investigate the prevalence of significant variation among cooperatives in impacting their member households (H_3).

The definition of variables used in the analytical framework

A number of variables are thought to influence membership of a coffee cooperative. These include household demographic characteristics, farm characteristics, income and some physical factors, such as distance to coffee collection points and geographic location. The matching of members and non-members was made on the basis of these observable characteristics in order to only point out the treatment effect on the outcome variables. Table 1 defines and quantifies the treatment, outcome and confounding variables.

Table 1. Definitions of variables and their measurement.[1]

Variables	Type	Definitions and measurements
Treatment variable		
cooperative membership	dummy	1 if member, 0 otherwise
Outcome variables		
income from agriculture (including coffee)	continuous	total income (in birr) obtained from the sale of all agricultural products including coffee in the 2012-2013 season
income from agriculture (excluding coffee)	continuous	total income (in birr) obtained from the sale of agricultural products excluding coffee in the 2012-2013 season
income from coffee	continuous	total income (in birr) obtained from the sale of both berries and dry coffee in the 2012-2013 season
total volume of supply	continuous	the amount of marketed berries and dry coffee (in kg) in the 2012/13 season
volume of berries supplied	continuous	the amount of marketed coffee berries (in kg) in the 2012-2013 season
price received	continuous	price (birr/kg) received from the sale of coffee berries in the 2012-2013 season
yield of berries	continuous	yield of berries (kg/hectare) produced in the 2012-2013 season
yield of dry coffee	continuous	yield of dry coffee (in kg) obtained from a hectare of berries in the 2012-2013 season
net margin	continuous	net margin (in birr/kg) obtained from sale of coffee berries in the 2012-2013 season
Confounding variables		
age	continuous	age of the household head in years
years of schooling	continuous	years of schooling of the household head
active household members	continuous	number of family members aged between 15 and 65 within a household
area of coffee land	continuous	area of farm land planted with coffee (hectares)
distance from the cooperative's coffee collection point	continuous	time (in hours) needed by the farmers to travel to reach their co-operative's coffee collection point (assuming travel on foot).
availability of off-farm income	dummy	1 if a household has an off-farm source of income, 0 otherwise.
risk 1 of effect of price volatility on coffee income	dummy	1 if 'high' and 0 otherwise
risk 2 of effect of price volatility on coffee income	dummy	1 if 'medium' and 0 otherwise
zonal location	dummy	1 if Jima, 0 if Kaffa
living in certified cooperative village	dummy	1if yes, 0 otherwise

[1] 10 birr = 0.45 USD, calculated on the basis of the exchange rate on October 11, 2016.

The choice of the explanatory variables set out in Table 1 is made on the basis of available empirical studies on the determinants of cooperative membership. In relation to the household characteristics, Bernard *et al.* (2008), Bernard and Spielman (2009) and Abebaw and Haile (2013) have shown that the age of the household head is positively correlated with the likelihood of cooperative membership. Bernard and Spielman (2009) and Verhofstadt and Maertens (2015) illustrate a positive relationship between education level and the probability of cooperative membership. They also have depicted a direct and significant relationship between the number of economically active household members and the likelihood of cooperative membership. In terms of farm characteristics, Bernard *et al.* (2008), Bernard and Spielman (2009), Fischer and Qaim (2012) and Abebaw and Haile (2013) have found a positive relationship between the size of landholding and cooperative membership. Landholding size also may influence being a member in our two study areas since some of the cooperatives set a minimum coffee land size (0.25 or 0.5 hectare) as a requirement for membership. The literature reports mixed results on the relation between market or road distance and cooperative membership. Fischer and Qaim (2012) and Abebaw and Haile (2013) showed a direct and significant link between cooperative membership and the distance to the nearest road, although Verhofstadt and Maertens (2015) found a significant negative effect of market distance on cooperative membership. In this study, we assume an inverse relation between the distance to the cooperative's coffee collection point and the probability of cooperative membership; as farmers who live nearby may potentially benefit more from the marketing services that the cooperative provides.

While Fischer and Qaim (2012) and Abebaw and Haile (2013) show a positive relation between off-farm income and cooperative membership, we assumed the opposite relation in this case study since having diverse sources of income makes farmers less vulnerable to poverty and potentially less likely to engage in collective action to safeguard their income from coffee.

Jena *et al.* (2012), Mujawamariya *et al.* (2013) and Abate *et al.* (2014) mention that cooperatives are viewed as a safety net that protect their member farmers from low and fluctuating prices in the mainstream market. Hence, we assumed that feeling at risk of coffee price volatility would be an incentive for farmers to become members of a cooperative. Finally, zonal and certified village dummy variables were introduced to capture other institutional, market and socio-economic heterogeneities between the sample zones and villages that might otherwise remain unobserved.

4. Descriptive results

Supplementary Table S1 gives an overview of the main characteristics of the cooperatives from which we drew our sample. Coffee is the main cash crop sold by the cooperatives. There are also other crops channeled via these cooperatives such as maize and fruits. The cooperatives were all established between 1976 and 1982. Most are certified to sell Fair Trade and organic coffee, a few not. The size of the membership varied greatly. In general the registration fees were low and the value paid in shares was reasonable. Table 2 compares the observable characteristics of households that were cooperative members and those that were not.

Household heads who were members of cooperatives were on average older than non-members. Members, on average, had more land planted with coffee than non-members. Meier zu Selhausen (2016) also found out that female members owned more than the non-members in his study of determinants of women cooperative participation in Uganda. Certified villages had a higher proportion of cooperative members.

In terms of the selected outcome performance variables, a substantially higher volume of supply and income from agriculture (with or without coffee) was noticed among member farmers than non-members, although there was no significant difference between members and non-members in terms of income from coffee, yield, the price received and margins obtained. However, these results cannot be used to draw inferences about the impact of coffee cooperatives on the performance of member farmers since other confounding factors would need to be controlled for.

Table 2. Comparison of the characteristics of cooperative members and non-members from survey data 2012-2013.[1]

	Members		Non-members		t-values[2]	P-values
	mean	std. dev.	mean	std. dev.		
age	47.56	9.69	40.37	8.74	6.22***	0.00
number of years of schooling	5.34	2.55	4.95	2.39	1.26	0.21
family members in the productive age range (15<age<65)	4.28	1.92	4.01	1.85	1.15	0.25
amount of land planted with coffee (ha)	1.33	0.94	0.72	0.55	6.27***	0.00
distance to coffee collection point of the cooperative (hours)	0.35	0.26	0.33	0.26	0.80	0.43
availability of off-farm income (1=yes)	0.09	0.29	0.10	0.31	-0.37	0.71
risk of price volatility on coffee income (scale from 1=low to 3=high)	1.90	0.66	2.05	0.77	-1.63	0.10
zonal location (1=Jima)	0.58	0.50	0.56	0.50	0.18	0.86
living in certified village (1=yes)	0.78	0.42	0.69	0.47	1.72*	0.09
income (birr)						
from agriculture including coffee	34,994	17,765.98	29,626.57	15,837.82	2.546**	0.011
from agriculture excluding coffee	11,307.77	94,35.69	8,504.44	10,133.87	2.29**	0.023
from coffee berries and dry coffee	23,686.29	14,556.20	21,293.85	13,821.73	1.34	0.18
volume supplied (kg)						
berries and dry coffee	961.03	801.91	639.32	660.09	3.09***	0.00
berries only	775.96	711.11	494.38	548.24	3.53***	0.00
price received for berries (birr/kg)	9.36	1.02	9.19	1.28	1.16	0.25
yield (kg/ha)						
of berries	1,330.96	1,028.90	1,420.42	827.34	-0.76	0.45
of dry coffee	443.65	342.97	470.86	278.64	-0.69	0.49
net margin on berries (birr/kg)	8.25	1.04	8.05	1.08	1.52	0.13

[1] 10 birr = 0.45 USD, calculated on the basis of the exchange rate on October 11, 2016.

[2] ***, ** and * denote significance at 0.01, 0.05 and 0.1 levels, respectively.

5. Econometric results

The econometric results are presented in the following three subsections. The first subsection provides the results of the estimation of the propensity scores and the probability of cooperative membership. The second sub-section presents the results of the PSM on the impact of cooperative membership on the selected performance indicators. Finally, a third sub-section discusses the heterogeneous treatment effect of cooperative membership on the performance indicators with cooperatives and among farm households.

Estimation of propensity scores and the probability of cooperative membership

We used a logit model to estimate the propensity scores and the probability of cooperative membership. A substantial number of covariates in the model showed the expected associations (Table 3).

The mean value of the estimated propensity scores for the whole sample was 0.5156, with minimum and maximum values of 0.0138 and 0.9899 respectively. The propensity scores of the control group were between 0.0138 and 0.9618 with a mean score of 0.3425 while for the treated group these figures ranged from between 0.0713 and 0.9899 with a mean score of 0.6783. Hence, the region of common support for the distribution of the estimated propensity scores of the control (non-member) and treated (member) groups ranged between

Table 3. Results of estimates of the probability of cooperative membership (logit model) survey data 2012-2013.

Variables	Marginal effect (d_y/d_x)[1]	Standard error
age (years)	0.06[*]	0.03
age squared	0.00	0.00
schooling (years)	0.03	0.06
schooling squared	0.00	0.01
active hh members	0.01	0.03
land planted with coffee (ha)	0.49[***]	0.17
land planted with coffee squared	-0.05	0.05
distance to coffee collection point (hours)	-0.28[*]	0.16
off-farm income[2] (1=yes)	-0.18	0.14
risk of price volatility[2] (1=high)	0.30[***]	0.10
risk of price volatility[2] (1=medium)	0.01	0.10
zonal location[2] (1=jima)	0.19[**]	0.09
living in certified village[2](1=yes)	0.06	0.09
pseudo r-square	0.27	
lr ch2 (13)	96.29[***]	
prob>χ^2	0.00	
% predicted correctly	52.55	
n	256	

[1] [***], [**] and [*] denote significance at 0.01, 0.05 and 0.1 levels, respectively.

[2] Marginal effects are calculated for a discrete change of dummy variable from 0 to 1.

0.0713 and 0.9618; this accounts for 127 members and 124 non-members with only 5 members outside this range. The propensity scores in the common support region were used to estimate the ATT.

The estimation results (Table 3) revealed that cooperative membership was directly correlated with some household, farm and risk-related characteristics. Older household heads were more likely to be members of cooperatives. Households further away from the cooperatives' coffee collection points were less likely to be members. The estimated marginal effect indicated that, for each additional hour of travel to the coffee collection point, the likelihood of belonging to a cooperative decreased by 28%. In addition having more land planted to coffee was positively and significantly correlated with the probability of being a cooperative member. For each hectare of coffee cultivated the likelihood of being a cooperative member increased by 49%. This result is contrary to the findings of Verhofstadt and Maertens (2015) who found that limited access to land was one of the determining factors for land-poor households participating in cooperatives in Rwanda. It is however in line with the findings of Abebaw and Haile (2013).

Respondents who said that they felt a high risk effect of price volatility on their income from coffee were also more likely to be cooperative members. This suggests that members see cooperatives as providing a safety net against price risks. Our results also suggested a positive and significant geographical influence on the probability of cooperative membership, with membership levels being higher in Jimma. Other variables, such as years of schooling, family size in the productive age group, availability of off-farm income and living in certified village did not have any significant impact on the likelihood of cooperative membership.

The overall treatment effects of membership in coffee cooperatives

The ATT was computed, using the kernel matching technique, in order to assess the impact of cooperative membership on the selected performance indicators: total income, income from coffee, agricultural income without coffee, total coffee supply, yields of berries and dry coffee, prices received and net margins obtained.

We also employed neighborhood matching to check the robustness of the PSM estimates obtained from the kernel matching. Both matching methods showed that cooperative membership did not have a significant impact on any of the performance indicators (Table 4).

Balancing the covariates

In order to fulfill the balancing requirements of PSM, a balancing test was used to verify whether all the observed covariates were similar between members and non-members after matching (Supplementary Table S2). The results depict that the unmatched samples showed a systematic difference between members and non-members in terms of a number of observed characteristics: age, size of coffee land, number of family members in the productive age range and risk perception of price volatility. After the kernel based and nearest neighbor matching, there was no systematic difference in the observed characteristics of members and non-members, as depicted by the insignificant t-statistics for both sets of results. The percentage bias values of the covariates are all below 20% after matching, suggesting that the differences after both matching procedures were not significant. Only one variable has a percentage bias value that is slightly above twenty, which is tolerable in the PSM balancing.

In relation to unobservable and hidden biases, we assumed that a positive and significant average treatment effect might partially result from member households having relatively better unobservable characteristics (for example talent, entrepreneurship or risk preference), as opposed to their solely being a result of the effect of cooperatives. In such cases, sensitivity analysis can be used to assess whether the ATT is overestimated as a result of those unobservable characteristics. Since our results indicated that cooperative membership had an insignificant impact on selected performance indicators it was not meaningful to do a sensitivity analysis since the insignificant impact of cooperative membership also reveals an absence of any hidden biases between members and non-members that would suggest that cooperative membership has a positive and significant impact (Faltermeier and Abdulai, 2009, cited in Abebaw and Haile, 2013; Hujer *et al.,* 2004).

Table 4. Estimates of the average treatment effect on the treated (ATT) from survey data 2012-2013.[1,2,3]

Outcome variables	Kernel matching				NN matching (5 neighbors)			
	ATT coef.	BSE	z-value	*P*-value	ATT coef.	BSE	z-value	*P*-value
volume of total coffee berries and dry coffee supplied (kg)	-180.64	202.90	-0.89	0.37	-100.08	183.80	-0.54	0.59
Ln (total income from coffee)	-0.27	0.16	-1.71	0.09	-0.22	0.17	-1.27	0.20
Ln (total income from agriculture including coffee)	-0.03	0.14	-0.18	0.86	0.03	0.18	0.14	0.88
Ln (total income from agriculture other than coffee)	0.30	0.23	1.31	0.19	0.35	0.24	1.44	0.15
volume berries supplied (kg)	-38.97	163.91	-0.24	0.81	32.38	159.32	0.20	0.84
price berries (birr/kg)	-0.22	0.20	-1.12	0.26	-0.19	0.20	-0.98	0.33
yield of berries (kg/ha)	-49.59	164.07	-0.30	0.76	-28.88	161.49	-0.18	0.86
yield of dry coffee (kg/ha)	-16.53	55.19	-0.30	0.76	-9.63	48.84	-0.20	0.84
net margin for berries (birr/kg)	-0.37	0.37	-0.98	0.33	-0.37	0.42	-0.90	0.37

[1] Estimates of the matching were obtained using 'psmatch 2' command (Leuven and Sianesi, 2003) in Stata (StataCorp LP, College Station, TX, USA).

[2] BSE = bootstrap standard error; these values are calculated with number of replications of 100.

[3] 10 birr = 0.45 USD, calculated on the basis of the exchange rate on October 11, 2016.

The heterogeneous treatment effect between cooperatives

The average ATT of performance indicators across cooperatives is given in Supplementary Table S3. It is rather tricky to interpret these figures, yet the main point is that the means of the ATT of members across cooperatives were different. The samples for each individual cooperative in this study were too small to have separate propensity score matches; hence it is not possible to verify if, for each of the cooperatives, the mean ATT reported is statistically significantly different from zero. Yet, the means do give an indication of the heterogeneity between cooperatives.

The cooperatives in Supplementary Table S3 are arranged along a scale of the mean ATT on agricultural income. Cooperatives, such as Wodiyo, Dirri and Emicho, which performed best on this criterion also performed better on volumes and prices for berries, but not on net margins. It is difficult to explain why these cooperatives perform well on these criteria. The cooperatives are presented in the same order as in Supplementary Table S1, in which we list their basic characteristics. The top three cooperatives have several features in common: they are located in Kaffa, they were certified, and were amongst the smallest in terms of membership. However, location may not mean that all members in Kaffa will be better off (see also next section). Two other cooperatives in Kaffa were amongst the poorest performers.

The heterogeneous treatment impact of cooperative membership

The estimated ATT value of all the outcome variables assumes that the impact of cooperative membership is homogenous among all members. However, average treatment effects can also hide considerable heterogeneity of this impact between member farmers (Abebaw *et al.*, 2010; Abebaw and Haile, 2013; Ali and Abdulai, 2010; Bernard *et al.,* 2008; Cunguara and Darnhofer, 2011). We refined our analysis to try to assess the heterogeneity of the impact of cooperative membership across households. To this end, ordinary least square regressions were estimated to express the relation of some of the household and farm characteristics of member farmers with the estimated ATT values of all the outcome variables considered (see Supplementary Table S4). This approach has been used before (e.g. Abebaw and Haile, 2013; Verhofstadt and Maertens, 2015) for estimating heterogeneous impacts. A visual inspection of the heterogeneous impact was made by plotting the ATT values and the covariates (Supplementary Figures S2-S8).

Our results corroborate those of other papers (Abebaw and Haile 2013; Bernard *et al.,* 2008; Verhofstadt and Maertens, 2015) and demonstrate that not all members benefited equally from membership of a cooperative. Significant heterogeneities were observed that were related to the demographic, farm and the physical characteristics of member households (Supplementary Table S4).

Heterogeneity in demographic characteristics

The results show a positive and significant impact of cooperatives for relatively older member farmers in all of the performance criteria considered. For farmers who have enjoyed more education, membership seemed to have a larger impact on the total volume of coffee supplied and income from agriculture and coffee. These findings imply that cooperatives were less effective in improving performance for younger and less literate members. Yet, the effectiveness of cooperatives for old members can also be attributed to the lower likelihood of young farmers becoming members of cooperatives (Table 3). Despite the insignificant impact of education on the membership of coffee cooperatives (Table 3), the results suggest that incentives provided by cooperatives were largely utilized by the more knowledgeable member farmers.

Heterogeneity in the size of coffee land owned

A positive and significant impact of cooperative membership on income from agriculture and coffee, volume of supply, price received and yield was observed for members with large farms, implying that the cooperatives are less effective for smaller scale farmers. Cooperatives contribute to economies of scale in

inputs, market access and a reduction in transaction costs and large farms that use more inputs and supply more coffee to the market can clearly benefit more. This result is similar to the findings of Verhofstadt and Maertens (2015) but contradicts the findings of Ito *et al.* (2012) and Fischer and Qaim (2012) who showed that cooperatives have a positive impact on small farms. Part of the result may be explained by that fact that land size is positively correlated with cooperative membership (Table 3). This may be the result of some cooperatives imposing physical capital constraints on membership, excluding the smaller-scale farmers from reaping the benefits of cooperative membership.

Heterogeneity in market access and location

Distance to the coffee collection point was positively associated with the ATT on the amount of coffee supplied. This could be related to the cooperative's marketing activities which can induce supply by reducing transaction costs, which are higher for more distant farms. Interestingly, farmers in distant places are less likely to join cooperatives (Table 3), although the potential benefits for them are large. Verhofstadt and Maertens (2015) found a similar positive relationship between market distance and the effectiveness of the cooperative, while Abebaw and Haile (2013) reported that market distance was negatively associated with the adoption of agricultural technologies (fertilizers) by member farmers. The impact of cooperatives on coffee income, volume of supply, and margins obtained was higher for member farmers living in Jimma than those in Kaffa. This can be traced to the better infrastructural facilities and services in Jimma which give easier access to markets, increases information sharing and also contribute to the higher probability of farmers in Jimma being cooperative members (Table 3).

5. Discussion

Contrary to our hypothesis, cooperatives in the case study areas did not bring clear economic leverage to all smallholder members. Overall the impacts of cooperative membership on the performance of coffee farm households in the areas were insignificant although there were considerable differences between cooperatives and individual members. We identify three important institutional factors to explain why coffee cooperative membership overall has an insignificant impact.

First, cooperatives in south-west Ethiopia are heavily financially constrained from purchasing coffee from their members. Most of the cooperatives (especially in Jimma) are in huge debt and have already lost trust from banks for borrowing money. Even when cooperative banks were established for the purpose of providing credit or loans to cooperatives, the service was not effective – due to a range of different administrative and technical factors. Thus, the cooperatives are forced to get loans through the unions to which these cooperatives belong; the unions borrow money from the banks and transfer it to their member cooperatives. However, the money obtained through the unions is not always delivered on time and is insufficient to purchase all the coffee from member farmers at prices that are competitive with traders who pay cash immediately. Consequently, cooperatives are not able to offer a significantly better price for coffee to their members than that received by non-members working in the conventional spot market. In addition to the price issue, cooperatives are also heavily constrained by the ways they make payment. Traders in the mainstream independent market make full payment to producers immediately upon purchase, whereas with the cooperatives there are payment lags until all outstanding debts and costs are settled. Coupled with the price problem, such payment delays inevitably impairs the ability of cooperatives to make coffee a more lucrative business for more marginal producers or to transform the power asymmetry in the mainstream/conventional market.

Financial constraints also mean that the cooperatives are not in a position to provide credit to their members. Government sponsored micro-finance schemes are the only financial institutions that provide credit services to producers in the study areas. However, they are not able to provide these services to all the producers who need them. As a result, a significant number of member farmers (more than 50%) are forced to have an interlocked contractual agreement with traders in which they take money in the form of loans with a promise to supply an equivalent amount of coffee to settle the debt at harvest time. In these contracts, the prices are

set by the traders at the time of delivering the loan with no possibility of improvement even if there is an increase in price at the time of harvest/supply. The study by Mujawamariya *et al.* (2013) also confirmed the need for credit as one main reason for cooperative farmers to side sell significant proportion of their coffee to traders in the mainstream market.

Efforts should therefore be exerted to make the cooperative banks work in line with the credit requirements of the cooperatives. There should also be a mechanism for engaging individual cooperatives with other banks and introduce the uses of revolving funds. This can build the trust that the cooperatives have lost with the banks and eliminate the current inefficient practice of getting loan from banks through the union. The study by Pitt *et al.* (2006) also emphasized the relevance of establishing a smooth working relation between cooperatives and banks which could enable cooperatives to get bank loan with a relatively low interest rate and longer repayment period. Cooperatives should also be encouraged to establish a credit and saving unit in their internal structure which motivates member farmers to save and then deliver them the loan when the need arises.

Second, provision of training and extension services by cooperatives help member farmers get the required knowledge and technical skill to improve their production/productivity and hence income. For example, the study by Meier zu Selhausen (2016) found out that previous trainings and extension services affect production and women's choice to market their coffee through the cooperatives. Nonetheless coffee cooperatives in the study area are not in a position to provide sufficient training and technical advice to their members. Due to the limited number of experts and low commitment of the cooperative management, trainings are organized only once a year in collaboration with the district bureau of agriculture. As a result, the yield and the possible income benefit that cooperatives should have realized from the use of improved techniques of production could not be achieved at the required level.

Third, the cooperative leaders lack managerial competencies. Almost all the cooperatives in the region are led by illiterate farmers who have no knowledge and skill in modern organizational management. Some 36% of respondents gave their cooperative leadership a low credibility, highlighting an absence of transparency and accountability on the management of some cooperatives in the region.

Even if cooperatives are not in a position to deliver direct significant economic benefit to their members, it is imperative to remember the indirect economic impact that cooperatives bring to their members via improving the working of markets and competition. The fierce price competition between cooperatives and traders wishing to purchase coffee from farmers leads private traders to adjust their price to what the cooperatives offer and this in turn means producers get a better price for their product (this is known as the competitive yardstick effect). Coffee cooperatives are therefore used as a safety-net by member farmers against being exploited by traders in the region despite them having an insignificant direct impact in improving incomes. The study by Chagwiza *et al.* (2016) and Mujawamariya *et al.* (2013) mentioned the importance of cooperatives for inducing a general higher price at the local level and pointed out their safety-net role for their members.

6. Conclusions

Despite the turbulent history of cooperatives mainly associated with the highly centralized governance of Ethiopia's socialist regime of 1974-1991, the present government of FDRE has expressed renewed interest in collective action to promote greater market participation by smallholders. In this paper we explored if cooperative membership does really impact on farmers' performance. Using a matching technique on household income, yield, volume of supply, price received and margins obtained as indicator variables, we evaluated the overall and heterogeneous impact of coffee cooperatives on performance of member farm households in south-west Ethiopia.

Our results suggest that coffee cooperative membership does not have a significant overall impact on the performance of member farm households in any of the selected performance indicators. Yet, these average

values hide considerable heterogeneity across member households. An analysis of the heterogeneity of these treatment effects showed that the impact levels differed across cooperatives and that cooperatives were more effective for member households whose household head is relatively older, educated and with a larger coffee farm.

From a policy perspective, our findings stress the need to design strategies to improve the functioning of cooperatives through developing their financial power, and the competency of the members and management personnel, in order to promote the development of the coffee sector. The fact that cooperative membership and effectiveness are positively correlated with age and size of land under coffee suggests that cooperatives should avoid placing entry barriers based on human and physical capital and should be more welcoming to young and small-scale farmers, encouraging their membership and helping them become more effective. Our findings on the negative selection of the estimated income and supply effects of cooperative membership with distance to the cooperatives' coffee collection point implies the possibility of expanding membership and calls for continued promotion of cooperatives in more distant places. The higher probability of cooperative membership and effectiveness in the Jimma area also shows the need for a concerted effort to empower and promote cooperatives in the Kaffa area in order that they can attract more members and improve their efficacy. As cooperatives are relevant institutions to safeguard producers from the adverse effect of market liberalization, empowering them financially through the provision of credit and helping them organize themselves in a business/entrepreneurial principle is vital for leveraging their competitive power in the market and improve their contribution to the income of member households. Our results demonstrate the relevance of looking beyond overall treatment outcome, examining heterogeneous effects and assessing the impact of institutional innovation in the agricultural sector. We realize that the issue of gender is pertinent when dealing with coffee production and marketing though we couldn't handle it due to the limited number of female headed households in the area. We therefore suggest future studies to give more focus on gender disaggregated impact assessment of cooperative membership. Finally, we would like to notify that our findings are not necessarily applicable to other coffee cooperatives in Ethiopia or elsewhere in Africa since the samples are relatively small and taken from specific localities.

Supplementary material

Supplementary material can be found online at https://doi.org/10.22434/IFAMR2015.0110.

Table S1. Overview of cooperative characteristics.
Table S2. Results of balancing tests.
Table S3. Mean (+ standard deviation) of the average treatment effect on the treated of selected variables by cooperative.
Table S4. Heterogeneous impact of cooperative membership on income, volume of supply, yield, price received and margins obtained from survey data 2012-2013.
Figure S1. IMap showing the location of the study sites (Jima and Kaffa).
Figure S2. Heterogeneity of the average treatment effect on the treated (ATT) of income from agriculture including coffee over different covariates.
Figure S3. Heterogeneity of ATT of income from coffee over different covariates.
Figure S4. Heterogeneity of ATT of total volume of supply of cherries and dry coffee over the different covariates.
Figure S5. Heterogeneity of ATT of volume of supply of cherries over the different covariates.
Figure S6. Heterogeneity of ATT of yield over different covariates.
Figure S7. Heterogeneity of ATT of price over different covariates.
Figure S8. Heterogeneity of ATT of net margin over different covariates.

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