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# Impact of cooperatives on smallholders' commercialization behavior: evidence from Ethiopia

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**Abstract**

This article examines the impact of marketing cooperatives on smallholder commercialization of cereals using detailed household data in rural Ethiopia. We use the strong government role in promoting the establishment of cooperatives to justify the use of propensity score matching to compare households that are cooperative members to similar households in comparable areas without cooperatives. The analysis reveals that although cooperatives obtain higher prices for their members, they are not associated with a significant increase in the overall share of cereal production sold commercially by their members. However, these average results hide considerable heterogeneity across households. In particular, we find that smaller farmers tend to reduce their marketed output as a result of higher prices, whereas the opposite is true for larger farmers.

*JEL classification:* O12, Q13

*Keywords:* Propensity score matching; Program evaluation; Market participation; Cooperatives

## 1. Introduction

It is increasingly recognized that the commercialization of output from small-scale farming is closely linked to higher productivity, greater specialization, and higher income (see Barrett, 2008, for a recent review). Furthermore, in a world of efficient markets, commercialization leads to the separation of household production decisions from consumption decisions, supporting food diversity and overall stability. At the macro level, commercialization increases food security and, more generally, improves allocative efficiency (Fafchamps, 2005; Timmer, 1997).

However, in the face of imperfect markets and high transaction costs, smallholders are rarely able to exploit all the potential gains from commercialization (de Janvry et al., 1991; Goetz, 1992; Key et al., 2000). In the absence of mechanisms to cope with these constraints, smallholders are less likely to participate in markets, or when they do, to realize the full benefits of participation. These challenges are particularly important in sub-Saharan Africa, where empirical evidence suggest that the proportion of farmers engaged in subsistence agriculture remains very high, and where those who participate in markets often do so only at the margins (Barrett, 2008; Jayne et al., 2006).

In a related development over the past decade, donors and governments have revived their interest in collective action mechanisms, including cooperatives, to overcome smallholders' marketing constraints (e.g., Berdegué, 2001; Collion and Rondot, 1998; World Bank, 2003), although the empirical record suggests varying levels of success (e.g., Attwood and Baviskar, 1987; Bernard et al., 2007; Chirwa et al., 2005; Damiani, 2000; Neven et al., 2005; Sharma and Gulati, 2003; Tendler, 1983; Uphoff, 1993).[1] This growing experience reveals external and internal conditions under which these organizations may be more or less effective at serving their members. Less studied however, is the effective impact of collective action on members' commercialization, as compared to their likely level had they not been members. One reason is the inherent challenge of addressing selection biases in both the location and the membership of these organizations.

This article is an attempt to address this challenge in the context of Ethiopia where smallholders represent the vast majority

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[1] See also the several case studies presented at a recent workshop on "Collective Action and Market Access for Smallholders" organized by the CGIAR system-wide program on collective action and property rights (CAPRi) at: http://www.capri.cgiar.org/wks_marketrel.asp.


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of farmers,[2] and where commercialization is very limited.[3] A pillar of the country's recent rural development strategy has been the active promotion of marketing cooperatives as a means of commercializing smallholder agriculture. Accordingly, it is envisaged that most farmers will have access to a cooperative by 2010, through which 60% of the marketable surplus will be commercialized, from 10% in 2005 (Federal Cooperative Agency, 2005).

We deploy propensity score matching techniques to appropriately identify the effect of cooperatives on the behavior and welfare of their members. We use the strong promotion of cooperatives by the government, to assume that the decision of where to establish a cooperative is exogenous to members themselves. If this is true, we can then compare households living in *kebeles*[4] with access to a cooperative to *similar* households living in comparable *kebeles* without access to a cooperative. At the time of our survey, the extent of coverage was less than 35% of all *kebele*s, and can thus be viewed as an interim stage in the long-term government target.

To be valid, however, our identification strategy requires significant reduction in our sample size. In particular, we limit ourselves to the cooperatives that were created with the help of an external partner(s) so as to ensure that the *location* of cooperatives is indeed exogenous to members' characteristics. We further reduce the sample by only considering the administrative regions for which a sufficient number of *kebeles* with and *kebeles* without cooperatives were available. This sample reduction comes at a cost in terms of the representativeness of the results at the national level. Nevertheless, we show that this reduction does not qualitatively change the results by comparing the arguably unbiased estimates to less robust but more representative ones.

Our results indicate that although cooperatives obtain higher price per unit of output for their members, the average cooperative member does not tend to sell more of his/her output to the market. These averages however hide considerable differences across members. We further refine the analysis by investigating the heterogeneity of cooperatives' impact, and find that poorer households tend to sell *less* of their product when facing a *higher price* obtained as a result of their membership, whereas larger farmers tend to behave conversely.

The remainder of this article is organized as follows. Section 2 presents the institutional background linked to the recent development of smallholders' marketing cooperatives in Ethiopia. Section 3 develops the empirical strategy adopted in the article. The data and the effective *kebele*-level and household-level matching procedures are detailed in Section 4. Results on the average impact are presented and discussed in Section 5, along with a number of robustness and representativeness checks. In Section 6, we further refine the analysis by investigating heterogeneous impact of cooperatives on smallholders' behavior and link the results to the predictions of a simple household model. Section 7 concludes with a set of policy recommendations.

## 2. Cooperatives in Ethiopia—recent developments

Cooperatives have a long and tumultuous history in Ethiopia starting from the Imperial era (1930–1974) and continuing through the military or Derg regime (1974–1991). The largely negative experiences with cooperatives led to their dissolution following the fall of the Derg,[5] until 1994 when the Government of the Federal Democratic Republic of Ethiopia (FDRE) expressed renewed interest in collective action to promote greater market participation by smallholders (FDRE: Proclamations 85/1994 and 147/1998). This was later reaffirmed in the Sustainable Development and Poverty Reduction Program (FDRE, 2002) and the Plan for Accelerated and Sustained Development to End Poverty (FDRE, 2005), in which cooperatives are given a central role in the country's rural development strategy.

In 2002, the Federal Cooperative Agency of Ethiopia was created to organize and promote cooperatives at the national level. Its ambitious strategic plan aims at providing cooperative services to 70% of the rural population by 2010, increasing the share of the cooperative input marketing up to 90%, and increasing the share of cooperative output marketing to 60% (from estimated 10% in 2005). This is expected to be achieved through the establishment of primary cooperatives in each *kebele*, and bolstered by the establishment of 500 new cooperative unions (100 exist at present), six cooperative federations, and a cooperative league (Federal Cooperative Agency of Ethiopia, 2005).

Despite a rapid growth, cooperative expansion remains incomplete. As of 2005, nearly 65% of the *kebeles* still do not have such an organization. When they do, participation rates are low, as, on average, only 17% of households living in *kebeles* with a cooperative are members. Importantly, cooperatives tend to be located in areas with relatively good market access, within which their members stand above average in terms of landholding and education level (Bernard et al., 2007).

## 3. Empirical strategy

Our empirical strategy aims to overcome three potential sources of biases. First, as mentioned above, participants tend

[2] Thirty-seven percent of the farming households cultivate less than 0.5 hectares and 87% less than 2 hectares (CSA, 2003).

[3] Estimates are that 28% of the total agricultural output is commercialized (Dessalegn et al., 1998). Data from the most comprehensive agricultural survey to date also indicate that only about 30% of grain production of smallholders is marketed (CSA, 2003). More recent estimates suggest that among all teff producers, only 38% sell part or all of their production. Similar estimates for the other cereals indicate even lower market participation rates (Alemu et al., 2006).

[4] In Ethiopia, *kebeles* or peasant associations are the smallest administrative unit below the *woreda* (district) level. For purposes of comparison, *kebeles* correspond to villages in other countries.

[5] A lot of cooperatives were already dissolved as a consequence of the tentative economic reform steps taken by the Derg in 1990.

to significantly differ from nonparticipants in a number of community and household-level observable characteristics that may have a direct effect on commercialization (such as a community's remoteness or a household's physical and human capital). As a result, part of the observed differences between members and nonmembers may, either totally or partially, reflect original differences between them, instead of the effects of the cooperative per se.

Second, such selection bias may also result from unobservable community or household characteristics. At the cooperative level for instance, it may be the case that the existence of the organization is in part driven by particularly dynamic local leaders. At the member level, a household's risk preference, its entrepreneurial spirit, or its relationship to other cooperative members may also be at play. Such biases are most often accounted for using an instrumental variables approach. However, instrumental variable methods are of limited help when the *treatment* of an observation may significantly affect the outcome of other nontreated observations through externalities or spillover effects.

Such may be the case here where a third source of bias may come from the likely externalities exerted by cooperatives on the commercialization capacities and/or choices of nonmembers. For instance, cooperatives may significantly affect the price offered by local traders to noncooperative members. This effect is likely to be enhanced by the often open-membership policy of cooperatives, and the usually low membership fees, such that participating in a cooperative is very often an open option for nonmembers.

To minimize these biases, we employ matching techniques extensively used in the recent economic evaluation literature (Jalan and Ravallion, 2003a). Applications of these techniques relevant for the present case include, for instance, impact assessments of farmers field schools (Gotland et al., 2004), community driven development (Rao and Ibanez, 2003), pipe water (Jalan and Ravallion, 2003b), and road rehabilitation (Van de Walle and Cratty, 2002). Specifically, our approach involves a two-step matching estimator, whereby *kebeles* with cooperatives are first matched to "similar" *kebeles* without cooperatives on the basis of marketing-relevant characteristics such as remoteness, agricultural potential, and population density. In a second step, we match cooperative members to "similar" households living in *kebeles* without cooperatives. The matching is based on a unique variable, the propensity score, defined as the probability that a given household would participate in a cooperative, given a set of observable characteristics.[6]

Overall, controlling for the households' observable characteristics minimizes the incidence of the first bias described above. Furthermore, because our strategy compares cooperatives members to similar households but living in other *kebeles*, it is likely that the incidence of the third bias is also limited. We are therefore left with the second source of bias, namely, the effect of nonobservable characteristics determining both the presence of cooperatives in particular *kebeles*, and the households' decision to participate.

In Ethiopia, however, most cooperatives were initiated under the influence of an external partner: 63% were created by government institutions, 11% by donor agency or NGOs, and only 26% by members themselves. Dropping from our sample those *kebeles* in which cooperatives were member created, we assume that the establishment of cooperatives is exogenous to communities' unobservable characteristics as well as to that of their members. Indeed, it was clear from several discussions with *woreda*-level cooperative promotion officers that encouragement for the creation of cooperatives mostly follows a top-down approach. In other words, *kebeles* with cooperatives created by government institutions do not self-select but are rather externally selected by the cooperative promotion agents. It was also clear from discussions with the agents from the Federal Cooperative Agency that no clear directions were given to *woreda*-level offices as to how to select *kebeles* to be targeted first. Overall, controlling for relevant observable characteristics appears sufficient to ensure comparability of *kebeles* with and *kebeles* without cooperatives.

Furthermore, because in such sample the existence of a cooperative is assumed independent of its members' characteristics, there is no *a priori* reason to believe that the distribution of household-level unobservable characteristics systematically differs across *kebeles* that share similar observable characteristics. It follows that differences in unobservable characteristics between cooperative members and households with similar propensity score (but living in *kebeles* without cooperatives) are considered here as random and will not bias the estimator.[7]

Finally, to further ensure the validity of such an approach, one must verify that treatment and comparison households are operating on the same markets (Heckman et al., 1998). In the present case however, this requirement has to be tempered by the need to minimize spillover effects from *kebeles* with cooperatives to those without. We address this double requirement by arguing that: (i) our matching procedure ensures that sample *kebeles* are sufficiently similar by accounting for important determinants of price such as remoteness, agro-ecological potential, and population density; (ii) cooperatives may generate spillover effects that are particularly strong at local market level. By ensuring that treatment and comparison *kebeles* are linked to different local markets, we ensure that the likelihood of spillover effects is minimized; and (iii) an extensive literature has shown the important increase in grain-markets integration in Ethiopia (Dercon, 1995; Jayne et al., 1998; Negassa, 1998; Negassa and Myers, 2007; World Bank, 2006) and, in particular, in the three regions considered in our final sample (Rashid et al., 2007). This grain-market integration ensures that treatment and comparison *kebeles* are indeed exposed to similar market conditions, although the operation of cooperatives is unlikely to

[6] Rosenbaum and Rubin (1983) show that households with similar propensity scores also have similar distributions of covariates.

[7] The greater the number of *kebeles* considered, the more this assumption is likely to hold.

significantly affect regional prices (recall that total output commercialized by cooperatives is 10% of total marketed outputs).

## 4. Data and matching

We apply the above-described empirical strategy using a new dataset specifically collected to investigate the commercialization behavior of Ethiopian smallholders. The Ethiopian Smallholders Commercialization Survey was jointly designed by the International Food Policy Research Institute, the Ethiopian Development Research Institute, and the Central Statistical Agency of Ethiopia, and aims to provide support to in-depth analysis of smallholders' commercialization behavior. Data were collected over the summer of 2005, and include 7,186 households randomly drawn from 293 *kebeles.* The sample is considered representative at the national level as well as at the regional level for four regions: Amhara, Oromia, SNNP,[8] and Tigray. However, and as discussed below, the final sample used in the analysis was considerably reduced to ensure that estimates properly capture the impact of cooperatives per se.

### *4.1. Matching* kebeles

Among the 293 *kebeles* in the sample, 94 had at least one cooperative at the time of the survey. However, all do not satisfy the identification assumption that the present spatial distribution of cooperatives is exogenous. Specifically, this assumption may not hold for *kebeles* with member-created cooperatives and such *kebeles* were removed from our sample. In addition, in a number of *kebeles* without cooperatives, it was reported that households had access to one in nearby *kebeles*. To further add to the robustness of our estimates, these *kebeles* were also removed from the sample. The remaining sample consists of 68 *treatment kebeles* where at least one cooperative can be found, and 134 *comparison kebeles* where no cooperatives exist.

The next step is to ensure that the treatment *kebeles* are sufficiently similar to the comparison ones. To do so, we apply the notion of development domains, as adapted to Ethiopia by Chamberlin et al. (2006). Development domains are defined as geographic locations sharing broadly similar rural development constraints and opportunities. The classification is based on the combination of four characteristics that best capture livelihood heterogeneity among smallholders in Ethiopia. These characteristics are altitude, population density, distance to the closest market, and moisture reliability. Their aggregation is based on thresholds established to maximize the predictive power of the domains.[9]

In our sample, *kebeles* can be classified into 22 different domains. To test the validity of these domains as predictors for the existence of externally created cooperatives, we use a Probit estimation where the dependent variable is the existence or absence of a cooperative, and the independent variables are dummy variables for each of the domains. Overall, this test performs relatively well in that domains successfully predict 70% of the existence of cooperatives.[10]

Next, according to our matching procedure, we need to ensure that a sufficient number of treatment and comparison *kebeles* exist within each domain. Such distribution is reported in Table 1, showing that five domains (1, 2, 5, 12, and 15) capture more than 70% of the *kebeles* with at least one externally created cooperative, whereas the remaining 30% are dispersed among 12 of the remaining 17 domains. It also appears that each of these five domains include enough comparison *kebeles* to perform the analysis. Finally, although selective, these five domains are quite heterogeneous: some domains are highland moisture-reliable domains (1, 2, 5) whereas the others are highland, drought-prone domains (12 and 15); some have high market access (1, 2, 13) whereas the others are more remote (5 and 12); most have medium population density (2, 5, 12, 15), whereas one is more densely populated (1). Accordingly, we further refine our sample by focusing on treatment and comparison *kebeles* falling within these five development domains.

To further check the sample's validity, we present in Table 2 the distribution of treatment and comparison *kebeles* across the administrative regions of Ethiopia. Indeed, regional cooperative offices can play an important role in the promotion and organization of cooperatives through directives passed down to *woreda* cooperative offices. Consequently, there are important differences in region-level development of cooperatives, which need to be accounted for (see Bernard et al., 2007, for detailed descriptions). As shown in Table 2, it is only in three regions—Amhara, Oromia, and SNNP—that a relatively balanced sub-sample between treatment and comparison *kebeles* exist. In contrast, the Tigray sub-sample contains only one *kebele* (out of 15) without a cooperative in 2005,[11] whereas the sub-samples in Beneshangul-Gumuz and Harari have a total membership of one *kebele* each. Hence, it appears necessary to further limit the sample to Amhara, Oromia, and SNNP regions to achieve still better comparability of treatment and comparison observations.

We test the balancing properties of both samples—one including all regions and the other excluding Tigray, Beneshangul-Gumuz, and Harari—to ascertain the significance of these concerns. Table 3 reports the results which indicate that the sample containing all regions performs poorly—a significant difference between treatment and comparison *kebeles* is found in five out of the thirteen tests performed. By comparison, the sample restricted to Amhara, Oromia, and SNNP performs

[8] Southern Nations, Nationalities, and Peoples Regional State.

[9] Although Chamberlin et al. (2006) conduct the necessary computation at the *woreda* level, the present analysis is based on the analogous computation at the *kebele* level.

[10] Similar results were obtained using a linear probability model. The corresponding tables are not reported here for the sake of brevity.

[11] As reported in Bernard et al. (2007), an estimated 85% of the *kebeles* in Tigray had a cooperative in 2005, whereas the national average attained 35%.

Table 1
Treatment and comparison *kebeles*, by development domains

| | Domain | % Comparison *kebeles* | % Treatment *kebeles* |
|---|---|---|---|
| 1 | Highland, moisture reliable, high market access, high population density | 8.21 | 13.24 |
| 2 | Highland, moisture reliable, high market access, medium population density | 23.13 | 20.59 |
| 3 | Highland, moisture reliable, high market access, low population density | 2.24 | 4.41 |
| 4 | Highland, moisture reliable, low market access, high population density | 4.48 | 0.00 |
| 5 | Highland, moisture reliable, low market access, medium population density | 19.40 | 10.29 |
| 6 | Highland, moisture reliable, low market access, low population density | 2.99 | 0.00 |
| 7 | Lowland, moisture reliable, high market access, medium population density | 3.73 | 1.47 |
| 8 | Lowland, moisture reliable, high market access, low population density | 0.75 | 0.00 |
| 9 | Lowland, moisture reliable, low market access, medium population density | 1.49 | 2.94 |
| 10 | Lowland, moisture reliable, low market access, low population density | 5.22 | 0.00 |
| 11 | Highland, drought prone, high market access, high population density | 1.49 | 1.47 |
| 12 | Highland, drought prone, high market access, medium population density | 2.99 | 13.24 |
| 13 | Highland, drought prone, high market access, low population density | 1.49 | 1.47 |
| 14 | Highland, drought prone, low market access, high population density | 1.49 | 1.47 |
| 15 | Highland, drought prone, low market access, medium population density | 2.99 | 14.71 |
| 16 | Highland, drought prone, low market access, low population density | 2.24 | 2.94 |
| 17 | Lowland, drought prone, high market access, high population density | 1.49 | 0.00 |
| 18 | Lowland, drought prone, high market access, medium population density | 0.75 | 2.94 |
| 19 | Lowland, drought prone, high market access, low population density | 2.99 | 1.47 |
| 20 | Lowland, drought prone, low market access, medium population density | 2.24 | 2.94 |
| 21 | Lowland, drought prone, low market access, low population density | 5.22 | 2.94 |
| 22 | Lowland, pastoralist, high market access, low population density | 2.99 | 1.47 |
| | | 100% (134 obs.) | 100% (68 obs.) |

Table 2
Treatment and comparison *kebeles*, distribution by region

| | Tigray | Amhara | Oromia | Beneshangul-Gumuz | SNNP | Harari | Total |
|---|---|---|---|---|---|---|---|
| Comparison *kebeles* | 1 | 18 | 33 | 1 | 22 | 1 | 76 |
| Treatment *kebeles* | 14 | 9 | 20 | 0 | 6 | 0 | 49 |

better—the *kebeles* are on average similar in all dimensions covered by these tests. We thus reject the suitability of the full sample and restrict ourselves to the sub-sample comprising three regions, which include 35 treatment and 73 comparison *kebeles*.

One last validity check is undertaken to ensure that treatment and comparison *kebeles* correspond to sufficiently close locations. Fig. 1 shows the geographic location of each *kebele* in our sub-sample against a shaded background that indicates the level of market access for each *kebele* based on the development domain calculations. We find that (i) treatment and comparison groups are geographically mixed, thereby ensuring that the impact of cooperatives will not be driven by area-specific characteristics, and (ii) the distribution of treatment and comparison *kebeles* by level of market access is also fairly balanced.

### 4.2. Matching households

As a result of the sample reduction, the sub-sample now includes a total of 2,532 households, of which 1,702 are in comparison *kebeles* and 830 in treatment *kebeles,* of which 150 are cooperative members (Table 4).

We now turn to the estimation of the propensity scores that are used to match the 150 household members in the treatment *kebeles*, or the "treated households," to households among the 1,702 in the comparison *kebeles* that most resemble them. For this, we first estimate each household's "propensity score" or likelihood of joining a cooperative in the treatment *kebeles*, using a flexible Probit model where the dependent variable is membership status. Domain dummies are used to ensure matching within the domains. Household characteristics include including education level, radio ownership, nonfarm income, landholding, and livestock introduced linearly as well as quadratically to augment the model's predictive power. Finally, a set of dummy variables is included to account for the household's cultivation of a particular cereal crop.[12,13]

The Probit estimation is better identified when undertaken on treatment *kebeles* only, where the choice to join a cooperative does exist (see Gotland et al., 2004, for a discussion). We report estimates of the coefficients in Table 5. We also report the associated *P*-values although the purpose here is not to identify particular relationships, but rather to maximize the

[12] All households in this sample are involved in cereal production.

[13] One may argue that involvement in a particular cereal's production may well be a response to participation in the cooperative. As such, the estimated impact may be downward biased as it may not take into account a household's switch into the production of higher-profit crops. However, the purpose of the present article is to investigate the cooperatives' impact on smallholders' marketing behavior. As such, one wants to compare marketing behavior of households engaged in similar production, whether or not this was driven by the cooperative. In addition, the present estimations are limited to cereals, for which production is largely driven by soil and weather conditions in Ethiopia (teff is mainly cultivated in highland areas north of Addis Ababa, maize in the lowlands south of Addis Ababa, sorghum in the northwest and the east, barley along a north–south meridian in the middle of the country (CSA, EDRI, and IFPRI, 2006, p. 59).

Table 3
Balancing tests: Treatment and comparison *kebeles*

| | Sample with all regions | | | Sample with Amhara, Oromia, and SNNP only | | |
|---|---|---|---|---|---|---|
| | Comparison *kebeles* | Treatment *kebeles* | Difference: $P > t$ | Comparison *kebeles* | Treatment *kebeles* | Difference: $P > t$ |
| Population | 4,548.29 | 5,359.72 | **0.0966** | 4,526.18 | 4,622.91 | 0.8550 |
| % Female-headed hh | 14.01 | 21.52 | **0.0116** | 13.98 | 18.60 | 0.1607 |
| % Households Orthodox | 45.97 | 57.77 | 0.1725 | 45.08 | 43.06 | 0.8298 |
| % Households Muslim | 38.09 | 26.21 | 0.2208 | 37.44 | 33.70 | 0.7306 |
| % Households speak Amharic | 50.95 | 48.15 | 0.7010 | 52.90 | 61.28 | 0.2875 |
| Existence commercial bank | 9.21 | 12.24 | 0.5910 | 9.58 | 17.14 | 0.2630 |
| Existence microfinance institution | 21.05 | 46.93 | **0.0021** | 19.17 | 31.42 | 0.1607 |
| Importance of traditional institutions* | 46.64 | 46.16 | 0.9193 | 46.50 | 50.91 | 0.4053 |
| Number of Das | 1.83 | 2.52 | **0.0023** | 1.84 | 2.05 | 0.3444 |
| Productive safety net *woreda*** | 27.63 | 38.77 | 0.1952 | 26.02 | 28.57 | 0.7825 |
| Existence of primary school | 86.84 | 91.83 | 0.3914 | 86.30 | 88.57 | 0.7452 |
| Direct access to seasonal/dry road | 55.26 | 69.38 | 0.1161 | 56.16 | 60.00 | 0.7019 |
| Access to safe water | 44.73 | 67.34 | **0.0131** | 45.20 | 57.14 | 0.2495 |
| Number obs. | 76 | 49 | | 73 | 35 | |

*Note:* Bold *P*-values indicate differences significant at the 10% level or lower.

*Percentege of conflicts resolved through Shimagile (council of elders) as opposed to local courts.

**The Productive Safety Net Program (PSNP) targets to provide food or cash through public work and direct support to 8.3 millions chronically food insecure individuals in 268 *woreda*s.

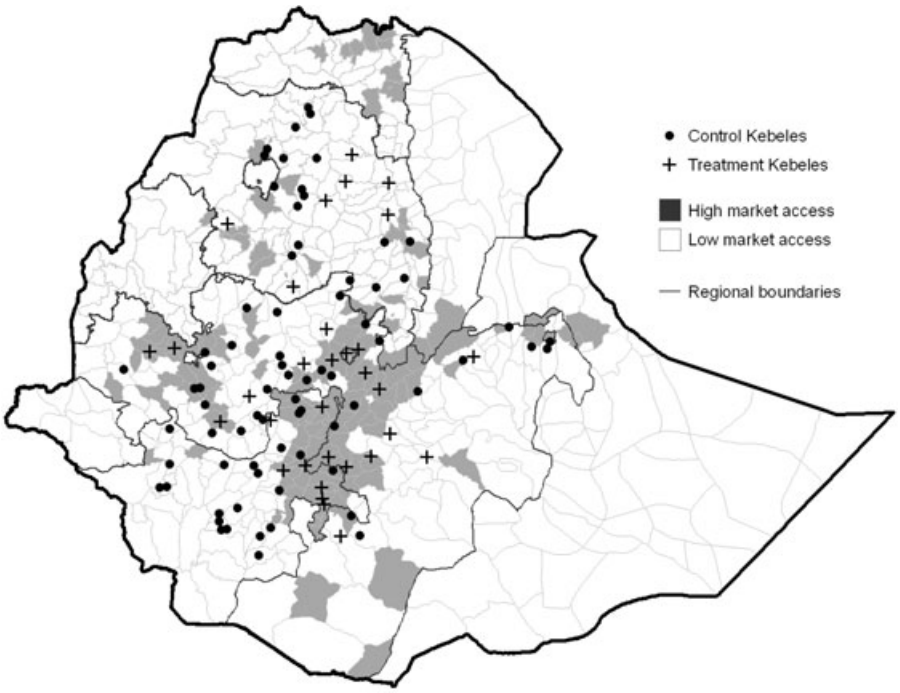


Fig. 1. Geographical location of treatment and comparison *kebeles*.

predictive power of the model. Such an approach, however, relies on out-of-sample prediction to generate propensity scores for the *comparison* households. To assess the importance of associated concerns, we also report estimates from the same model applied to the entire sample. Overall, parameter estimates and their statistical significance are similar, except for variables linked to nonfarm income and type of cereals production, which may well be influenced by *kebele*-level characteristics. We find, however, that estimates based on the restricted sample are better able to predict the rare event (membership in cooperatives),

Table 4
Distribution of households across treatment and comparison *kebeles*

| | Comparison *kebeles* | Treatment *kebeles* | Total |
|---|---|---|---|
| Noncooperative members | 1,702 | 680 | 2,382 |
| Cooperative member | 0 | 150 | 150 |
| Total | 1,702 | 830 | 2,532 |

than the ones based on the full sample. We therefore use the former to generate propensity scores for households living in comparison *kebeles* determining which would have *probably* participated had they had access to a cooperative.

The distribution of propensity scores among the treatment and comparison groups are reported in Fig. 2. As is clear from the figure, the distributions appear quite different, such that matching techniques will be necessary to ensure the robustness of our estimates. Several techniques can be used. Here we focus on two broadly used methods, namely (i) nonparametric kernel regression matching proposed by Heckman et al. (1998), and (ii) five nearest neighbors matching. In the first case, each treated household is matched with the entire sample of comparisons. However, each comparison observation enters the estimate with a weight inversely proportional to its distance to the treatment one, based on the propensity score distribution. In the second

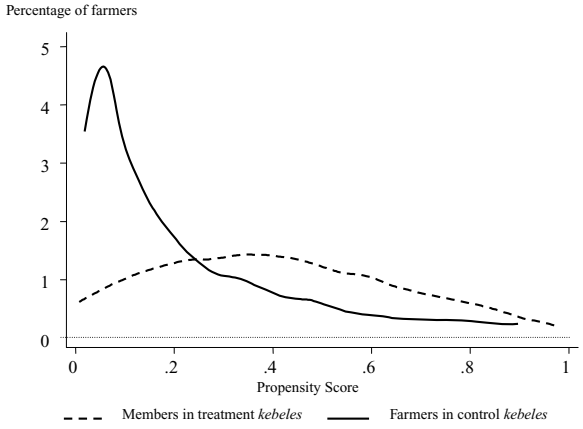


Fig. 2. Propensity scores distribution among treatment and control groups.

Table 5
Probit estimation of determinants of cooperative participation

| | Sample 1: members and nonmembers from *kebeles* with cooperatives only | | Sample 2: members and nonmembers from *kebeles* with cooperatives and *kebeles* without cooperatives | |
|---|---|---|---|---|
| | Coefficient | *P*-value | Coefficient | *P*-value |
| Age of household head | 0.009 | 0.028 | 0.009 | 0.003 |
| Gender of household head | −0.579 | 0.002 | −0.311 | 0.038 |
| Household head reads | −0.003 | 0.978 | 0.066 | 0.539 |
| Household size | 0.082 | 0.513 | 0.142 | 0.129 |
| (Household size)$^2$ | −0.006 | 0.562 | −0.010 | 0.161 |
| Radio ownership | 0.005 | 0.970 | 0.064 | 0.549 |
| Household receives nonfarm income | −0.166 | 0.190 | −0.216 | 0.027 |
| Number of hectares held | 0.551 | 0.000 | 0.380 | 0.000 |
| (Hectares held)$^2$ | −0.053 | 0.025 | −0.033 | 0.038 |
| Number of oxen owned | 0.061 | 0.656 | 0.128 | 0.161 |
| (Oxen owned)$^2$ | −0.001 | 0.978 | −0.007 | 0.616 |
| Number of cattle owned | 0.022 | 0.632 | −0.017 | 0.630 |
| (Cattle owned)$^2$ | −0.002 | 0.425 | 0.001 | 0.877 |
| Number of small ruminant owned | 0.051 | 0.051 | 0.036 | 0.072 |
| (Small ruminant owned)$^2$ | −0.001 | 0.498 | −0.001 | 0.455 |
| Number of poultry owned | 0.029 | 0.378 | 0.026 | 0.310 |
| (Poultry owned)$^2$ | −0.001 | 0.367 | −0.001 | 0.627 |
| Produces teff | 0.134 | 0.326 | 0.245 | 0.020 |
| Produces wheat | 0.060 | 0.703 | 0.055 | 0.607 |
| Produces maize | −0.333 | 0.028 | −0.251 | 0.026 |
| Produces barley | −0.629 | 0.000 | −0.699 | 0.000 |
| Produces sorghum | −0.159 | 0.264 | −0.315 | 0.003 |
| Produces oats | −0.403 | 0.389 | −0.204 | 0.579 |
| Produces dagussa | −0.524 | 0.033 | −0.319 | 0.111 |
| Dev. domain dummies (5-1) | Yes | | Yes | |
| Constant | −2.658 | 0.000 | −1.906 | 0.000 |
| Number of observations | | 830 | | 2,532 |
| Pseudo $R^2$ | | 0.2444 | | 0.2130 |
| Correct prediction rate (%) | | 84.45 | | 94.43 |
| Correct prediction rate among participants (%) | | 32.66 | | 7.33 |

Table 6
Balancing tests of matched samples

| | (1) Unmatched samples | | | (2) Kernel-based matching | | | (3) 5 nearest neighbors matching | | |
|---|---|---|---|---|---|---|---|---|---|
| | Treatment *kebeles* | Comparison *kebeles* | Diff: *P*-value | Treatment *kebeles* | Comparison *kebeles* | Diff: *P*-value | Treatment *kebeles* | Comparison *kebeles* | Diff: *P*-value |
| Age of household head | 47.79 | 42.82 | **0.000** | 47.60 | 47.79 | 0.915 | 47.60 | 48.55 | 0.608 |
| Gender of household head (1 = male, 2 = female) | 1.10 | 1.17 | **0.015** | 1.10 | 1.06 | 0.336 | 1.10 | 1.05 | 0.185 |
| Household head reads (1 = yes, 2 = no) | 39.59 | 30.69 | **0.025** | 40.00 | 36.43 | 0.541 | 40.00 | 32.71 | 0.207 |
| Household size | 6.04 | 5.19 | **0.000** | 5.92 | 5.84 | 0.768 | 5.92 | 5.74 | 0.513 |
| Radio (1 = yes, 2 = no) | 1.40 | 1.21 | **0.000** | 1.37 | 1.31 | 0.343 | 1.37 | 1.32 | 0.368 |
| Nonfarm income (1 = yes, 2 = no) | 1.48 | 1.53 | 0.262 | 1.48 | 1.49 | 0.920 | 1.48 | 1.49 | 0.868 |
| Land owned (hectares) | 2.10 | 1.34 | **0.000** | 1.95 | 2.07 | 0.449 | 1.95 | 2.06 | 0.475 |
| Oxen (number) | 1.63 | 0.90 | **0.000** | 1.47 | 1.38 | 0.553 | 1.47 | 1.38 | 0.583 |
| Cattle (number) | 5.16 | 3.50 | **0.000** | 4.80 | 4.55 | 0.593 | 4.80 | 4.54 | 0.587 |
| Ruminant (number) | 3.42 | 2.44 | **0.003** | 2.84 | 3.73 | **0.089** | 2.84 | 3.70 | **0.075** |
| Poultry (number) | 3.66 | 2.11 | **0.000** | 3.60 | 3.39 | 0.688 | 3.60 | 3.41 | 0.715 |
| Cereal production (in kg) | 1,148.9 | 650.94 | **0.000** | 1,073.00 | 896.39 | 0.135 | 1,073.0 | 897.6 | 0.115 |

*Note:* Bold *P*-values indicate differences significant at a 10% level or lower. Samples limited to common support region.

method, each treatment observation is matched with the average value of its five nearest comparison neighbors, again based on the propensity score distribution. To ensure maximum comparability of the treatment and comparison groups, the sample is restricted to the common support region, defined as the propensity score values interval where both treatment and comparison observations can be found.

A straightforward way to test the validity of the matching procedure is to compare an average household's characteristics within the treatment sample to the corresponding characteristics of the comparison group generated. Accordingly, the absence of significant differences between the treatment and comparison groups is indicative of a valid matching. We thus undertake a series of statistical tests for differences in household characteristics on three different samples: (i) cooperative members in treatment *kebeles* compared to all households in the comparison *kebeles* (an unmatched sample); (ii) cooperative members in treatment *kebeles* compared to the subset of households satisfying the common support restriction in the comparison *kebeles,* with kernel-based matching; and (iii) cooperative members in treatment *kebeles* compared to the subset of households satisfying the common support restriction in the comparison *kebeles*, selected through the five nearest neighbors matching method.

As shown in Table 6, the unmatched sample fails to satisfy the balancing properties in that households in treatment *kebeles* are on average significantly different from the households in the comparison *kebeles* in all aspects considered bar one (column 1). By comparison, only one such significant difference is observed in the matched samples—the number of ruminants owned by the household. Overall, these results suggest that the two matched samples suit our comparability requirements whereas the nonmatched sample does not.

## 5. Average impact of cooperatives on commercialization

### 5.1. Measures of commercialization indicators

We assess smallholders' commercialization through two related indicators. The first one measures the extent to which cooperatives provide smallholders with better market conditions, through better output prices. The second one measures smallholders' actual response to it, via the percentage of output being commercialized.

The impact of cooperatives on output prices is intended to capture whether cooperatives effectively enable their members to obtain a higher price for their output. This is a fundamental indicator because cooperatives-promoting policies often flag, as a rationale, the possibility that collective action can help smallholders obtain higher prices for their output through reduced transaction costs, increased bargaining power over traders, or the ability to reach more attractive markets. The price indicator that we use is an acreage-share weighted sum of the difference between the price received by the household member for each type of cereal sold and the corresponding average price in the sample:

$$PD_i = \sum_j l_{ij} \cdot \left( \frac{p_{ij} - \bar{p}_j}{\bar{p}_j} \cdot 100 \right), \quad (1)$$

where $PD_i$ is the price indicator for household $i$, $l_{ij}$ is the proportion of land that is allocated to cereal $j$ by household $i$ in year 2005, $p_{ij}$ is the unit price received by household $i$ for crop $j$, and $\bar{p}_j$ is the average unit price of crop $j$ received by the sampled households.[14]

[14] The aggregation process across crops is meant to capture the effects of the household's crop production profile.

Table 7
Effect of cooperatives on members' cereals commercialization

| | Kernel-based matching | | Five nearest neighbors matching | | Number of observations |
|---|---|---|---|---|---|
| | ATT | Std. error | ATT | Std. error | |
| A. Two-step matching, final sample | | | | | |
| % Price difference (PD) | 7.249 | 3.229** | 8.901 | 4.361** | 862 |
| % Production sold (PS) | −0.122 | 1.862 | −1.116 | 2.202 | 1,817 |
| B. Checks of robustness | | | | | |
| 1. Two-step matching, final sample limited to Oromia region only | | | | | |
| % PD | 8.545 | 3.952** | 7.141 | 6.373 | 454 |
| % PS | −2.881 | 3.671 | −2.914 | 3.141 | 787 |
| 2. Two-step matching, final sample excluding *kebeles* with NGO-created cooperatives | | | | | |
| % PD | 5.567 | 3.674 | 6.196 | 4.366 | 861 |
| % PS | 0.761 | 1.876 | −1.402 | 2.442 | 1,805 |
| 3. Two-step matching, final sample, with propensity scores estimated on whole sample | | | | | |
| % PD | 7.206 | 3.229** | 7.562 | 3.771** | 862 |
| % PS | −1.180 | 1.964 | −3.224 | 2.550 | 1,817 |
| C. Checks of representativeness | | | | | |
| 1. Two-step matching, sample with all regions | | | | | |
| % PD | 11.451 | 2.060*** | 10.607 | 2.765*** | 1,449 |
| % PS | −1.174 | 1.147 | −0.944 | 1.340 | 2,993 |
| 2. Two-step matching, sample with member-created cooperatives | | | | | |
| % PD | 9.294 | 1.831*** | 8.626 | 2.327*** | 1,471 |
| % PS | 0.005 | 1.07 | −0.084 | 1.325 | 2,972 |
| 3. Two-step matching, sample with all regions and member-created cooperatives | | | | | |
| % PD | 13.120 | 1.923*** | 12.118 | 2.206*** | 1,504 |
| % PS | −1.380 | 0.923 | −1.295 | 1.093 | 3,105 |
| 4. One-step matching, final sample within treatment *kebeles* only | | | | | |
| % PD | 7.606 | 3.980* | 7.259 | 3.571** | 368 |
| % PS | −1.083 | 1.811 | −1.410 | 2.135 | 822 |

*Note:* Stratified bootstrap with 100 replications are used to estimate the standard errors.
***Significant at 1% level, **significant at 5% level, and *significant at 10% level.

The second indicator aims to capture if smallholders' participation in marketing cooperatives leads to a more market-oriented behavior. For this, we use the share of the cereal production that was sold by a household in 2005, denoted *PS*, and defined as:

$$PS_i = \sum_j \frac{S_{ij}}{Q_{ij}}, \quad (2)$$

where $Q_{ij}$ is the quantity of crop $j$ that was produced by household $i$ and $S_{ij}$ is the amount of crop $j$ that was sold by household $i$ in 2005. If cooperatives are able to enhance market participation, then their impact on this indicator shall be positive.

### 5.2. Estimators

Because the impact estimates may be sensitive to the estimator chosen, we use two separate classes of estimators to assess the robustness of our results. In the first one, we simply compute the difference in outcome between treatment and comparison units that are matched according to the two procedures described above. Because analytical standard errors are not computable for the kernel density matching method, we use 100 bootstrap replications stratified at the development domain level to compute robust estimates of them. The second estimator is based on least squares and Tobit estimations, including a number of control variables. To further ensure comparability of the treatment and comparison groups, we restrict the sample to the common support region of the five nearest neighbors matching described above.[15]

### 5.3. Results: average impact of cooperatives on their members

We report the nonparametric estimates of the *average treatment effect on the treated* (ATT)—the mean impact that cooperative membership has had on members' output commercialization and price—in panel A of Table 7. Starting with the price difference indicator, we find that on average, cooperative members receive between 7.2% and 8.9% higher prices for their cereal products than their nonmember counterparts. This effect is statistically significant and robust across both matching

[15] The common support region of the kernel matching function led to essentially the same results. Only the results corresponding to that of the five nearest neighbors are discussed for the sake of brevity.

Table 8
Heterogeneous effects of membership on commercialization

| | Price difference OLS | | % Production sold Tobit | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | | (4) | |
| | Coefficient | Coefficient | Coefficient | Marg. effect | Coefficient | Marg. effect |
| Land owned (in ha) | 0.331 | 0.010 | 4.112 | 1.947 | 3.655 | 1.732 |
| | (0.835) | (0.878) | (0.675)*** | | (0.708)*** | |
| Hh head reads | 3.778 | 4.241 | 3.789 | 1.829 | 3.904 | 1.887 |
| | (2.176)* | (2.279)*** | (1.767)** | | (1.847)* | |
| Household size | 0.014 | 0.153 | −1.005 | −0.476 | −0.927 | −0.439 |
| | (0.501) | (0.520) | (0.382)*** | | (0.394)** | |
| Market access | 7.429 | 7.149 | 4.217 | 1.968 | 4.058 | 1.897 |
| | (2.305)*** | (2.314)*** | (1.799)*** | | (1.797)*** | |
| Population density | −5.408 | −5.297 | −6.690 | −2.962 | −6.303 | −2.803 |
| | (3.398) | (3.404) | (2.555)** | | (2.556)** | |
| Agricultural potential | −22.235 | −22.679 | 11.788 | 4.872 | 11.336 | 4.713 |
| | (4.113)*** | (4.139)*** | (2.985)*** | | (2.990)*** | |
| Treatment | 10.007 | 14.007 | 0.731 | 0.349 | −2.455 | −1.130 |
| | (3.838)*** | (11.687) | (3.089) | | (9.360) | |
| Treatment × ··· | | | | | | |
| Land owned (in ha) | | 3.272 | | | 4.830 | 2.289 |
| | | (2.933) | | | (2.314)*** | |
| Hh head reads | | −3.344 | | | 0.416 | 0.198 |
| | | (8.054) | | | (6.358) | |
| Household size | | −1.763 | | | −1.153 | −0.546 |
| | | (1.959) | | | (1.534) | |
| Constant | 8.340 | 8.540 | −16.094 | | −15.389 | |
| | (4.916)* | (5.000)* | (3.669)*** | | (3.723)*** | |
| # Observations | 856 | 856 | 1,808 | | 1,808 | |
| | | | | | (931 obs. censored at % = 0) | |

*Notes:* Robust standard errors in parentheses.
*Significant at 10%; **significant at 5%; and ***significant at 1%.
Samples limited to common support for each estimation.

techniques, consistent with the idea that collective action may increase the returns to commercialization for smallholder farmers. Turning to the share of production sold PS, however, we find that cooperative membership does not have an average impact significantly different from zero.

Similar results are obtained using the ordinary least squares and Tobit specifications described above, controlling for several household and community-level characteristics expected to influence both. Because participation in a cooperative may directly affect the production level of the members, we use the number of hectares of farm land "owned" by the household as a proxy for its actual level of production. Given the land ownership regime in Ethiopia, this variable is considered as exogenous, at least in the short or medium term.[16] Other variables in the estimation include the household head's reading ability, household size, and the set of *kebele*-level control variables used in the definition of the development domains. The sample is the same as that underlying the estimates reported in panel A of Table 7, except that a few observations with missing data were dropped.

Results are presented in columns (1) and (3) of Table 8. Coefficients in the upper part of the table indicate that households living close to markets sell more of their production and at higher prices, whereas the opposite is true for households living in higher population density areas. Favorable agro-climatic conditions (i.e., surplus-producing areas) tend to have depressing effects on prices. From among the household-level characteristics, land owned positively affects the share of production that is commercialized by a household, whereas the education of the head has a clear and significant effect on the price he/she is able to obtain for a unit of output. In the middle part of the table, we report the coefficients on a membership dummy. Accordingly, cooperative membership does have a significant positive impact on output price, similar in magnitude as the results presented in Table 7. In contrast, the direct effect on the share of production sold cannot be distinguished from zero, further supporting the conclusions of the previous table.

[16] Land in Ethiopia is the property of the state and cannot be owned by individual farmers. Nevertheless, land is allocated to households for an undetermined period. Although land cannot be sold, it can be rented out and eventually passed on to heirs. The variable we use here as landholding is the amount of land allocated by the state to the household. For a detailed description of the Ethiopian land tenure system, see Gebreselassie (2006).

### 5.4. Discussion

The conclusion from these estimates is somewhat surprising: on average, despite a higher average price received for their outputs, cooperative members do not tend to supply more of their output to the market. Two types of biases may however be at play. First, the obtained estimates may be influenced by the estimation procedures and the indicators used. Second, given the important reduction in the size of the sample, the obtained estimates may lack representativeness of the general situation in Ethiopia. To account for these sources of bias, we present in panels B and C of Table 7 a series of robustness and representativeness checks.

For instance, one may argue that the use of the sample average as the reference point in the price indicator is problematic. Although our estimations control for important determinants of output prices via the development domains, it could still be that if cooperatives are located in areas with higher prices to start with, a higher price for cooperative members may wrongly be attributed to the cooperatives instead of local conditions. To avoid such biases, using zonal or regional-level aggregates as the reference point instead of the entire sample might be recommended. In this case, however, the relatively small size of our sample at the zonal level as well as in some regions would provide us with imprecise estimates of the mean price, which in turn may severely affect the precision of our estimates. To test the importance of such potential bias, we compute the average treatment effects when only the Oromia region is considered in the analysis. As shown in Table 2, this is the only region where a sufficiently large sample of treatment and comparison *kebeles* exist. Results reported in panel B-1, although less precise, are qualitatively similar to the ones of panel A.

Second, we investigate whether the inclusion of NGO-created cooperatives in the final sample may affect the results. Indeed, if NGOs deliberately choose the *kebeles* in which they intervene on criteria linked to the likely performance of the organizations they help set up, results may be artificially high. In panel B-2, we present estimates from a sample excluding *kebeles* where NGO-created cooperatives exist. We note that the estimates are reduced in their magnitude and in their precision, although the main features remain.

Third, we check whether our use of the sample of *kebeles* with cooperatives only to derive the propensity score estimates may have affected the results. Results are reported in panel B-3, and do not show any meaningful differences with those of panel A.

Next we investigate how the estimates may be affected by more representative but arguably more biased samples. A first concern may come from our limitation to cereal crops cooperatives, although evidence suggests that cooperatives are often more efficient when operating with high-value products such as coffee. Here, however, we focus on the capacity of cooperatives to provide market access to smallholders who are predominantly engaged in cereals production and marketing. The six crops considered here (teff, sorghum, maize, barley, wheat, and millet) account for 99% of cereal acreage as well as output. Cereals in turn capture 75% of cropped land and 69% of crop production.[17] Finally, 98% of grains produced in Ethiopia are produced by smallholders (Gabre-Madhin, 2001). As such, the estimates reported below are likely to reflect the general situation of nonpastoralist smallholders in the country. Although it is likely that cash crop oriented cooperatives may present interesting contrasts to these results, our data originally contained less than 20 members of such cooperatives—a sub-sample too small to allow valid comparisons.

Further, in panel C-1, we use a sample where all regions, including Tigray, Beneshangul-Gumuz, and Harari, are a part of. Again, the results do not clearly differ from those of panel A. The same conclusions are drawn from panels C-2 and C-3, where the sample include all *kebeles* with member-created cooperatives, first restricted to only three regions (Amhara, Oromia, and SNNP) and then extended to cover all the regions, respectively. Finally, in panel C-4, results are based on the sample of panel A, but further restricted only to *kebeles* where an externally created cooperative exists. The comparison is then done between cooperative members and nonmembers living in the same *kebeles*. Again, the results do not change in nature.

Overall, both robustness and representativeness checks support the general conclusions that although cooperatives may provide significantly higher prices to their members, the average impact on fraction of output marketed is not statistically different from zero. Furthermore, a number of these results point toward larger estimates of the impact of cooperative on prices, suggesting that the results in panel A may be conservative. However, these estimates capture average outcomes and do not capture potentially important heterogeneity across farmers' responses to their participation into cooperatives. We investigate this issue in the next section.

## 6. Heterogeneous impact of cooperatives

There is no reason to believe *a priori* that membership in a cooperative will imply homogenous responses for different categories of farmers. To see this, we plot in Fig. 3 the distributions of cooperatives' impact on members' percentage production sold.[18] The figure displays a great amount of heterogeneity in members' response to their participation in cooperatives. We note in particular that some cooperative members' share of production sold is almost double the level of their nonmember counterparts. However, for a large number of

[17] Note that in value terms the share of permanent crops is higher given their higher market prices. This is particularly true of coffee and *khat*. Figures in this paragraph are computed from data generated by the Ethiopian Sample Enumeration Survey 2001/02 (CSA, 2003).

[18] Let $PS$ measure the household's share of production sold and $\overline{PS}$ the share of production sold by its generated counterfactual, the curves in the graph represent the distribution of the difference $(PS-\overline{PS})$, expressed as a percentage of $\overline{PS}$, across households.

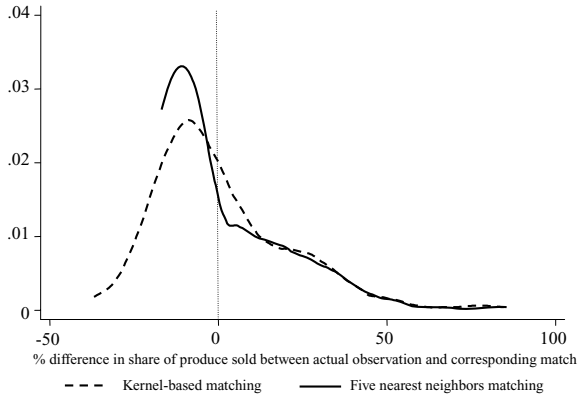


Fig. 3. Distribution of cooperative membership impact across households, kernel density estimates.

other members, this level is significantly lower than their estimated counterparts, possibly despite higher prices within the cooperative.

We further investigate this heterogeneity by interacting the treatment dummy with household-level variables in columns (2) and (4) of Table 8. In column (2), none of the obtained coefficients on the interacted terms differs significantly from zero, indicating that no obvious heterogeneity exists between cooperative members regarding the impact on output price received. In column (4), however, we find that the effect of membership on the percentage production sold increases significantly with the size of the landholding, indicating that the larger a household's landholding—standing in for potential production—the more responsive it will be to the price incentive secured by the cooperative. With an average impact null, these results suggest that smaller farmers tend to be the ones substituting out of the market in response to the price increase.

Given the staple nature of the crops considered, this phenomenon may be explained by the potentially counteracting effects of the price increase on the household's production and consumption choices. Although a price increase will probably lead to positive (or zero) production response, its effect on consumption is more ambiguous. As a consequence, the impact on marketed output is uncertain. This may be particularly the case for poorer households with lower supply response capabilities and greater (positive) income elasticity of cereals consumption.[19]

A slightly more formal presentation of this argument can be achieved using an agricultural household model. With a standard specification it is possible to drive the following expression that captures the impact of cooperative membership on market position of farm households:[20]

$$\frac{\partial q^j}{\partial p_i^j} dp_i^j = \left[ \frac{\partial Q_i^j}{\partial p^j} - \left( \frac{\partial C_i^j}{\partial p^j}\bigg|_{d\tilde{e}_i=0} - \left(Q_i^j - C_i^j\right) \frac{\partial C_i^j}{\partial E} \right) \right] dp_i^j, \tag{3}$$

where $q_i^j$, $p^j$, $Q_i^j$, and $C_i^j$ represent household $i$'s marketed output, market price (net of transaction costs), output, and consumption of crop $j$, respectively, and:

$$dp_i^j = \left[p_i^j(A_i = 1)\right] - \left[p_i^j(A_i = 0)\right]$$

with $(A_i = 1)$ indicate the household is a cooperative member and $(A_i = 0)$ indicate otherwise. The following expression of the impact is obtained after some manipulation of (3):[21]

$$\xi_{q,p^i}^j = s_{q^j}^{-1}\left[\xi_{Q,p^i}^j - (1 - s_{q^j})\xi_{C,p^i}^j\right], \tag{4}$$

where $\xi_{q,p^i}^j$, $\xi_{Q,p^i}^j$, and $\xi_{C,p^i}^j$ are the own-price elasticity of household $i$'s marketed output, total output, and consumption of crop $j$, respectively; and $s_{q^j} = \frac{q_i^j}{Q_i^j}$ represents the ratio of the marketed output of crop $j$ to the total output of crop $j$.

The expression shows that the direction and magnitude of the response of marketed output to own-price changes depend on the sign and size of the response of production and consumption to the same changes and the (initial) share of marketed surplus in total output. The relative strength of the latter three would, in turn, reflect household endowments (such as landholdings, livestock owned, and human capital stock) in circumstances where markets are rather imperfect. For instance, it is reasonable to expect that, compared to richer farm households, poorer ones are more likely to:[22] (i) have bigger unmet consumption needs (bigger food gap, for example) with consequently higher income/profit effect of price changes on demand; (ii) supply a smaller fraction of their production to the market; (iii) confront more stringent constraints in trying to expand production, which may lead to lower responsiveness of production to price

[19] Evidence suggesting that preference for food self-sufficiency falls with income/wealth is uncovered in Ethiopia (Taffesse et al., 2007).

[20] From among others, Strauss (1986) and Taffesse (1999) provide further details regarding agricultural household models. Note also that, with thin or absent markets, some prices may be endogenous to the household. Such prices are determined not only by exogenous variables (including market prices), but also by household preferences, endowments, and production technology. As a consequence, market price changes can have direct effects and/or effects through endogenous prices (de Janvry et al., 1991; Strauss, 1986; Taffesse, 1999). We just note, without going into details, that the response to price changes due to cooperative membership can accordingly be more complicated. The simple characterization in the text is deemed sufficient for the present purpose, however.

[21] Multiplying $\frac{\partial q^j}{\partial p_i^j} = [\frac{\partial Q_i^j}{\partial p^j} - \frac{\partial C_i^j}{\partial p^j}]$ by $\frac{p^j}{q_i^j}\frac{p^j}{p^j}\frac{Q_i^j}{Q_i^j}\frac{C_i^j}{C_i^j}\frac{e_i}{e_i}$ ($e_i$ measuring the household's net expenditures) and rearranging appropriately results in the expression in the text.

[22] Note also that farm households in developing economies tend to be risk averse, and the poorer ones more so (Antle, 1987; Barrett, 1993; Ellis, 1993; Fafchamps, 1999; Kurosaki and Fafchamps, 1999; Morduch, 1990, 1995; Rosenzweig and Binswanger, 1993; Rosenzweig and Wolpin, 1993; Saha, 1994). Some evidence to that effect has also been obtained in relation to Ethiopian farm households (Belete et al., 1993; Cummins, 1999; Kebede et al., 1990). In particular, using experimental data collected from a sample of farmers, Cummins (1999) concludes that most farmers are risk averse and that the degree of risk aversion falls with wealth.

changes; (iv) face higher transactions costs; and (v) need to fulfill minimum liquidity requirements (for consumption, production, or tax purposes).

As a consequence, for poorer households, the likelihood is higher that the positive full income effect on consumption due to own-price changes dominates the negative substitution effect and that the consumption effect exceeds the production effect. The net result is a reduction in the fraction of the poorer households' marketed output in response to increases in crop prices obtained by them.

## 7. Conclusion

Over the past decade, Ethiopia has embarked on a major policy drive to promote farmers' marketing cooperatives as a way to increase the commercialization of smallholder agriculture and the improvement of rural livelihoods. Using data drawn from a survey of nearly 7,200 rural Ethiopian households collected in 2005, this article attempts to shed light on the role and impact of cooperatives and thereby contribute to the relevant policy discourse.

Towards that end, it assumes that the actual location of most cooperatives can be considered as exogenous to members' characteristics. The assumption reflects two related features of cooperative formation in Ethiopia: most existent cooperatives were created with an external partner (the government or NGOs) taking the initial lead in their formation; and the government of Ethiopia aims to see a cooperative operating in each *kebele* by 2010.

With this assumption, we apply a propensity score matching approach to compare cooperative member households to households living in similar *kebeles* but without cooperatives. The latter households are similar to the former households in the sense that, controlling for *kebele* characteristics, they have a comparable likelihood of joining a cooperative if only they had had access to one. We evaluate impact on two possible outcomes: the extent of household market participation as measured by the share of output households supply to the market; and the crop prices households obtained in the market.

The results are somewhat sobering. First, compared to nonmembers, cooperative members do not on average supply a greater fraction of their output to the market. In other words, cooperative membership does not necessarily lead to a statistically detectable increase in output commercialization. Second, on average, cooperatives managed to secure a higher price for the output marketed by their members—at least 7% higher than that obtained by nonmembers. The first impact is rather puzzling when confronted with the second impact—higher prices generally induce greater supply. A possible explanation emerges when the analysis is further refined to account for heterogeneity of cooperative members. With this we find that smaller farmers tend to sell less on the market given the higher prices achieved via cooperative membership, whereas relatively larger farmers supply more. To account for these results, we propose a theoretical explanation whereby the staple nature of the crops studied is considered. In particular, we hypothesize that price variations are likely to positively affect the own-consumption of output by poorer households, and that this effect is likely to be larger than the corresponding (positive) effect on the production of such households. The net impact is thus likely to be a negative marketed output response to the price incentives that cooperative membership afforded poorer households. This response may cancel out the positive marketed output response expected of larger members such that the average impact becomes statistically not different from zero.

These tentative findings have significant policy implications. In particular, they show that cooperatives seem effective at providing marketing services to their members: the positive and significant impact of membership on price reveals that cooperatives do serve their expected purpose of commercialization through better market opportunities, higher bargaining power, and/or reduced transaction costs. However, and as has been highlighted on several occasions in the literature, price incentives may not be sufficient to ensure greater market participation by the poorest farmers.

Finally, although careful attention was given to biases due to the location of cooperatives and members' self-selection into them, these biases may not be fully neutralized through propensity score matching. Nevertheless, we believe that the results are more than sufficient to warrant further research into the potentially diverse impact of cooperatives.

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