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Linking Smallholders to Markets: Determinants and Impacts of Farmer Collective Action in Kenya

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Summary. — This article investigates determinants and impacts of cooperative organization, using the example of smallholder banana farmers in Kenya. Farmer groups are inclusive of the poor, although wealthier households are more likely to join. Employing propensity score matching, we find positive income effects for active group members. Yet price advantages of collective marketing are small, and high-value market potentials have not yet been tapped. Beyond prices, farmer groups function as important catalysts for innovation adoption through promoting efficient information flows. We discuss the conditions under which collective action is useful, and through what mechanisms the potential benefits emerge.

Key words — agricultural markets, smallholder farmers, collective action, cooperative organization, Kenya, East Africa

1. INTRODUCTION

Many of the world's poor still directly or indirectly depend on agriculture for their livelihoods, most of them as small-scale farmers. Besides building up farmers' production capabilities, improving their access to markets has become a key element in strategies to promote rural development and poverty reduction. In order to be successful, development programs have to address the multiple market failures that the small farm sector suffers from (Jayne, Mather, & Mghenyi, 2010). In particular, small-scale farmers face many constraints that impede them from taking advantage of market opportunities. Often living in remote areas with poor infrastructure, they face high transaction costs that significantly reduce their incentives for market participation (Barrett, 2008; Key, Sadoulet, & de Janvry, 2000; Omamo, 1998). This holds true for both agricultural input and output markets. In addition, small farms with few assets often have limited access to services, including effective extension and rural credit, which are important preconditions for upgrading production systems (Reardon, Barrett, Berdegué, & Swinnen, 2009; Wiggins, Kirsten, & Llambí, 2010).

Farmer organizations, cooperatives, and similar forms of collective action are avenues to reduce high transaction costs (Markelova, Meinzen-Dick, Hellin, & Dohrn, 2009; Valentinov, 2007). They can be oriented toward improving production, marketing, or livelihoods in general, sometimes serving more than one purpose (Bernard & Seyoum Taffesse, 2009; Bernard, Seyoum Taffesse, & Gabre-Madhin, 2008; Francesconi & Heerink, 2011). The promotion of farmer organizations through outside assistance has recently re-gained popularity in the context of the agri-food system transformation (e.g., Narrod *et al.,* 2009; Rao & Qaim, 2011), which is characterized by a growing role of supermarkets and high-value exports. Emerging high-value chains often involve strict standards and new procurement systems of agribusiness companies—factors that may further exacerbate market access for small farms (Reardon *et al.,* 2009).

While there is much evidence indicating that smallholders are unable to compete in high-value markets, there are various examples where they successfully participate through collective action and institutional support (Narrod *et al.,* 2009). For example, Roy and Thorat (2008) showed that in India marketing cooperatives for grapes reduced transaction costs and contributed to a better bargaining position of smallholders vis-à-vis foreign traders. For the dairy sector in Ethiopia, Holloway, Nicholson, Delgado, Staal, and Ehui (2000) demonstrated the positive role of cooperative marketing for small producers. Wollni and Zeller (2007) found that coffee cooperatives in Costa Rica facilitated small-scale growers' participation in specialty markets with higher prices. In Kenya, Ethiopia, and Zambia, green bean growers organized in farmer groups were able to enter markets in Europe (Okello, Narrod, & Roy, 2007).

However, these examples cannot simply be generalized. There are also cases where collective action did not improve the farmers' situation and where groups dissolved after disappointing experience (Markelova *et al.,* 2009; Poulton, Dorward, & Kydd, 2010). In particular, while cooperative organization has proven successful for high-value crops, there is little empirical evidence that the same is true for food grains and other staples (Barrett, 2008; Berdegué, 2001). One exception is Bernard *et al.* (2008), who find that smallholder grain marketing cooperatives in Ethiopia achieve higher prices, even though this has no significant effect on the overall level of commercialization. In a study on collective marketing in Tanzania, only very few farmer groups improved the market situation in cereals and legumes, while all groups analyzed improved the situation in fruits and vegetables (Barham & Chitemi, 2009). There is a need to better understand under what conditions and for whom collective action is useful, and through what mechanisms the potential benefits emerge.

This article contributes to the literature by analyzing the example of production- and market-oriented farmer groups in the Kenyan banana sector. In particular, we make three contributions to the literature. First, we provide insights into the determinants of group membership. This allows us to draw implications on the group outreach, or inclusiveness. For

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example, understanding whether marginal farmers are also motivated to join is important from a poverty perspective. Second, we investigate impacts of group membership on marketing and nonmarketing outcomes. Previous studies have mostly focused on impacts in terms of access to output markets, output prices, marketable surplus, and farm profits (e.g., Bernard *et al.,* 2008; Holloway *et al.,* 2000). One exception is Shiferaw, Obare, Muricho, and Silim (2009), who also evaluated the impact on technology adoption. We extend this focus and analyze the effects of group membership on access to information and innovation, input intensification, commercialization, and broader household welfare. This is important in order to grasp the potential for future productivity and commercialization impacts, especially when groups are still relatively young. Third, in our evaluation of these impacts, we distinguish between different modes of group participation, because membership *per se* may not determine impacts when members participate in group activities to varying degrees.

Banana in Kenya is an interesting example. In the regional context, the crop is gradually transforming from a subsistence food crop to a cash crop for small-scale farmers. Banana also has the potential to penetrate higher-value domestic and export markets, although this has not yet happened at a large scale. With outside assistance by international nongovernmental organizations (NGOs), farmer groups were recently formed, in order to promote innovation and improve market access (Acharya & Alton Mackey, 2008). Our analysis is based on a cross-section survey of members and nonmembers of such farmer groups. For the impact assessment, we use propensity score matching to correct for selection bias.

The article is organized as follows. In Section 2, we briefly discuss transaction cost economics and organizational theory as a conceptual basis for the advantages and disadvantages of cooperative organization in a small farm context. In the same section, we also provide some further background on the Kenyan banana sector. In Section 3, we describe the survey data and the methodological approach. The estimation results are presented and discussed in Section 4, while Section 5 concludes.

2. BACKGROUND

(a) *Family farms and the role of cooperative organization*

Transaction cost economics (Williamson, 1985) provides the conceptual basis for explaining the role of smallholder cooperative organization. Transaction costs are the observable and unobservable costs of market exchange. Key *et al.* (2000) distinguish between fixed and variable transaction costs. Fixed transaction costs include the costs of (i) searching for a trading partner with whom to exchange goods or services, (ii) negotiating a price and bargaining, and (iii) screening, enforcement, and supervision. Variable transaction costs depend on the volumes traded and are for example related to transferring the product to its destination. These costs may prevent or reduce market exchange. Market failure is further exacerbated by information asymmetries, imperfectly specified property rights, and risk. This gives rise to different institutions of governance, or different modes of managing transactions to reduce transaction costs (Coase, 1973). These include market and hierarchical modes, as well as hybrid structures.

Despite substantial structural change in global agri-food systems over the last decades, family farms continue to dominate the agricultural sector, even in developed countries. Compared to larger, hierarchically organized enterprises, family farms tend to have lower internal transaction costs through their ability to minimize the costs of supervision and monitoring of labor. This is so, because more family than hired labor is employed, and family labor is usually characterized by higher levels of intrinsic motivation and loyalty (Pollak, 1985). Small family farms may also have an advantage because of their greater local knowledge (Poulton *et al.,* 2010). However, there are also two major disadvantages for small family farms when considering their interactions with upstream and downstream agents. First, small farm sizes are associated with higher external transaction costs, because economies of scale cannot be realized. Hence, they have higher unit costs of procuring inputs, obtaining credit and other financial services, getting agronomic and market information, implementing standards and certification, and marketing (Wiggins *et al.*, 2010). Second, higher degrees of concentration in upstream and downstream markets can lead to asymmetries in market power. This makes small family farms more vulnerable to opportunistic behavior. These problems are particularly severe in developing countries, where institutions and physical infrastructure are often weak.

Hence, under some conditions, hierarchical organization may be too costly for production activities, while market organization may be too costly for marketing activities (Valentinov, 2007). This provides a functional niche for hybrid organizations that allow the combination of hierarchical and market mechanisms and help to make family farms a viable option. Farmer organizations can achieve the necessary economies of scale and thus economize on external transaction costs, reduce information asymmetries, and build up countervailing market power. Farmer organizations are a form of collective action that is defined as voluntary action taken by a group of individuals, who invest time and money to pursue shared objectives (Markelova *et al.,* 2009).

Farmer organizations may take over responsibilities for accessing agricultural extension, input provision and distribution, bulking, grading, selling, and even processing. The relevance of collective action may potentially increase with agricultural development, because more intensive use of purchased inputs and higher degrees of commercialization increase the number of market transactions. Moreover, modernizing supply chains are often associated with tighter product and process-related quality and food safety standards. These factors can add to external transaction costs, and the observed tendency toward vertical supply chain integration may also further aggravate power asymmetries (Reardon *et al.,* 2009; Wiggins *et al.,* 2010). In such situations, collective action is likely to improve market access for smallholders (Holloway *et al.,* 2000; Rao & Qaim, 2011).

On the other hand, agricultural development is often associated with improved physical infrastructure and institutions, reducing external transaction costs and potentially also lowering incentives for collective action. More generally, the disadvantage of family farms varies across different production systems and institutional contexts, which determines the extent of benefits that can be achieved through cooperative organization (Valentinov, 2007). The establishment and sustainability of farmer organizations is often conditioned on external support, for example by NGOs, government agencies, or private businesses. Moreover, farmer organization itself induces transaction costs related to internal governance and incentive problems. Finally, the realization of economies of scale can differ between different production and marketing operations (Roy and Thorat, 2008), which may affect the optimal scope and mix of activities.

Markelova and Mwangi (2010) identified the types of markets and products, characteristics of farmers and their organizations, institutional arrangements, and the external environment as important factors that determine the success of collective action. For example, markets with long marketing channels and high quality and food safety requirements increase incentives for farmer cooperation, because it can lower the cost of coordination. Furthermore, since farmer organizations can pool resources to obtain access to special equipment and transportation services, collective action is more attractive for perishable commodities, such as fruits, vegetables, and milk, than for staple crops that are easier to store and transport. In terms of group size, smaller groups improve internal cohesion, while larger groups may be preferable with a view to economies of scale (Agrawal, 2001; Stringfellow, Coulter, Lucey, McKone, & Hussain, 1997).

(b) *Cooperative organization in the Kenyan banana sector*

Recent developments in the Kenyan banana market provide an interesting example to analyze determinants and impacts of cooperative organization. Banana and plantains are among the four most important staple food crops and an important source of income for millions of people in developing countries (Arias, Dankers, Liu, & Pilkauskas, 2003). In contrast to large-scale, export-oriented banana production in Latin America, the majority of the banana growers in East Africa are small-scale farmers who produce for their own consumption and domestic markets.[1] Traditionally, banana in Kenya has been seen as a security crop, because it provides continuous food supply and cash income even under low input regimes (Qaim, 1999). This is gradually changing, however. Although banana yields are still quite low—mostly due to poor crop management, low input levels, and use of inferior planting material—the crop's commercial potential is increasingly being recognized.

With continuing urbanization, a growing middle class, and the expansion of supermarkets, the demand for high-quality dessert banana is growing in Kenya. Hence, over the past few years smallholder producers have become more reliant on the cash income generated from banana sales. This has occurred especially in areas where farmers saw their incomes from coffee and other traditional cash crops decline (Wambugu & Kiome, 2001). However, unlike coffee, for which marketing is usually done through cooperatives, bananas are mostly marketed individually. While procurement systems for some higher-value commodities gradually change toward tighter vertical integration (Neven, Odera, Reardon, & Wang, 2009; Reardon *et al.,* 2009), Kenyan supermarkets still largely source bananas from traditional wholesalers.

A few banana producers in Kenya are able to sell at local markets or to small shops, the majority sells their harvest to local traders at the farm gate. Because of remoteness, poor infrastructure, market information asymmetries, perishability, and bulkiness, smallholders have very limited marketing alternatives. This also contributes to low bargaining power vis-à-vis farm-gate traders. With a view to emerging nontraditional markets, high-value chains require a regular and reliable flow of supply of consistent quality, which small-scale producers can rarely satisfy. Collective action could reduce transaction costs and improve coordination in production and marketing.

Recognizing the problems of low banana yields and farmers' limited access to high-value markets on the one hand, and the increasing commercial potential of the crop on the other, efforts have been started by different development agencies to improve the situation through dissemination of better planting material and related measures. One of these initiatives was jointly launched by Africa Harvest and TechnoServe—two international NGOs. Since 2003, Africa Harvest and TechnoServe have been working together in encouraging banana farmers to establish self-sustaining groups, in order to facilitate access to clean planting material, technical extension, and output markets. This initiative builds on a whole value chain approach, as it encompasses activities from technology acquisition, via production, down to marketing (Acharya & Alton Mackey, 2008). Since 2003, several thousand small-scale banana growers in the central highlands of Kenya became organized in such farmer groups.

One tangible benefit of these farmer groups is improved access to tissue culture (TC) planting material for banana. Traditionally, bananas in Kenya are propagated by suckers from old plantations, a procedure through which pests and diseases are spread. In contrast, TC bananas are propagated in the lab, so that the plantlets are pathogen-free. Yet, buying TC plantlets instead of using suckers is more expensive. In some cases, Africa Harvest has provided limited subsidies; more importantly, the NGO facilitates contacts and linkages between farmer groups, TC labs in Nairobi and elsewhere, and local nurseries. Group members collectively order TC plantlets, thereby reducing transaction costs. Since each farmer usually only buys a few plantlets at a time, individual purchases would be associated with excessive per-unit search and transportation costs. Successful TC adoption also requires certain changes in traditional banana cultivation practices (Qaim, 1999). Africa Harvest provides technical advice on proper plantation establishment and maintenance through special training sessions organized for farmer groups. The groups do not collectively purchase agricultural inputs, such as chemical fertilizers or pesticides.

TechnoServe concentrates on the marketing side and provides assistance to group members with respect to business practices, such as bookkeeping and negotiation skills. When members are able to deliver the necessary quantity and quality, groups are encouraged to sell collectively. Through the organization of group marketing days, middlemen are excluded and farmers are directly linked to wholesalers from urban centers. On the marketing days, group members are invited to deliver their bananas to designated collection centers, where bunches are weighed, graded, and picked up by wholesale traders. While farmers have to pay a certain fee for group membership, they keep individual accounts; that is, sales revenues are distributed according to actual delivery. A small tax of one Kenyan Shilling (KSh.) per kilogram is deducted from individual sales, which is used to build up group savings to be re-invested in service provision.

These farmer groups, which are analyzed in this article, focus on bananas only. Beyond collective marketing activities, all groups provide nonmarketing services in terms of access to technical innovation and extension, as described. In fact, several groups have not yet started collective marketing, because they are relatively young and first focused on upgrading production technologies. Africa Harvest and TechnoServe also have plans to directly link banana farmer groups to high-value markets, including supermarkets, processing companies, or exporters, but these plans have not yet materialized.

3. DATA AND METHODOLOGY

(a) *Household survey*

The data used in this study were collected in June and July 2009 in the central highlands of Kenya. Using a carefully designed and tested questionnaire, we conducted structured, household-level interviews with banana growers in the districts of Muranga, Nyeri, Embu, and Meru. These districts are all located within the same agro-ecological zone, have similar access to road infrastructure, and are classified as high-potential banana-growing areas. We randomly sampled banana growers who are members of farmer groups as well as nonmembers for comparison.

In order to select members and nonmembers we used stratified random sampling. We first obtained a complete list of 240 banana farmer groups; out of these, 17 groups were randomly selected, which were located in different sub-locations. Within each group, around 12 member households were randomly selected, resulting in a total of 201 group member observations. In the same 17 sub-locations, we also randomly sampled 137 nonmembers. As these nonmember households are located in areas where farmer groups operate, they are exposed to the initiative and might potentially be affected by spillover effects. In order to have a more robust control group, we further identified 10 sub-locations in the same districts but without any group activities. In these control regions, we randomly selected another 106 banana growers.

Thus, the total sample consists of 444 banana-growing households, including group members, nonmembers in regions where groups operate, and farmers (nonmembers) in control regions where no groups operate. As agroecological and socioeconomic conditions vary across different banana-growing areas of Kenya (Qaim, 1999), our sample is not representative for the country as a whole. But because we used stratified random sampling it is representative for members and nonmembers of banana farmer groups in the central highlands of Kenya. Sample descriptive statistics are provided further below.

(b) *Methodology for analyzing determinants of group membership*

Our first objective is to identify determinants of farmer group membership. Membership is associated with potential costs and benefits, which may be perceived differently by different households. Costs involve membership fees, time to participate in group activities, and transportation costs to deliver bananas to the collection centers, whereas the benefits are mostly in terms of better access to input and output markets, including technology and information. The individual decision to become member can be modeled in a random utility framework, which is a common approach to analyze innovation adoption under uncertainty (Feder, Just, & Zilberman, 1985; Marra, Pannell, & Abadi Ghadim, 2003). Hence, group membership can be modeled as a binary choice decision, assuming utility maximization subject to household resource constraints (Manski, 1977). The actual utility level of each individual farmer U_i is not observed. The part of the utility function that is observable can be expressed as a function of a vector of exogenous variables X_i and a vector of parameters β to be estimated:

$$V_i(\beta X_i), \quad \text{where} \quad U_i = V_i(\beta X_i) + u_i \tag{1}$$

The vector X_i includes farm and household characteristics, such as asset endowment, as well as proxies for financial, human, and social capital. The unobservable part of the farmers' utility is represented by an error term u_i and assumed to be independently and identically distributed with mean zero. The farmer will choose to be member if the utility U_i^c derived from group participation is higher than the utility U_i^f derived from nonparticipation.

The probability of a farmer being a member of the group is given by $P(u_i < \beta X_i)$. Hence, the membership model to be estimated is:

$$P(C_i = 1) = P(u_i < \beta X_i) = \beta X_i + u_i, \tag{2}$$

where $C_i = 1$ if $U_i^c > U_i^f$ and $C_i = 0$ if $U_i^c > U_i^f$.

Farmers face different transaction costs that stem from asymmetries in access to assets, information, services, and markets, leading to different market behavior (Barrett, 2008; Key *et al.,* 2000). The farmer's choice whether to join the group depends on the comparison of benefits and costs, hence on individual comparative advantage. This binary choice model can be estimated with a probit specification. Since farmers in control regions did not have the chance to join a group, the sample for this estimation will be confined to group members and nonmembers in treatment regions.

To identify explanatory variables, we draw on the existing literature. Supporting the hypothesis that human capital increases "the ability to perceive, interpret, and respond to new events" (Schultz, 1982), education and age, both proxies for human capital, are included in our analysis. Since we expect openness to innovations to decrease with old age, we also include a squared term of age. Physical assets, such as financial capital, land, and labor, are other important factors of innovation adoption (Boahene, Snijders, & Folmer, 1999). Cash is needed to buy agricultural inputs or TC planting material. Although group members are not required to adopt particular new technologies, improved access to TC planting material and related extension is one of the advantages of membership on the production side. Furthermore, farm size can play a role, because larger land holdings contribute to lower average fixed costs of membership. Sufficient labor availability is required for participating in direct group activities. And, with the upgrading of farm management practices the amount of labor required is likely to increase, too. We use physical assets such as land holding, value of agricultural equipment, number of cattle owned, access to credit, and nonfarm employment as proxies for physical and financial capital. Household size is used to measure labor availability. As increased land-tenure security has been found to increase investment incentives (Besley, 1995), we also include a variable for property title into our group membership model.

Even though selling bananas collectively is not an obligation for group members, it is one of the major expected benefits on the marketing side. Hence, for many banana growers, the decision to join a group is also a decision between selling individually at the farm gate and selling collectively at the collection center. Selling collectively may be associated with higher prices, but delivering to the collection center also involves a cost. In a similar context, Fafchamps and Hill (2005) found that output quantity sold and proximity to the collection center positively influence the likelihood of traveling to a market. We use the size of the banana plantation as a proxy for quantity sold. In order to avoid problems of endogeneity, we asked farmers for their banana holding 5 years ago, before farmer group activities had started.[2] Collection centers are typically located near paved roads, so that distance to the nearest paved road is also included as an explanatory variable. Furthermore, we use ownership of a donkey cart and motorized vehicle as indicators for transportation costs.

Gender can also influence a farmer's choice to participate in groups. Women may have different opportunities, motivation, and capabilities than men to engage in collective action (Pandolfelli, Meinzen-Dick, & Dohrn, 2007). For example, in the case of group-based extension approaches, women are often neglected, because male extension agents prefer to work with male landowners (Doss, 2001). Because of their reproductive responsibilities in addition to farming, women may also have higher opportunity costs of time, which may reduce their incentives for group membership (Meinzen-Dick & Zwarteveen, 1998). We include a dummy for female headed households to account for possible gender effects.

And finally, the efficiency of information flows may influence the decision to join a group. Empirical evidence shows that individual social networks are often relevant for the adoption of technologies and other innovations among smallholder farmers (Boahene et al., 1999; Conley & Udry, 2010; Matuschke & Qaim, 2009). We account for this by considering whether or not a farmer participates in other community-based groups (e.g., church groups, savings clubs). Moreover, we include a dummy for mobile phone ownership, because mobile phones can reduce the cost of information exchange substantially. This is especially true in the context of central Kenya, where households belonging to one community are not located in a central village place, but are scattered in the countryside.

(c) *Methodology for analyzing impacts of group membership*

Our second objective is to estimate impacts of farmer group membership on various variables of interest. These variables are explained further below. We first elaborate on the methodology of estimating unbiased treatment effects. We are interested in how membership affects the outcome for those who have decided to join a group; hence, we want to estimate the average treatment effect on the treated (ATT). Since we cannot observe how the outcome levels would have looked like without membership, we face the problem of missing data on the counterfactual. The challenge is to identify a suitable control group among those farmers who are not members, which can be used as a counterfactual. Due to nonrandom self-selection into farmer groups, we cannot simply compare outcomes of members and nonmembers, but need to account for self-selection bias.

There are two potential sources of bias. First, group members may differ from nonmembers with respect to observed characteristics, such as education and wealth. We control for observed characteristics by using propensity score matching (PSM). The main idea of PSM is to construct a suitable comparison group with nonmember individuals that are similar to group members in all relevant observed characteristics (Caliendo & Kopeinig, 2008). Second, members may differ with respect to unobserved characteristics, such as motivation. While PSM cannot control for bias due to unobservables, we test the robustness of the impact results through alternative model specifications and by using different matching algorithms.

Applying a PSM approach, the effect of group membership is modeled in two stages. In the first stage, we generate propensity scores $P(X)$ from a probit model, which indicate the probability of a farmer to be a group member. Then we construct a control group by matching group members to nonmembers according to their propensity scores. Members for whom an appropriate match cannot be found, as well as nonmembers not used as matches, are dropped from the further analysis. In the second stage, we calculate the ATT of group membership on outcome variable Y using matched observations of members and nonmembers. The PSM estimator of the ATT is the difference in outcomes between treatment and control group appropriately matched by the propensity score:

$$\tau_{\mathrm{ATT}}^{\mathrm{PSM}} = E_{(P(X)|C=1)}\{E[Y(1)|C=1,P(X)] - E[Y(0)|C=0,P(X)]\}, \quad (3)$$

where $Y(1)$ and $Y(0)$ are the outcomes for the treated with treatment (group membership) and control farmers without treatment, respectively, while $C = 1$ indicates treated farmers and $C = 0$ control farmers.

We consider a broad set of outcome variables, in order to understand group impacts and dynamic potentials from a wider perspective. We use the size of the banana plot, plot size changes over the past 5 years, and the share of banana in household income, to assess impacts on crop specialization. Share of banana sold is used to capture potential effects on commercialization. To measure the impact of groups on technology adoption, we use a TC adoption dummy. Moreover, we look at the quantity of inputs used, such as family and hired labor, fertilizers, and pesticides. Farmer group effects on productivity and quality are captured through yield per acre and average bunch weight (larger bunches are preferred by traders). Finally, we analyze differences in banana gross margins and total annual household income, to assess potential welfare effects of group membership.

Another question of relevance concerns the first-stage probit model to generate propensity scores. In Eqn. (2) we developed and explained a model to analyze determinants of group membership. While the idea of the probit for the PSM approach is related, its specification may differ, because the choice of variables is constrained by the requirements to satisfy the balancing properties (Heckman, Ichimura, & Todd, 1998). However, Rubin and Thomas (1996) argue that probit models for PSM should not be "trimmed" in the name of parsimony. They emphasize that a variable should only be excluded if there is consensus that it is either unrelated to the outcome or not a proper covariate. Furthermore, Caliendo and Kopeinig (2008) showed that the inclusion of nonsignificant variables in a PSM probit will not bias the estimates or make them inconsistent. Therefore, we use the same probit model as the one explained in Eqn. (2), which proved to achieve balancing for all important variables. However, instead of confining the estimation to farmers in treatment regions, this time we use the full sample that includes members and nonmembers in treatment and control regions. This allows us to exploit a larger set of control observations that can be used as potential matches for group members. [3]

4. RESULTS AND DISCUSSION

(a) *Descriptive statistics*

Some group characteristics are reported in Table 1. The oldest group in our sample was founded in 2000, before the NGO activities started in 2003; the youngest group was founded in 2008. The first groups started collective marketing in 2005. Three of 17 groups sampled were not involved in group marketing activities at the time of the survey: one group because of organizational difficulties and two others because they had just recently been formed. Group size ranges from 25 to 103 members. On average, 40% of the members are female, with a minimum of 10% and a maximum of 70%. The share of female members is negatively correlated with group size, which may suggest that women prefer groups in which they have closer social ties with other members.

There is evidence from other studies that the mix of activities and services provided by farmer groups significantly influences marketing performance and commercialization outcomes (Bernard & Seyoum Taffesse, 2009; Francesconi & Heerink, 2011). The groups analyzed here focus on banana production and marketing activities; they do not involve other

Table 1. *Group characteristics*

	N	Mean	SD	Median	Minimum	Maximum
Year group was formed	17			2006	2000	2008
Year group started selling banana collectively	14[a]			2008	2005	2009
No. of members	17	51.9	21.9	44	25	103
Share of female members	16[b]	0.4	0.2	0.4	0.1	0.7
No. of group buyers	14[a]			1.5	1	6
Average banana price received from buyers (KShs./kg)	14[a]	9.6	0.7	10.0	8	10.5
Average share sold through group	14[a]	0.53	0.18	0.55	0.27	0.82
Average participation in group market days (no. per year)	14[a]	8.1	8.4	5.1	0.8	28.5
Average participation in meetings (no. per year)	17	7.4	2.5	7.5	2.2	13.1
Average participation in technical trainings (no. per year)	17	2.6	0.9	2.3	1.4	4.6
Group savings (1,000 KShs.)	17	25.7	54.7	6.0	0	222

[a] Three groups were not selling collectively at the time of the survey.
[b] Data unavailable for one group.

crops or social services. Table 1 shows that there are differences in the extent of member commitment across groups in terms of participation in meetings and collective marketing days. The share of banana sales made through the group varies from 27% to 82%.

Table 2 reports sample mean values for farm and household characteristics of group members, nonmembers in the same regions (treatment regions), and farmers (nonmembers) in control regions where no groups operate. On average, group members are wealthier in terms of land and various other assets owned than farmers in the two nonmember categories. They are also slightly older and better educated. This hints at a positive selection bias in farmer group participation; better-off farmers are more likely to join groups. Nonetheless, for many of the variables the differences between members and nonmembers are relatively small. Members can still be considered small-scale farmers; their average farm size is 3.22 acres.

Control regions without farmer group activities were specifically sampled to have similar characteristics as the "treatment regions" in terms of agroecological and infrastructure conditions. We performed tests on the inequality of variable means between nonmembers in the treatment and control regions. We found significant differences with respect to the number of cattle owned, membership in other groups, and distance to the nearest paved road, where farmers in control regions have higher values than nonmembers in treatment regions. This is plausible, because farmers in control regions could not self-select into group membership. For all other variables, differences are not statistically significant, so that we conclude that farmers in treatment and control regions are generally similar and comparable.

(b) *Determinants of group membership*

We now estimate the probit model of farmer group membership, as described above in Eqn. (2). As mentioned, the sample for this estimation is confined to group members and nonmembers in treatment regions. The results are shown in Table 3, column (1). The size of the land holding has a positive and significant effect on the probability of membership; each additional acre of land owned increases the probability by almost 4.3 percentage points. This is plausible, because larger farms are not only wealthier but also have a higher capacity to expand banana production. The probability of membership decreases again for farms larger than 11 acres, as implied by the negative effect of squared land holding. Hence, we can

Table 2. *Farmer characteristics*

Variable	Description	Members		Nonmembers		Farmers in control regions	
		Mean	SD	Mean	SD	Mean	SD
Land holding	Total land owned by household in acres	3.22	2.988	2.25	3.566	1.79	1.407
Property title	Household has property title for land (yes = 1, no = 0)	0.76	0.427	0.64	0.481	0.56	0.499
Lagged banana area	Size of banana plantation 5 years ago	0.17	0.320	0.10	0.169	0.09	0.153
Equipment	Log of value of agricultural equipment in 1,000 KShs.	3.90	1.596	2.84	1.305	3.09	1.367
Donkey cart	Household owns donkey cart (yes = 1, no = 0)	0.54	0.499	0.32	0.469	0.40	0.491
Motorized	Household owns car, pick-up or motorbike (yes = 1, no = 0)	0.19	0.396	0.05	0.221	0.06	0.232
No. of cattle	No. of cattle owned by household	2.39	1.778	1.55	1.388	1.93	1.593
Age	Age of household head in years	55.99	13.029	51.59	15.615	52.42	14.910
Education	Head has primary education or above (yes = 1, no = 0)	0.81	0.396	0.67	0.471	0.67	0.473
Female head	Female headed household (yes = 1, no = 0)	0.15	0.362	0.20	0.399	0.15	0.360
Household size	Number of household members	4.70	2.086	4.43	1.901	4.49	1.822
Phone	Household owns mobile phone (yes = 1, no = 0)	0.92	0.279	0.70	0.460	0.78	0.414
Social participation	Household participates in other groups (yes = 1, no = 0)	0.85	0.362	0.71	0.456	0.81	0.393
Credit	Household has access to credit (yes = 1, no = 0)	0.94	0.238	0.82	0.382	0.88	0.330
Road distance	Distance to nearest paved road in km	2.07	2.557	1.66	2.627	2.81	4.844
Employed	Household member has nonfarm employment (yes = 1, no = 0)	0.35	0.478	0.31	0.463	0.30	0.461
Self-employed	Household member has nonfarm self-employment (yes = 1, no = 0)	0.41	0.494	0.31	0.463	0.26	0.443
	No. of observations	201		137		106	

Table 3. *Probit model of group membership*

	(1) Restricted sample: members and nonmembers from treatment regions			(2) Full sample: members and nonmembers from treatment and control regions		
	Coefficient	SE[a]	Marginal effect	Coefficient	SE[a]	Marginal effect
Land holding	0.113**	0.055	0.043**	0.144***	0.039	0.057***
Land holding squared	−0.005**	0.002	−0.002**	−0.005***	0.001	−0.002***
Property title	−0.119	0.199	−0.045	0.056	0.184	0.022
Lagged banana area	0.397	0.750	0.152	0.388	0.557	0.153
Lagged area squared	−0.165	0.310	−0.063	−0.068	0.270	−0.027
Equipment	0.122*	0.067	0.047*	0.089	0.064	0.035
Donkey cart	0.299	0.189	0.114	0.146	0.172	0.058
Motorized	0.092	0.258	0.035	0.118	0.213	0.047
No. of cattle	0.053	0.053	0.020	0.002	0.043	0.001
Age	0.082*	0.044	0.031*	0.042	0.041	0.016
Age squared	−0.001	0.000	−0.000	−0.000	0.000	−0.000
Education	0.096	0.206	0.037	0.305	0.194	0.118
Female head	0.093	0.220	0.035	0.122	0.220	0.048
Household size	0.007	0.042	0.003	0.030	0.044	0.012
Phone	0.602***	0.180	0.236***	0.456***	0.173	0.172***
Social participation	0.250	0.161	0.097	0.096	0.142	0.037
Credit	0.575*	0.303	0.226*	0.451*	0.274	0.168*
Road distance	0.156**	0.062	0.060**	0.223***	0.073	0.087***
Road distance squared	−0.014**	0.006	−0.005**	−0.021***	0.007	−0.008***
Employed	0.092	0.168	0.035	0.059	0.148	0.023
Self-employed	0.233*	0.129	0.088*	0.332***	0.114	0.131***
Constant	−4.730***	1.093		−3.905***	0.945	
Observations		338			444	
Pseudo R-squared		0.201			0.186	

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.
*** Denotes significance at the 1% level.
[a] Standard errors are robust and cluster corrected.

observe a middle-class effect where very small and large farmers are less likely to be members. The value of agricultural equipment has a positive effect, which reflects higher ability to invest in innovations and inputs. Somewhat surprisingly, the banana plot size 5 years ago has no significant effect on the probability of being a member. This implies that specialization on banana prior to group membership does not affect farmers' interest or ability to join.

Age exhibits a positive effect. This can be explained by farming experience, which is usually positively correlated with age. Furthermore, additional discussions that we had with farmers in the survey regions revealed that the younger generation is not very interested in farming but rather hopes to find employment outside agriculture in the future, preferably in urban areas. Education and gender do not have significant effects. Especially the fact that there is no gender bias in group membership is an important and welcome finding, because banana has traditionally been a women's crop in Kenya.

In terms of social networks, participation in other community groups does not affect the decision to join a banana group significantly, but mobile phone ownership seems to be an important determinant of group membership. One explanation is that phone owners may have been the first to learn about farmer group formation. Moreover, farmers with mobile phones are more easily contacted and notified to attend market days and other group activities. It follows that efficient means of communication can facilitate the formation of farmer collective action, especially when households are not located in a central village place.

Access to credit also shows a positive effect on group membership. As mentioned, farmers have to pay a membership fee when they join a group. Also, the adoption of TC technology and related investments require access to sufficient financial capital. During the time of the survey, TC plantlets were sold at a price of 80–100 KShs. each, so that buying only a few plantlets already entails a relatively large investment for resource-poor smallholders. Finally, the distance to the nearest paved road has a positive, curvilinear effect on the probability of group membership. Farmers located very near to a paved road have better access to markets anyway, so that they are less dependent on group activities, especially collective marketing. In contrast, farmers with greater difficulties in accessing road infrastructure may expect higher returns of group membership and are hence more likely to join. Distance increases the probability of membership, but only up to a distance of about 6 km, after which the probability decreases again. This is plausible, because the cost of transportation to banana collection centers and the cost of participation in group meetings increase with distance. Thus, farmers in very remote locations may prefer selling to traders at lower prices at the farm gate.

It should be noted that some of the covariates may potentially be endogenous. For example, ownership of mobile phones among group members could be higher due to higher incomes as a result of group membership, which would lead to reverse causality. Likewise, higher incomes from group marketing could potentially be used for additional investments into farm and nonfarm assets. However, most of the groups have only started with collective marketing shortly before we implemented the survey, so that the monetary benefits may not yet have resulted in significant new investments. We also tested for differences in all covariates between group members who started collective marketing before and after 2008, in order to find out whether members in older groups have accumulated more assets than members in younger groups. While, we found significant differences with respect to some of the human capital covariates (age, education, and household size), differences were not statistically significant for most of the asset variables. One exception is the value of agricultural equipment, but, strikingly, this is higher for members in younger farmer groups. Therefore we conclude that issues of endogeneity are negligible in our context.

(c) *Impacts of group membership*

Following the procedure outlined in Section 3, we re-estimated the probit model of group membership, now using the full sample of members and nonmembers in treatment and control regions, in order to calculate individual propensity scores. The results of this full sample probit are shown in Table 3, column (2). The propensity scores were then used to match members to nonmembers. We imposed a tolerance level (caliper) on the propensity score distance of 0.008 to avoid the risk of bad matches (Caliendo & Kopeinig, 2008). We then performed radius matching, which uses a weighted average of all available comparison observations within the caliper as the counterfactual.[4] Figure 1 shows the density of propensity scores for group members and nonmembers. As can be seen, the condition of common support is fulfilled, since the propensity score distributions largely overlap. From this overlap it also follows that farmer groups are relatively inclusive of the poor. The majority of group members seem to be comparable to the majority of the nonmembers.

Some randomness in the selection into treatment is needed, such that individuals with similar characteristics can be observed among the treated as well as the nontreated (Heckman *et al.,* 1998). With perfect selection into treatment and nontreatment, effects could not be estimated. Furthermore, the major objective of propensity score modeling is not to perfectly predict selection into treatment and nontreatment, but rather to balance all covariates (Caliendo & Kopeinig, 2008). Since PSM does not match treatment and nontreatment observations on all covariates, but on a single dimension variable

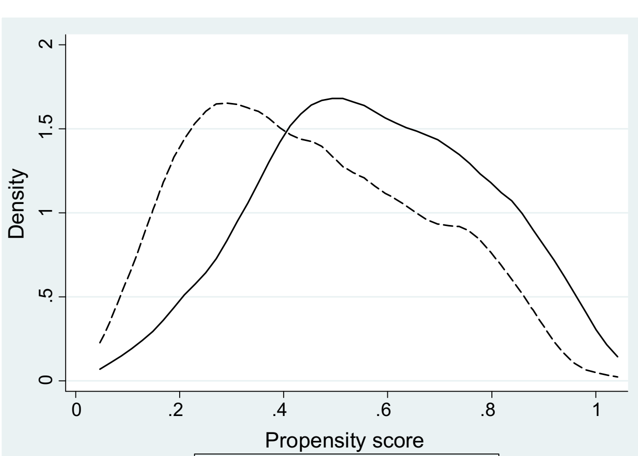

Figure 1. *Propensity score distribution.*

that is a function of the covariates, one has to ensure that similar propensity scores emerge from similar characteristics. Therefore, we performed balancing tests after matching. Table 4 reports the means of all covariates for the treated and nontreated before and after matching. Average land holding of group members is reduced if only matched group members are considered. On the other hand, average land holding is increased for nonmembers, when those that are not used as matches are dropped. Similar changes can also be observed for other covariates, such as value of agricultural equipment, ownership of motorized vehicle, and number of cattle owned.[5] After matching, no significant differences in covariates remain.

After matching, the ATT for the various outcome variables can be calculated according to Eqn. (3). The results are shown in Table 5. Since different modes of participation in group activities can be observed among the members, we differentiate between additional sub-categories. In particular, we observed that around 40% of the members did not participate in collective marketing, but continued to sell individually. This may affect output prices obtained and thus also gross margins and incomes. Therefore, we separately compare nonmembers with members who market collectively and with members who market individually. For the purpose of this analysis, members who market individually are defined as those who sell nothing through the group. On the other hand, members who market collectively may sell all or part of their produce through the group, but some of them also sell other parts individually. Since one of our main interests is analyzing the effect of collective *versus* individual marketing, we restricted the sample to banana farmers that had actually been selling bananas during the 12 months prior to the survey. A small number of farmers who had only produced bananas for home consumption were dropped from the PSM analysis. Thus, we remain with a sample of 181 group members and 198 nonmembers.

First, we find that group members and nonmembers have increased the area allocated to banana production over the past 5 years. This is due to the fact that banana has become more profitable relative to other crops. However, members have expanded their plantations significantly more than nonmembers, which is likely due to their improved access to technical extension information, clean planting material, and other incentives offered through the farmer groups. Indeed, adoption of TC banana is much more widespread among group members, with adoption rates ranging between 72% and 73% compared to 14–20% among nonmembers.

Second, we find that marketing through the group yields a higher price than selling individually. The average price per kg of banana has increased by 1.73 KShs. for those members who market collectively, which is an increase of 23%. The same increase in prices cannot be observed for group members who continue to sell individually. It should be noted that strictly speaking the prices are not comparable, because most farmers who sell individually do so at the farm gate, while collective marketing requires transportation to the group collection center. However, most group members use family labor for transportation, so that no monetary cost accrues that would need to be accounted for in gross margin or income calculations. Nonetheless, a simple calculation reveals that, the magnitude of the price premium for collective marketing is not much larger than the opportunity cost of family labor valued at the market wage rate. While the average premium is about 47 KShs. for a bunch of typical size, a casual laborer hired to transport a bunch to the group collection center would earn about 20–50 KShs., depending on the distance. This relatively low price premium is surprising, because one of the objectives of group marketing is also to reduce the

Table 4. *Balancing test results*

	Unmatched			Radius matching		
	Treated	Control	Difference *p*-value	Treated	Control	Difference *p*-value
Land holding	3.28	2.09	0.00	2.51	2.42	0.68
Land holding squared	19.91	12.98	0.40	10.49	8.55	0.34
Property title	0.77	0.64	0.01	0.74	0.73	0.94
Lagged banana area	0.18	0.11	0.01	0.13	0.13	0.84
Lagged area squared	0.14	0.04	0.04	0.04	0.05	0.66
Equipment	179.75	59.35	0.00	3.59	3.43	0.26
Donkey cart	0.55	0.39	0.00	0.49	0.48	0.95
Motorized	0.2	0.06	0.00	0.11	0.09	0.60
No. of cattle	2.46	1.75	0.00	2.22	1.98	0.20
Age	56.29	52.14	0.01	55.1	55.69	0.70
Age squared	3340.3	2948.3	0.02	3210.4	3270	0.73
Education	0.82	0.7	0.01	0.8	0.78	0.78
Female head	0.15	0.18	0.40	0.16	0.19	0.60
Household size	4.65	4.38	0.19	4.56	4.75	0.39
Phone	0.91	0.77	0.00	0.89	0.9	0.72
Social participation	0.86	0.79	0.06	0.84	0.81	0.42
Credit	0.95	0.88	0.01	0.94	0.97	0.24
Road distance	2.03	2.09	0.85	1.94	2.03	0.78
Road distance squared	10.7	17.75	0.10	10.47	11.23	0.80
Employed	0.35	0.32	0.61	0.35	0.35	0.94
Self-employed	0.41	0.29	0.01	0.37	0.34	0.65
Median bias		25.71			3.51	
Pseudo R-squared		0.17			0.03	
p-value of LR		0.00			0.96	

Table 5. *Average treatment effects on the treated (ATT)*

Outcome	Collective marketing				Individual marketing			
	Members	Nonmembers	ATT	SE[a]	Members	Nonmembers	ATT	SE[a]
Banana plot size (acres)	0.41	0.25	0.16	0.049***	0.30	0.24	0.06	0.049
Plot increase past 5 years (acres)	0.26	0.12	0.14	0.035***	0.20	0.10	0.10	0.034***
TC plantlet adoption	0.72	0.14	0.58	0.063***	0.73	0.20	0.53	0.095***
Average price per kg (KShs.)	9.33	7.60	1.73	0.508***	7.65	7.93	−0.28	0.607
Yield (kg/acre)	13.59	15.38	−1.79	1.546	9.63	15.02	−5.39	1.610***
Average bunch weight (kg)	26.97	25.77	1.19	1.077	26.35	25.34	1.00	1.418
Family labor (hours/acre)	145.51	125.83	19.68	21.299	109.50	107.99	1.51	19.055
Hired labor (hours/acre)	129.20	51.30	77.91	24.862***	178.24	43.27	134.97	45.889***
Manure (1,000 kg/acre)	12.58	10.69	1.89	1.557	13.59	9.51	4.08	2.734
Fertilizer and pesticide costs (1,000 KShs./acre)	2.00	0.43	1.57	0.487***	3.16	0.43	2.72	1.408
Total costs (1,000 KShs./acre)	8.95	4.23	4.71	1.295***	10.52	3.64	6.88	2.244***
Share of bananas sold	0.71	0.64	0.07	0.036**	0.60	0.64	−0.05	0.045
Banana gross margin (1,000 KShs./acre)	125.08	108.61	16.47	15.452	55.89	108.49	−52.60	12.527***
Total banana income (1,000 KShs.)	45.98	23.34	22.64	0.021***	20.81	23.07	−2.25	6.714
Share of banana income to total income	0.18	0.10	0.08	6.358***	0.09	0.10	0.00	0.021
Total annual income (1,000 KShs.)	342.67	268.77	73.91	39.087*	300.52	283.43	17.09	47.119
No. of participants with match		103 of 121				49 of 60		

* Denotes significance at the 10% level.
** Denotes significance at the 5% level.
*** Denotes significance at the 1% level.
[a] Standard errors are bootstrapped with 500 replications.

number of middlemen and directly link farmers to wholesalers with a better bargaining position. We do not find clear evidence of reduced inefficiencies or improved bargaining power. A possible explanation is that physical infrastructure has improved considerably in the central highlands of Kenya during the past 5 years (Chamberlin & Jayne, 2009). This has probably contributed to more efficient marketing channels and lower external transaction costs, even without collective marketing. The modest price incentive may also explain why many group members prefer to sell individually.

Third, we find no change in yields for group members who market through the group and a significant decrease in yields for members who market individually. One explanation is that a number of group members who have recently expanded their banana plantations and adopted TC technology have not yet harvested from the new plants; it takes more than 1 year until newly planted bananas bear fruits. In addition, in 2009, when the survey was carried out, bananas had suffered from a prolonged drought. Even though traditional bananas suffered under drought conditions as well, TC plantlets are particularly susceptible to water stress in the first few months after establishment (Qaim, 1999). The low yield performance in 2009 may also explain why some group members continued to market individually: they cannot (yet) deliver sufficient quantities that make collective marketing profitable for them. Hence it is not surprising that the share of bananas sold has increased for members who sell through the group, but not for members who market individually.

Fourth, regarding input use for banana production, we find that family labor hours per acre have not changed significantly for members. On the other hand, a significant increase in hired labor use can be observed. Obviously, group members face family labor constraints when expanding banana production, which are compensated through hired labor. In terms of manure use, we find no significant effects of group participation. Even though manure use is recommended by NGO extensionists, manure availability is limited in central Kenya (Lekasi, Tanner, Kimani, & Harris, 1998). Yet, we find a significant increase in the use of chemical fertilizers and pesticides among group members. [6] Likewise, total cash outlays have increased significantly, even though input use still remains far below recommended levels.

Finally, for members selling through the group we observe a significant increase in total banana income, which also translates into a higher contribution of this crop to total income. Furthermore, we find an increase in total annual income in a magnitude of 27%, implying that group membership has a positive impact on household welfare. Yet the same effects are not observed for members who sell individually, which stresses that not only membership *per se* but also the mode of group participation matters. Furthermore, for the members who sell collectively the positive income effects seem to be more due to the expansion of banana production rather than price premiums or productivity gains, because no significant impact on banana gross margins per acre can be observed. This suggests that the benefits of farmer groups in this particular context are more indirect through better access to information and planting material needed for successful expansion of the crop.

To analyze the effects of membership on access to information further, we compare to what extent certain practices recommended by extensionists are followed by farmers in our sample. Figure 2 shows differences in management practices between matched group members and nonmembers. As can be seen, more group members follow recommendations with respect to most of the practices recommended. One exception is the time of harvesting: while 77% of the nonmembers wait until bananas are fully mature, only around 70% of the members do so. This may be explained by the fact that the income-generation function of banana is more important among members, so that they tend to market bunches as early as possible. Overall, however, it can be concluded that group membership influences plantation management positively, underlining that access to technical information is improved through participation.

(d) *Testing the robustness of the ATT results*

One of the assumptions of PSM is conditional independence, or un-confoundedness (Rosenbaum & Rubin, 1983), which implies that treatment assignment is entirely based on observed characteristics. Therefore, PSM can only account for selection bias due to observables. The assumption is violated if unobserved characteristics also determine treatment assignment. Following Godtland, Sadoulet, de Janvry, Murgai, and Ortiz (2004) we test the robustness of the estimated ATTs by using variations in the specification of the probit model of group membership. The ATT results for members marketing collectively from the base model and two variations are reported in Table 6. The first variation, shown in column (2), uses a reduced probit model, which excludes potentially endogenous variables, such as number of cattle owned, value of agricultural equipment, means of

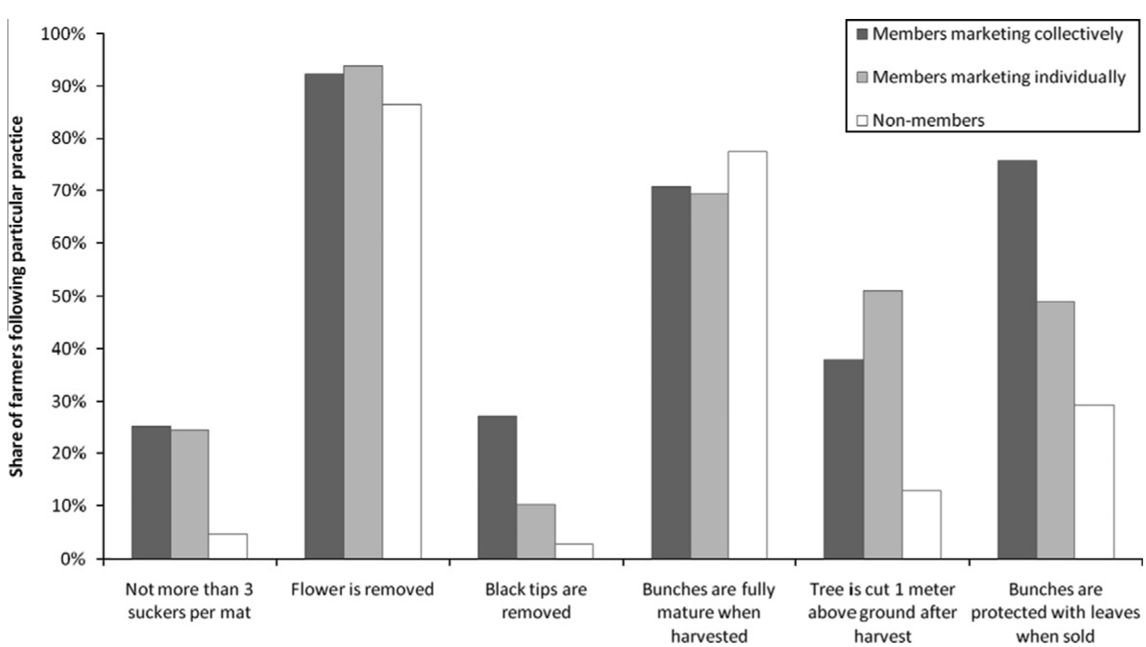

Figure 2. *Differences in banana plantation management.*

Table 6. *Robustness of ATT results for collective marketing*

Outcome	(1) Base model	(2) Reduced model	(3) Extended model	(4) Kernel-based matching	(5) 5-Nearest neighbor matching
Banana plot size (acres)	0.16***	0.19***	0.16***	0.16***	0.17***
Plot increase past 5 years (acres)	0.14***	0.17***	0.14***	0.14***	0.14***
TC plantlet adoption	0.58***	0.55***	0.53***	0.58***	0.58***
Average price per kg (KShs.)	1.73***	1.71***	1.83***	1.68***	1.74***
Yield (kg/acre)	–1.79	–1.01	–1.50	–1.93	–1.76
Average bunch weight (kg)	1.19	1.26	0.64	1.26	1.19
Family labor (hours/acre)	19.68	20.84	25.46	19.07	19.07
Hired labor (hours/acre)	77.91***	102.75***	92.29***	79.70***	78.21***
Manure (1,000 kg/acre)	1.89	2.28*	1.53	1.91	2.01
Fertilizer and pesticide costs (1,000 KShs./acre)	1.57***	1.47***	0.95	1.59***	1.59***
Total costs (1,000 KShs./acre)	4.71***	5.00***	4.58***	4.43***	4.76***
Share of bananas sold	0.07**	0.09***	0.04	0.07***	0.07**
Banana gross margin (1,000 KShs./acre)	16.47	19.74	13.47	15.36	17.27
Total banana income (1,000 KShs.)	22.64***	32.42***	21.19***	22.84**	22.97***
Share of banana income to total income	0.08***	0.08***	0.06***	0.08***	0.08***
Total annual income (1,000 KShs.)	73.91*	72.52*	47.63	71.68*	75.68**
Balanced covariates	Yes	Yes	Yes	Yes	Yes
No. of members with match	103	109	95	103	103

Significance levels are based on bootstrapped standard errors with 500 replications.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.
*** Denotes significance at the 1% level.

transportation, and mobile phone ownership. The second variation, shown in column (3), uses an extended model, including additional variables, such as risk attitude, cash crop production, a dummy measuring the efficiency of the banana supply chain in the sub-location, and ownership of irrigation equipment 5 years ago. The matching quality of both variations is similar to the base model; all covariates are balanced between treatment and control.

Comparison of the results reveals that some of the outcomes are sensitive to the probit specification. While the signs of the ATTs are mostly unchanged, the magnitudes and significance levels vary. For example, fertilizer and pesticide costs are significantly different between members and nonmembers with the base and reduced model, but not with the extended model. Likewise, the total annual income effect is smaller and not significant with the extended model. The other outcome indicators are relatively robust to alternative probit model specifications. Therefore, even if unobserved characteristics should play a certain role, they are unlikely to overturn most of the general findings on the impacts of group membership.

We also carried out robustness tests, using the base model for the probit specification, but matching algorithms other than radius matching. In particular, we used kernel-based and nearest-neighbor matching, results of which are shown in columns (4) and (5) of Table 6. As can be seen, the ATT results are very similar to those with radius matching shown in column (1), implying that they are not sensitive to different matching algorithms.

(e) *Heterogeneous impacts*

Since groups differ in their age, and many of the farmers in newer groups have recently established TC banana plantations that are not yet bearing fruits, it is also interesting to analyze ATTs disaggregated by group age. This is done in Table 7, where we differentiate between groups that started in 2007 or earlier and groups that started in 2008 or later. As before, we use radius matching. Yet, here we do not distinguish between collective and individual marketing. The results for all group members are shown for comparison in the first column of the table. We observe that the decrease in yields is only significant for the younger groups, which is plausible, given that it takes about 1 year until a newly established banana plantation produces. Accordingly, rates of participation in collective marketing are lower for members in younger groups. The yield decrease also explains the negative gross margin effects observed, even though these are not significant. Input use is slightly higher in younger than in older groups, which is probably related to the fact that new TC plantations have higher input requirements in the initial stages. By contrast, a significant increase in banana income can only be observed in older groups. Likewise, the group membership effect on the share of banana income to total income is higher in older than in younger groups. These results imply that the benefits of group membership do not materialize immediately, especially when group activities go beyond collective marketing and also involve aspects of technology adoption and production in perennial crops like banana.

Another interesting disaggregation is by farm size. Previous studies showed that farmers with different land holdings may respond differently to new opportunities offered through collective action (e.g., Bernard & Spielman, 2009; Quisumbing, McNiven, & Godquin, 2008). Hence, in the right-hand part of Table 7 we categorize members by farm size. Surprisingly, the biggest effect of group membership on the level of commercialization, as measured by the share of bananas sold, is observed for the smallest farms with a total land holding of up to 1 acre. This suggests that group membership may stimulate the market orientation of very small farms. In addition, the impact on TC technology adoption is somewhat higher for the smallest farms

Table 7. *ATTs disaggregated by groups' age and members' farm size*

Outcome	All members[a]	Time group started		Members' land holding		
		Before or in 2007	In 2008 or after	0.10–1 acre	1–3 acres	>3 acres
Banana plot size (acres)	0.14***	0.11**	0.14***	0.05	0.14***	0.210**
Plot increase past 5 years (acres)	0.13***	0.13***	0.13***	0.06*	0.12***	0.20***
TC plantlet adoption	0.60***	0.64***	0.52***	0.57***	0.53***	0.64***
Participation in collective marketing	0.68***	0.75***	0.63***	0.73***	0.61***	0.75***
Average price per kg (KShs.)	1.08**	1.54***	0.81	0.73	1.37**	0.83
Yield (kg/acre)	−3.11***	−1.15	−4.036***	−1.25	−3.95***	−2.55
Average bunch weight (kg)	1.31	1.29	1.04	0.44	0.74	2.66
Family labor (hours/acre)	12.26	11.68	15.11	57.11	22.77	−48.32
Hired labor (hours/acre)	92.92***	79.03***	106.67***	2.16	76.19***	232.85***
Manure (1,000 kg/acre)	2.42*	2.96	2.38	3.42	2.59	1.79
Fertilizer and pesticide costs (1,000 KShs./acre)	1.99***	1.38**	2.28***	1.25	2.16**	2.19**
Total costs (1,000 KShs./acre)	5.10***	3.53***	6.54***	1.96	4.84***	10.07***
Share of bananas sold	0.04	0.01	0.05	0.11*	0.02	−0.03
Banana gross margin (1,000 KShs./acre)	−12.01	17.81	−19.96	10.67	−15.37	−2.08
Total banana income (1,000 KShs.)	13.40***	27.69***	6.76	12.14*	13.08*	20.31
Share of banana income to total income	0.04***	0.09***	0.03*	0.07**	0.03	0.07**
Total annual income (1,000 KShs.)	49.75	65.91	49.40	−7.07	67.99	92.11
No. of members with match	149 of 181	57 of 66	95 of 115	37 of 37	78 of 82	37 of 62

Significance levels are based on bootstrapped standard errors with 500 replications.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.
*** Denotes significance at the 1% level.
[a] This includes group members who market collectively and individually.

than it is for the 1–3 acre category. The group membership effect on total banana income is positively correlated with farm size, when the effect is expressed in absolute monetary terms. However, as the smallest farms have much smaller banana plots and lower total banana incomes, the relative gain is highest for them. The effects on total household income are not statistically significant for any of the farm size categories, which may be due to the relatively small subsample sizes.

5. CONCLUSION

In this article, survey data from central Kenya were used to analyze the multiple benefit pathways of farmer organizations. In particular, factors influencing the participation of small-scale banana growers in farmer groups and impacts of group membership were investigated. The groups considered were recently formed with the support of NGOs, in order to improve farmers' access to new banana technology, related technical extension, and output markets.

The results show that the groups are generally inclusive of poor farmers. Nonetheless, ownership of land and other agricultural assets as well as access to credit significantly increase the probability of joining a group. This is in line with findings from other studies showing that the poorest of the poor are sometimes left out of collective action arrangements (e.g., Bernard & Spielman, 2009; Quisumbing et al., 2008). Moreover, distance to paved roads and ownership of a mobile phone influence the decision to join a group. Hence, farmers with greater capacity to implement innovations and absorb and exchange information are more likely to engage in collective action. Group membership is not associated with a gender bias.

Impacts were analyzed with a propensity score matching approach. We found that group membership leads to a significant increase in household income, but only for those farmers that also market collectively. This underlines that it is not group membership *per se* that matters, but the degree of participation in certain group activities. While this may seem obvious, it was not always considered in previous studies. The benefits observed are mainly due to specialization effects. That is, group members expanded their banana area significantly more than nonmembers, so that the share of banana income and the degree of banana commercialization increased. Group participation is also associated with higher adoption rates of tissue culture technology and higher use intensities of chemical inputs in banana production. Similarly, more group members follow plantation management practices as recommended by extension workers. These are clear indications that collective action can spur innovation through promoting efficient information flows. This is also an explicit objective of the groups analyzed, with group activities that go far beyond collective marketing. Against this backdrop it is surprising that no positive productivity effects could be observed. This may potentially be due to unfavorable weather conditions, in particular the persisting drought in the survey year. Moreover, some of the newly established tissue culture plants were still very young, so that positive yield effects may occur when the plantations are further developed.

Output price advantages associated with collective marketing are positive and significant, but relatively small in magnitude. This may also explain why many group members continue to sell individually. The reason for the relatively low price advantage is probably that infrastructure conditions in central Kenya were substantially improved in recent years. Thus, traditional banana markets became more transparent and efficient even without collective action. This does not mean that there is no role for farmer groups to further improve marketing performance, especially with respect to high-value markets. Emerging supermarket and export supply chains are often associated with new transaction costs through standards, contractual relationships, or other requirements (Reardon *et al.,* 2009; Schipmann & Qaim, 2011). Cooperative organization provides important preconditions for better linking smallholders to such emerging value chains, but this potential is still untapped in the Kenyan banana sector.

The findings from this study also offer some broader lessons. Some of the theoretical motivations for collective marketing seem to apply less strongly for bananas in Kenya, which may also explain the relatively modest price and income effects observed. The first motivation for collective marketing is to reduce external transaction costs through exploiting economies of scale in selling. In many developing countries, poor infrastructure and remoteness have led to highly inefficient supply chains, with a number of nonvalue adding intermediaries involved. Collective marketing can reduce the number of intermediaries and is therefore particularly relevant in cases where supply chains are long and inefficient (Markelova & Mwangi, 2010). When supply chains are relatively short, as is now the case for bananas in central Kenya, the potential for additional efficiency gains through group marketing is small. A second motivation for collective marketing is the creation of countervailing power toward buyers, who are often larger in size and thus may show opportunistic behavior. But banana farmers in central Kenya are hardly suffering from such opportunism, as the traders themselves are small and numerous. The market structure for bananas in Kenya could potentially change in the future, when supermarket or export channels gain in importance. Such emerging channels are often associated with a higher degree of monopsony power. Overall, collective marketing seems to be more beneficial in high-value supply chains than in local markets for staples and other traditional food crops.

The general conclusion to be drawn is that cooperative organization does not *per se* improve market access for smallholder farmers. The potential benefits are very product and context specific, and they also depend on the concrete collective activities pursued. Focusing group efforts on better linking farmers directly to emerging high-value chains seems to be one promising avenue to increase benefits and make the groups more sustainable. Yet, the findings also suggest that—beyond mere price advantages—farmer organizations can function as important catalysts for innovation adoption and upgrading of production systems through promoting efficient information flows. These are also crucial conditions for smallholders to remain competitive in rapidly changing environments.

NOTES

1. According to a recent publication by the Kenyan Government, small-scale farmers are defined as those that produce on less than 10 acres of land (Ministry of Agriculture, 2010).

2. The project to establish and promote banana groups by Africa Harvest and TechnoServe started in 2003. A few groups had already existed before this, but most of the groups in our sample were established in 2004 or later. The first activities of collective banana marketing in our sample groups started in 2005 (see Table 1).

3. An alternative to using the full sample for the probit would have been to only use farmers in treatment regions and then make out-of-sample predictions to generate propensity scores for nonmembers in control regions. However, this would have complicated the estimation of correct standard errors for the ATTs.

4. We also used other matching methods to test the robustness of the results, which is reported in detail further below. Moreover, we performed sensitivity analysis using different caliper sizes, results of which can be made available upon request.

5. These patterns suggest that the poorest nonmembers either do not have access to farmer groups or do not find it sufficiently profitable to join. The PSM analysis here cannot make any predictions about how the effects might look like for them if they were to join a group.

6. We collected data on fertilizer and pesticide quantities and prices. No significant differences in input prices between group members and nonmembers could be observed. This should not surprise, because the farmer groups do not purchase fertilizers and pesticides collectively.

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