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Abstract

This paper assesses determinants of crop market participation among smallholder farmers in Tanzania, with a focus on transaction cost, asset endowment and cooperatives. The study is based on household survey data from Southern Tanzania where cooperatives play a significant role in the cash crop market. We analyse market participation using Cragg's double-hurdle model and account for potential endogeneity of cooperative membership using control function approach. We find that distance to market negatively influences cash crop sales while better access to information and communication encourages both food and cash crop marketing. Among asset endowments, only agriculture-specific resources have significant impact. The study shows that marketing cooperatives enhance crop market participation of their members as the cooperatives improve the productive capacity of farmers. However, we also found that marketing cooperatives appear to *stunt local food market activities*. Having a marketing cooperative branch in the village reduces both the likelihood of selling food crops and the amount sold by residents of the village. It does not affect cash crop marketing decision.

Key words: Crop market participation; agricultural market; smallholder market participation; cooperatives; Africa; Tanzania

1 Introduction

African economies experienced significant economic growth in recent years, creating a surge of optimism around the continent's future (MGI, 2010). However, in many cases, the observed economic growth was not accompanied by significant structural change. Labour productivity remained low and agriculture remained the main employer in most of these economies (Rodrik, 2016; McMillan and Headey, 2014; UNECA, 2014). Tanzania is one of the countries that experienced rapid economic growth with slower structural transformation (WB, 2017; NBS, 2017a). There is high hope that a recent discovery of natural gas reserve in Tanzania will accelerate this economic growth and facilitate inclusive economic development (Kamat et al., 2019; Poncian, 2014). However, 70 percent of Tanzania's population live in rural areas, often engaged in agriculture (NBS, 2017a). A sustained and broad based development cannot happen without a structural transformation and commercialization in agriculture, where 66% of the labor force is employed (NBS, 2018b). Active agricultural markets are central to structural transformation and for enabling farmers to receive gains from growth in other sectors of the economy. Currently, the majority of farmers in Tanzania are subsistence oriented smallholders (NBS, 2017b) and are not likely to benefit from new opportunities generated in other sectors of the economy.

This is not unique to Tanzania. In many agricultural dependent countries in Africa, agriculture is dominated by subsistence farmers whose production is primarily targeted for home consumption (Heltberg and Tarp, 2002; Boughton et al., 2007; Barrett, 2008; Alene et al., 2008; Morris et al., 2009, Jayne et al., 2010). It does not mean, however, that these farmers do not sell any crops. Rather, the smallholder farmers primarily engage in producing food for own consumption and produce enough cash crops to cover their cash expenses, including expenses on additional food crops (Barrett, 2008). In other words, price and profit is not the primary driver of market participation decision for smallholders. This becomes evident for both policy makers and economists when the market liberalizations measures of the 1980s and 1990s failed to generate significant supply responses.

To explain this phenomenon, research on commercialization in developing countries focused attention on transaction cost and production capabilities as major constraints to smallholder market participation (de Janvry et al., 1991; Omamo, 1998a, b; Renkow et al., 2004; Boughton et al., 2007; Barrett, 2008; Mather et al., 2013). At the same time, a separate strand of literature on smallholder market access in developing countries focused on producer cooperatives (Stringfellow et al., 1997; Stockbridge et al., 2003; the special issue of Food Policy journal in 2009; Markelova and Mwangi, 2010). The research on producer cooperatives often focused on the impact of cooperatives on prices (and income) received by members and their organizational performance and sustainability (Bernard et al., 2008; Shiferaw et al., 2008; Markelova et al., 2009; Markelova and Mwangi, 2010). Overall, the findings in the literature suggest that members of producer cooperatives are more likely to receive higher price than non-members and often earn more income. Although most of producer cooperatives are established explicitly to address the market access and technological constraints smallholders face, the literature on cooperatives paid little attention to the conceptual and empirical link with transaction cost. This literature also ignored the potential effect of large cooperatives on local market, particularly how these cooperative affect the market condition for non-members or non-targeted crops.

Our study contributes to the literature on smallholder commercialization by bringing the lessons from these two strands of literature together and empirically test the impact of transaction cost, asset endowment and producer cooperatives on smallholder crop market participation in Tanzania. The study also examines the potentially negative effect of producer cooperatives on local markets. Tanzania is an interesting case study as the country is on a turning point with high opportunity for structural transformation. Tanzania is also a country where cooperatives have strong presence in agriculture.

The study is based on a survey data of more than 1000 households in Lindi and Mtwara regions of Tanzania. We analyse crop market participation decision using Cragg's double-hurdle model (Cragg, 1971) that produces separate estimates for the decision to sell (or not) and the amount sold. We control for potential endogeneity of cooperative membership using the Smith and Blundell (1986) approach for controlling endogeneity in a corner solution model. We found that factors that decrease the cost of

transacting crops positively influence the marketing decision of farmers, for both food and cash crops. Longer distance to market negatively influence cash crop sales while better access to information and communication encourage both food and cash crop marketing. Farmers who belong to marketing cooperatives have higher likelihood of selling food crops and sell more food and cash crops than non-members do. However, we found that marketing cooperatives in Southern Tanzania potentially stunt local food markets. The estimation result shows that having a cooperative branch in a village reduces both the likelihood of selling food crops and the amount sold by residents of the village. It did not affect cash crop marketing decision.

2   Conceptual framework

Our conceptual framework draws from the household model with missing markets. More specifically, we will discuss the importance of transaction cost and household asset on market participation decision of farm households within this framework. We will then discuss how cooperatives may help address some of these constraints.

Building on Sing et al. (1986) non-separable household model, de Janvry et al. (1991) introduce transaction cost as one of the key causes of market failure. They argue that market fails for individual farmers when transaction costs are so high that the disutility of exchange becomes higher than its utility. Such farmers could choose not participate in the market even in the face of an increase in demand and price of crops (de Janvry et al., 1991). Market failure is not commodity specific but household specific. It is possible that in the same market some farmers actively participate while others are excluded due to prohibitive transaction cost.

Subsequent literature further expand on this concept and provide evidence on the negative impact of transaction cost on supply response of farmers (Goetz, 1992; Omamo, 1998a ; Key et al., 2000; Renkow et al., 2004; Barrett, 2008). Key et al. (2000) distinguish between proportional transaction costs that vary with the volume of goods traded and fixed transaction costs that are invariant to quantity traded. Proportional costs (PTC) include costs associated with transferring the commodity between trading agents such as transportation cost. Fixed transaction costs (FTC) include 1) search

costs associated with identifying a buyer, seller or market, 2) negotiation and bargaining costs associated with information asymmetry and 3) screening, enforcement and supervision costs. Both the PTC and FTCs lower the effective price received for a commodity and increase the effective price paid for a commodity. Transaction costs will thus make products less profitable to sell and more expensive to buy (Renkow et al., 2004).

In the case of food crops, where farmers may be both buyers and sellers (at different time), the price band may have stronger impact. An empirical study based on data from Mexico suggests that proportional transaction costs are important in selling decisions while fixed transaction costs are important for both sellers and buyers (Key et al., 2000). Another empirical study from Kenya estimate that the fixed transaction cost is equivalent to a 15% ad valorem tax (Renkow et al., 2004). Transaction cost has stronger effect on food-deficit farmers as they have to buy food at a high price. They are thus less likely to engage in crop marketing. In Zimbabwe, for example, food-surplus farmers were found to be more likely to sell cash crops than food-deficit farmers due to higher purchasing price of food for net-buyers and lower food selling price for net-sellers of food (Jayne, 1994). Other studies provide estimates showing higher cost of entering crop market and lower profits for subsistence farmers (Omamo, 1998b; Cadot et al., 2006).

The relevance of household assets for market participation is also related to missing or imperfectly functioning markets. The need for food self-sufficiency in the presence of imperfect food markets imply that large producers are in a better position to satisfy their food needs and produce marketed surplus (Fafchamps, 1992). Similarly, an important implication of factor market imperfection is that production and marketing capacity of farmers is constrained by the resources they own. Households who have more labor, land and other farm asset have better potential to produce marketable surplus and hence engage in crop marketing (Barrett and Dorosh, 1996; Boughton et al., 2007).

In theory, farmer organizations such as marketing cooperatives can help farmers cope with market failures by reducing transaction cost and developing their asset endowment. Producer cooperatives provide price information, establish contact with large buyers, organize bulk transportation for members, and provide storage facility for members (Thorp et al., 2005; Markelova et al., 2009;

Shiferaw et al., 2011). All of these services contribute to reducing transaction cost, both PTC and FTC. Cooperatives can also help in building production capacity of their members, enabling them to produce more marketable surplus. For example, cooperatives increase production and productivity of farmers by facilitating access to quality input, training, collective investment and credit (Kaganzi et al., 2009; Devaux et al., 2009; Fischer and Qaim, 2012; Shiferaw et al., 2011; Ma et al., 2018).

But what will happen if a cooperative become a sole agent for farmers, effectively having a monopolistic power to connect buyers with farmers? How would the overall crop market evolve if buyers of cash crops do not do business in the local market? As will be discussed in the next section, currently cash crop marketing in Tanzania is conducted only through agricultural marketing cooperatives. We argue that while cooperatives may improve the capacity of farmers to produce marketed surplus and increase members' bargaining power they may also risk stunting the local markets in the villages. In this study, we test for both of these effects.

3 Background

3.1 Crop production in Southern Tanzania

Agriculture is the most important sector in Tanzania's economy. While its contribution to GDP is only 30% (NBS, 2018a), it employs 66% of the labor force (NBS, 2018b). Tanzania's agriculture is dominated by small-scale subsistence farmers. The majority of farm households (84 percent) own less than 4 hectares of land. One-third of the farm households do not sell any of their harvest, while the rate is even lower for food crops. 64% of maize producers in Tanzania do not sell their crop (NBS, 2017b).

Our study is conducted in coastal regions of Lindi and Mtwara. Like the rest of the country, these two southern regions are primarily agricultural. Crop production is the main activity in these two regions. Almost all households were engaged in crop production while 90% farmers in Lindi and 93% in Mtwara identify crop farming as the main source of livelihood (NBS, 2012a, NBS, 2012b). Although there are two growing seasons in Tanzania (the short rainy season and the long rain season), in

Mtwara and Lindi almost all crop production is undertaken during the long rainy season (NBS, 2012b; NBS, 2012a).

Maize is the leading food crop produced in both Mtwara and Lindi. In 2007/08, maize covers 65% of area planted with cereals in Mtwara and 57% in Lindi. Other important food crops in these two regions are cassava, sorghum and paddy. Among cash crops, cashew is the leading crop in these two regions. Half of the farm households have cashew trees, with the average area under cashew nut cultivation at 1.5 hectares (NBS, 2012b; NBS, 2012a). In fact, these two regions are among the leading producers of cashew accounting for 82 percent of production in mainland Tanzania (NBS, 2018c).

3.2 Agricultural marketing cooperatives (AMCOs) in Southern Tanzania

Tanzania has gone through significant liberalization reforms in the late 1980s opening up the agricultural produce market to private traders. However, cash crop marketing is still highly regulated[1] and farmer cooperatives play significant role. Agricultural marketing cooperatives (AMCOs) are the second most common type of cooperative in the country, next to saving and credit cooperatives. There are more than 3400 AMCOs across Tanzania (TCDC, 2019). In addition to facilitating the marketing of crops, these cooperatives also facilitate input supply and training for member farmers.

In terms of crop marketing in Tanzania, AMCOs play more than a facilitation role. In the study area, for example, all cash crop marketing is carried out through AMCOs. Traders are not allowed to purchase cash crops directly from farmers. Traders have to receive permit from district administrators to buy cash crops. They then negotiate prices with AMCOs and engage them to collect the crop from their members and other farmers. The fact that permits are required to transport cash crops out of the villages makes enforcement of this restriction possible. In the case of cashew nuts, a warehouse receipt system was introduced in 2008 requiring that all cashew production is auctioned via cooperatives at an auction managed by the Cashew Board of Tanzania. Accordingly, all farmers

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[1] In a dramatic escalation of government intervention in export goods pricing, the President of Tanzania, John Magufuli, threatened that if traders do not buy cashew nut at an approved price of 3000 TZS/Kg and the government will buy up all the country's cashew nut stock and may use military vehicles to collect the crops. He also fired two ministers and dissolved the industry regulator in a row over the price of the commodity - https://www.bbc.com/news/world-africa-46166985

deliver the crop to the AMCOs and they receive payment in two installments. AMCOs pay the first installment before the cashew is sold, often using bank loan, and the final payment is made after cashew nuts are sold to traders at the auction. As a payment for their service, the AMCOs deduct a small commission from the total sells revenue. This money will eventually be distributed among members once all administrative costs are covered. While transaction of cash crops outside of the AMCOs is prohibited, some farmers sell their crops directly to the few middle men engaged on this in their villages[2].

In the study area, each of the districts have several independent AMCOs and each AMCO typically have a head office in the ward (lower administrative unit composed of average of 5 villages) and branches in some of the villages. Farmers report that selling cash crops through AMCOs enables them to earn higher prices, however, many also complained about the long wait to get payed for their delivery. Recent scandal surrounding the disappearance of large amount of cashew nuts and incidences of corruption by AMCO administrators in Southern Tanzania is also likely to damage trust on cooperatives.

4 Methods

4.1 Data

This study is based on farm household survey data from Southern Tanzania. The survey was conducted in Lindi and Mtwara regions in the summer of 2017. The sample covered 36 villages and 1074 farm households across the two regions. The survey collects detailed demographic and land holding data and information on production and sales activities of the households for the 2016 production year. The sample districts are selected from pulse producing areas of Lindi and Mtwara[3].

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[2] Key informant interviews

[3] This survey was conducted as part of a larger study on crop market development related to gas industry in the Lindi and Mtwara region. The villages are purposefully selected to include villages with a food value chain development project and control villages. This is a baseline data.

4.2 Estimated model

As discussed earlier, product and factor market imperfection imply that at any given price, households' crop market participation decision is influenced by households' resource endowment and the transaction cost they face. Let **S** refer to the level of crop market participation:

S = f (**L, K, T**, M, A; **Z**)

The vector **L** refers to labor endowment and include amount of adult labor in the household, and education and farm experience of the household head. We expect that the amount of labor endowment will be positively correlated with the probability of participation in crop market and the amount of crop sold. In the presence of market imperfections, hired labor is not a substitute for own labor and thus households with more labor endowment have better capacity to produce market surplus and spend time and effort in marketing their produce. Similarly, we expect that households with more educated and experienced household head are more likely to participate in crop market.

The vector **K** refers to agricultural capital. It includes land, the most important resource in agriculture, and other farm assets. Similar to the case for labor, farmers with more agricultural capital are expected to be more likely to engage in crop market.

The vector **T** includes two variables that influence the magnitude of transaction cost. The first is transportation cost to large markets, which is proxied here by distance to district center. We expect that farmers living further away from these centers are less likely to engage in marketing their crops. The second variable captures access to information and communication. We include phone penetration (the share of households in the village with phone) to capture this access and expect that access to information and communication reduces transaction cost for farmers in the village, thereby promote market participation. *M* is a variable that captures membership in agricultural marketing cooperatives (AMCOs). As indicated earlier, AMCOs play a key role in marketing of crops in Southern Tanzania. We expect that AMCO members are more likely to engage in crop market as they face lower transaction cost of trading as the cooperatives carry out product aggregation, price bargaining and search for buyers on their behalf. In addition to the transaction effect, AMCOs offer other services to

their members including training, input supply and information. These additional services are likely to improve the capacity of members to produce marketed surplus.

On the other hand, the monopolistic control of AMCOs in export crop marketing and their high involvement in other cash crop marketing may have unintended consequences by stunting the development of the local market for food crops. If local traders and out of village buyers are not allowed to buy cash crops freely, it will undermine trade activities in the village even if purchase and sale of food crops are not so restricted. The variable A in the above equation is included to test for this possible negative effect. In the estimation, we capture this by an indicator variable for villages with an AMCO branch. We expect that villages with AMCO branches are more likely to enforce exclusive transaction of cash crops through AMCO, thereby undermine trade in the village. In non-AMCO villages, it is likely that some cash crop transaction maybe conducted outside of the AMCO channel. This is because there will not be an interested party to monitor and enforce restrictions in crop transaction, as well as because farmers have an incentive to sell to intermediaries instead of transporting their produce to another village. As a result, there is likely more trading activities in the non-AMCO villages, which allows for more food crop market participation. Finally, Z refers to a vector of household characteristics and includes age and gender of household head and dependency ration in the households. We expect that households with more dependents have stronger food security needs and are thus less likely to sell crops. Because of market failure in developing countries, the production and sale of crops is not separable from the consumption needs of the household (Sadoulet and De Janvry, 1995).

4.3 Estimation strategy

We will separately estimate the crop market participation equations for food and cash crops. We expect that some of the factors may have different influence on food and cash crops as the priorities and needs are different.

We formulate the market participation decision in the framework of a corner solution model as there are many households who did not sell food crops. Unlike a data censoring case, we argue that the

zeros here represent the optimal choice for some of the agents facing various constraints (Wooldridge, 2010). Therefore, we write market participation decision of the household as:

$$S = \max(0, S^*)$$

Where the latent variable S^* refers to a linear specification of the market participation equation:

$$S^* = \beta_0 + + \beta_1 L + \beta_2 K + \beta_3 T + \beta_4 M + \beta_5 A + \beta_6 Z + \varepsilon$$

The term ε is a mean zero, identically and independently distributed random error and is assumed to be uncorrelated to all the explanatory variables. This model will be estimated using a two-tier truncated normal hurdle model (Cragg, 1971). Unlike the Tobit model (Tobin, 1958), the Cragg model allows different factors to influence the decision to sell and the amount sold. In the Cragg model, the decision to sell (product market participation decision) follows a probit model, while the amount decision has a truncated normal distribution. Market participation and amount decisions are assumed independent in this model. To be able to aggregate sales of multiple crops, we use value sold instead of quantity in the amount sold equation.

Endogenous AMCO membership?

It is likely that the indicator variable for AMCO is not an exogenous variable. It is possible that some unobserved factor influences both the decision to join (remain a member of) an AMCO and the decision to participate in the product market. Thus, the AMCO membership variable M in the above equation is possibly correlated with the error term. We will use the control function approach to test and control for possible endogeneity of AMCO membership. The Smith and Blundell (1986) approach involves using the residuals from the reduced form regression of the endogenous variable to control for endogeneity in the structural equation. Our estimation thus involves two steps. First, we estimate the reduced form model for AMCO using probit and obtain the generalized residual, and second we estimate the two-tier truncated normal hurdle model that includes the generalized residual from the first stage. We use bootstrapping in the second stage to adjust standard errors for the two-step procedure. We use three instrumental variables that we believe are correlated with membership in

AMCO but do not affect crop marketing decision. The instruments are: years of ownership for land (how long the household owned the farm land), the of untitled land and a dummy for general trust in institution[4]. We expect that farmers who have owned land in the village for a longer period are more likely to belong to AMCO as they are likely to be in the village during establishment of an AMCO and perhaps play a role in its establishment. On the other hand, farmers who have weak property right in the form of having a higher share of their land without title will be less likely to join an AMCO as they would not want to attract attention to the size of their production activity and size of cultivated land. Controlling for the size of farm land, years of land ownership and share of untitled land are not expected to directly affect crop market decision. In general, farmers with lower sense of trust towards institution are expected to be less likely to join AMCO. Institutional trust is not expected to affect crop market participation directly.

5   Results and discussion

5.1   Descriptive Statistics

5.1.1   Crop production and marketing in Lindi and Mtwara

Table 1 shows the market participation of farmers, disaggregated by the type of crop sold. In total we find that 90% of farmers participated in the cash crop market while the market participation rate for food crops is 53%. The level of market participation in our study area is higher than reported for the country as a whole (65%) (NBS, 2017b). This seems to be mainly due to the fact that Lindi and Mtwara are among the leading export crop producing regions in the country.

Table 1 Crop market participation in Lindi and Mtwara

Crop sold	Sellers (%)
Both food and cash crop	49
Sold only cash crop	41
Sold only food crop	4
Did not sale any crop	6

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[4] This is if the respondent agrees or strongly agrees with a statement "In the years to come, I trust the government to do what is right for Tanzania.

Source: own sample

While the overall share of farmers selling crops suggest a high level of general market participation, it should be noted that there is in fact a wide variation on the intensity of market participation. Some farmers sell a few kilograms of grains while others are more actively and extensively engaged in crop marketing. Previous studies on agricultural market participation suggest that smallholder farmers are typically net buyers of food crops while at the same time selling cash crops to finance their food crop purchase (Barrett, 2008). Table 2 shows the distribution of share of output sold in the market for the top three crops produced. It is evident that cashew is produced for the market while maize is produced for home consumption. There is also significant variation among households both in the share of output sold in the market and the absolute amount supplied.

Table 2 Extent of market participation among crop producers

Crops sold	The share of produce sold			Quantity sold- in kg.			Number of producers
	Mean	Median	SD	Mean	Median	SD	
Pigeon pea	0.62	0.7	0.328	162	100	217	922
Maize	0.08	0.0	0.217	52	0	176	813
Cashew nuts	0.94	1.0	0.139	745	388	1141	619

Source: own sample

5.1.2 Crop revenue by wealth

Previous studies indicate that the crop supply of small holder farmers is dominated by the better-off farmers (Barrett, 2008; Mather et al., 2013). We explore this for our sample in Figure 1. The plot shows a non-parametric regression of sales revenue over household asset endowments. We see that for both cash and food crops, earning from crop sales increases with land holding and labor endowment of farmers, two of the most important resources for smallholder crop production. For food crops, sales did not increase significantly for changes in asset beyond the median land (6 acres) and adult labor (2) while for cash crop it show a continuous rise with asset. The positive relations between crop sales and asset endowment, particularly for cash crops, is not surprising given the imperfectly functioning factor market. A weak factor market imply that production and sales capacity is inherently determined by resource endowment since farmers cannot easily obtain the necessary factors of production from the

market (Binswanger and Rosenzweig, 1986). Market imperfection also imply that the production and consumption decision of farmers is interrelated (Binswanger and Rosenzweig, 1986; de Janvry et al., 1991).
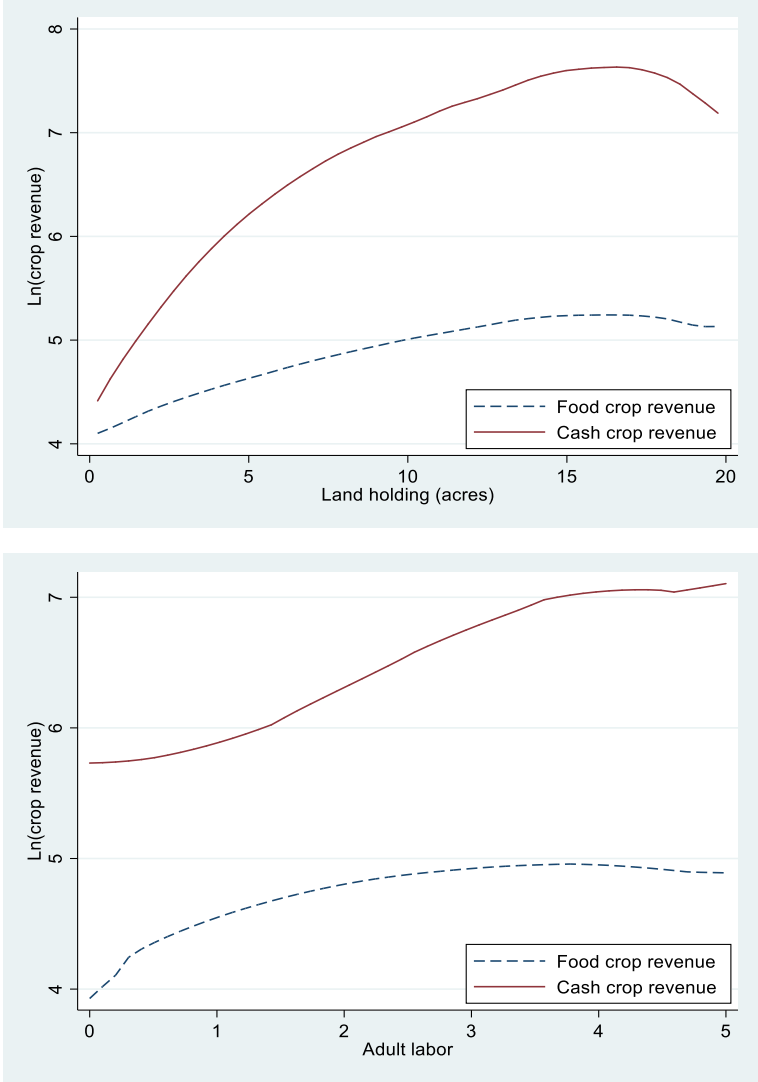

Figure 1 Non-parametric regression of household sales revenue over resource endowment (Local polynomial smoothing)

5.1.3   AMCO membership and market participation

Although there is an AMCO in each of the districts and wards, not all crop producers are members. In fact, only one-quarter of the sample households are members of an AMCO. AMCOs are established primarily to serve the marketing and other support needs of their *members*. However, because of their government assigned role as a channel for organizing cash crop marketing in their wards, they collect

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cash crops from all farmers in the village. Other AMCO services, such as training are provided only to their members. In Table 3 we show the difference between AMCO members and non-members in terms of revenue earned from crop marketing.

Table 3 Revenue from crop sells for AMCO members and non-members

Crop revenue in '000 TZS	Not AMCO member		AMCO member		Difference in		Total	
	Mean	SD	Mean	SD	Mean		Mean	SD
Food crop revenue	132	274	181	371	49	**	143	302
Cash crop revenue	1395	2522	2590	3808	1195	****	1694	2941
Cashew revenue	1764	2729	3201	4091	1437	****	2179	3246
Maize revenue	35	164	50	179	15		39	168

Source: own sample. TZS (Tanzanian Shillings, 1USD ≈ 2300TZS)

5.2 Econometric estimation results

5.2.1 Determinants of food and cash crop marketing decision among smallholders

Table 4 shows the main regression results from the double hurdle model for smallholders' cash crop and food crop marketing. To control and test for endogeneity of AMCO membership, we included the generalized residual from the reduced form model for AMCO membership into the market participation equations. The results suggest that AMCO dummy is indeed endogenous as the coefficient on the residual is significant. The result from the AMCO participation equation is reported in the appendix.

We will start our discussion with the AMCO variables. We find that being a member of an AMCO increases the likelihood of selling food crops and the amount of both food and cash crops sold. This suggests that AMCOs in Southern Tanzania are able to reduce members' transaction cost of marketing crops since the AMCOs absorb the cost of search and negotiation by taking the responsibility of contacting traders and negotiating prices. In addition, AMCOs facilitate training and input supply to their members thereby improve the marketed surplus capacity of their members through better productivity. The fact that AMCO membership did not affect the likelihood of cash crop market participation but influences how much cash crop is sold is consistent with AMCOs' roles in Tanzania. While membership influences productive capacity of members, in terms of access to cash crops

markets, all farmers are expected to sell their produce through AMCOs regardless of their membership status. As a result, members and non-members have similar access to price information and local market access for cash crops.

On the other hand, we found that having an AMCO branch in the village is negatively correlated with participation in food market (significant at 1% level) and amount of food crop supplied (significant at 5% level). It has no effect on cash crops marketing. This suggest that having a marketing cooperative with a monopolistic power in cash crop transaction may stunt food crop market. If cash crops are not freely traded in the village, it may not be profitable for many traders to come to the village only to buy food crops. And those farmers who have large enough quantity to sell have either to travel to district towns or to the capital. While AMCOs benefit their members and encourage supply of food and cash crops, the monopolistic position AMCOs have in the rural crop market introduces an adverse effect and potentially damage the food crop market. The two AMCO variables work in opposite directions. Keeping all other variable at the mean, AMCO members are 60% more likely to participate in food markets[5]. On the other hand, having an AMCO branch in the village reduces the likelihood of participating in food market by 13%.

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[5] Marginal effect using STATA **mfx** command on first tier (probit).

Table 4 Determinants of smallholder crop market participation decision in Southern Tanzania: Cragg's Double Hurdle model

| | Probability of selling | | | | Amount sold | | | |
| | Food crops | | Cash crops | | Food crops | | Cash crops | |
	Coeff.	Robust Std.Err	Coeff.	Robust Std.Err	Coeff.	Robust Std.Err	Coeff.	Robust Std.Err
Age of household head	-0.0040	0.0040	-0.0060	0.0070	-0.015 *** 0.005		-0.001	0.005
Farm experience of household head	-0.0080 * 0.0050		0.0070	0.0090	0.002	0.006	0.001	0.005
Household head is male	-0.0020	0.1280	0.2370 * 0.1430		0.151	0.106	0.332 ** 0.141	
Education (years) of household head	0.0170	0.0160	-0.0190	0.0250	0.050 *** 0.010		0.020	0.015
Consumer-worker ratio	0.0540	0.0360	0.0580	0.1050	-0.001	0.047	0.064 * 0.038	
Number of adult labor	-0.0430	0.0400	-0.0010	0.0940	-0.002	0.057	0.070	0.066
Land holdings (acres)	-0.0030	0.0080	0.0380	0.0270	0.034 *** 0.009		0.073 *** 0.011	
Ln(Value of livestock owned)	0.0020	0.0100	0.0230	0.0180	0.004	0.008	-0.003	0.008
Ln(Value of farm asset owned)	0.2120 *** 0.0590		0.0300	0.0830	0.149 *** 0.051		0.244 *** 0.074	
Distance to district center (KM)	0.0000	0.0000	-0.0010 * 0.0000		0.000	0.000	-0.001 ** 0.000	
Share of households with phones	0.7570	0.5050	1.5210 ** 0.6430		0.643 *** 0.175		-0.043	0.357
There is AMCO branch in the village	-0.3440 *** 0.1160		-0.0590	0.2100	-0.195 ** 0.096		0.087	0.259
Household is member of AMCO	2.0730 *** 0.5180		-0.6280	1.2620	1.873 *** 0.483		1.973 *** 0.656	
Residual(test of endogenous AMCO)	-1.1820 *** 0.3070		0.2930	0.7920	-1.121 *** 0.320		-0.948 ** 0.377	
Constant	-1.1230 *** 0.3520		0.1750	0.3610	3.778 *** 0.333		2.341 *** 0.469	
Sigma					1.021 *** 0.044		1.281 *** 0.042	
Log likelihood					-1481.2		-1928.656	
Number-observation					1072		1072	

The model includes district dummies (not reported here). Standard errors are clustered at Ward level. We also used bootstrapping to adjust standard errors for the two-stage estimation.

***, **, * indicate significance at 1%, 5% and 10% level respectively

The other results are consistent with theory. Factors that increase transaction cost reduce the likelihood of market participation and the amount supplied. On the other hand, factors that facilitate information and market access increase both the likelihood of crop market participation and the amount sold. The estimation results show that better information and communication in the village, as captured by the phone penetration rate, improves market participation. For cash crops, higher phone penetration in the village is positively correlated with higher probability of market participation by farmers. The coefficient is significant at 1% level. While phone penetration does not influence the probability of participation in food crop market, it influences the amount supplied for those participating in the market. Together, these results suggest that better information and communication reduces the transaction cost of trading and motivate farmers to participate in crop market. Similar findings were documented for Kenya and Zambia with radio and cell phone ownership (Mather et al., 2013). Distance from district centers has the opposite effect for the cash crop model. The coefficient on distance to district center is negative and significant at 10% in the participation equation and negative and significant at 5% in the quantity equation. Farmers living further from the district center are less likely to participate in cash crop market; and if they participate, they supply less than those who live close to the center. However, the effect size is small. In the literature, the effect of distance on market participation is not conclusive and depend on which distance measures are used. Some find a negative effect of distance to roads (Heltberg and Tarp, 2002) while others find no or negligible effect based on a different measure of distance (Mather et al., 2013). Chamberline and Jayne (2013) show challenges of selecting appropriate market access variables. They found that there is in fact low correlation between alternative indicators of market access and it significantly vary widely over time and space.

Among resource endowments, the significant variables refer to those resources that are exclusively used for farming: farm assets and farmland. Larger land holding is associated with more crop supply. This holds for both food and cash crops. Non-land farm asset holding positively influences food market participation decision. The coefficient is significant at 1% level, both in the probability and amount

equation. These results are consistent with findings from other similar economies where strong positive correlation is documented between access to land and farm asset and crop market participation (Olwande et al., 2015, Markelova et al., 2009, Heltberg and Tarp, 2002, Mather et al., 2013). Labor endowment was not found to be significant for crop market participation.

The household demographic characteristics do not have strong effect on the decision to participate in crop market while some of these factors have statically significant effect on the amount sold. The older the household head, the smaller the amount of food crops sold while education of household is positively correlated with the amount of food crops sold. Households headed by men tend to sell more cash crops than those headed by women. Education of the household head has a positive effect on the amount of food crops sold.

To summarize, we found that factors that influence the cost of transacting crop influence the marketing decision of farmers for both food and cash crops. Distance to market negatively influence cash crop sales while better access to information and communication encourage both food and cash crop marketing. Farmers who belong to a marketing cooperatives have higher likelihood of selling food crops, and among sellers, cooperative members sell more food and cash crops than non-members do. We found that marketing cooperatives in Southern Tanzania potentially stunt food market. Having an AMCO branch reduces both the likelihood of selling food crops and the amount sold. It did not affect the cash crop marketing decision. Among resource endowments, only agriculture-specific resources have significant impact. We found that the amount of food and cash crop sold increases with land holding and other farm asset owned.

5.2.2   Result sensitivity for aggregation

While separate estimation of food and cash crops allows for different factors to influence the two types of crops, we also recognize that farmers often draw from the same farm resources and skills to produce and sell both types of crops. We thus re-estimated the model for the aggregate crop market participation decision. We estimated Cregg's double-hurdle (DH) model of market participation for all crop crops to compare with the disaggregated results reported above. Since 94% of households participated in the market (some supplying only few kilograms of grains), the important difference among farmers at this aggregate level is not whether they sold any crop but how much they sold. Hence, for comparison we also estimated a two-stage least square (2SLS) model that directly controls for endogenous AMCO membership.

The results from the DH model and the 2SLS model are reported in Table 5. Results from the estimation on aggregate crop is qualitatively similar to that of disaggregated models. Because there is little variation in probability of participation, many of the variables are not significant in the first tier of the DH model. However, the variables that are significant in the amount equation are similar to those in the disaggregate estimations.

In both the DH model and 2SLS model, land endowment and farm asset positively and significantly influence amount sold, similar to the disaggregated models. In both models, distance to the district center is negatively correlated with amount of crop sold, although in the 2SLS model it is significant only at 10% level of significance. In the 2SLS model, phone penetration is positively and significantly correlated with amount of crop supplied. At a household level, with both cash and food crops taken together, the impact of having an AMCO branch in the village is not detectable but membership in AMCO is positively correlated with amount supplied, significant in both models.

Table 5 Determinants of smallholder crop market participation decision in Southern Tanzania: All crops

| | Crop sells decision-All crops (DH Model) | | | | Crop sells decision-All crops (2SLS) | | |
| | Probability of selling | | Amount Sold | | | | |
	Coeff.	Robust Std.Err	Coeff.	Robust Std.Err	Coeff.	Robust Std.Err
Age of household head	0.002		0.008	-0.004		0.004	-0.003		0.006
Farm experience of household head	-0.001		0.011	0.001		0.004	0.000		0.010
Household head is male	0.271	**	0.125	0.234	*	0.127	0.468	**	0.183
Education (years) of household head	-0.007		0.025	0.029	**	0.012	0.021		0.022
Consumer-worker ratio	0.015		0.082	0.049		0.041	0.066		0.079
Number of adult labor	0.025		0.088	0.073		0.047	0.077		0.113
Land holdings (acres)	0.053		0.040	0.064	***	0.011	0.082	***	0.016
Ln(Value of livestock owned)	0.025	**	0.011	0.000		0.006	0.015		0.016
Ln(Value of farm asset owned)	0.035		0.094	0.255	***	0.054	0.244	***	0.088
Distance to district center (KM)	0.000		0.000	-0.001	***	0.000	-0.001	*	0.001
Share of households with phones	1.183		1.130	0.199		0.284	3.231	***	0.568
There is AMCO branch in the village	0.045		0.185	-0.005		0.232	-0.002		0.168
Household is member of AMCO	-0.650		1.419	2.214	***	0.430	2.261	*	1.250
Residual(test of endogenous AMCO)	0.286		0.862	-1.132	***	0.242			
Constant	0.184		0.826	2.529	***	0.348	1.336	***	0.324
Sigma				1.193	***	0.039			
Log likelihood				-1826					
Number-observation				1072					

The model includes district dummies (not reported here). Standard errors are clustered at Ward level. We also used bootstrapping to adjust standard errors for the two-stage estimation in the DH model.
***, **, * indicate significance at 1%, 5% and 10% level respectively

We also separately estimated the sales decision for maize and cashew, as these are two key crops in the Southern Tanzania. Maize is a very important staple food in Tanzania and the leading cereal crop produced in the country accounting for 70% of areas planted by cereal crops (NBS, 2018c). Cashew is the leading cash crop in the study area. In fact, 90 percent of planted area with cashew nuts is found in the two study regions (Lindi and Mtwara) plus Pwani (NBS, 2018c). As the estimations were on single crops, we are able to use quantity instead of sales value in the amount equation. The result from the maize and cashew crop market mirror what we found for food crop model and cash crop model, respectively. Here we only briefly discussed the result for this crops and give the estimation table in the appendix. Among asset endowment, land holding and farm assets positively influence market participation for both maize and cashew. Having an AMCO branch in the village negatively affect maize (food crop) sells but not cashew (cash crop) sells decision. Membership in an AMCO is positively correlated with market participation decision for both cashew and maize. Access to information and communication, as captured by phone penetration, is positively correlated with probability of participation in cashew market but did not influence maize sells decision.

6   Policy Implications

Smallholder farmers account for the largest group of farmers in agriculture dependent economies. As a result, smallholders' crop market participation plays a key role in structural transformation of these economies. In Sub-Saharan Africa, smallholder farmers primarily produce for home consumption while at the same time selling cash crops to meet their cash needs (Heltberg and Tarp, 2002; Boughton et al., 2007; Barrett, 2008; Jayne et al., 2010). We argued that one of the key barriers to crop market participation is transaction cost (de Janvry et al., 1991; Renkow et al., 2004; Barrett, 2008; Mather et al., 2013). The results from our study in Tanzania is consistent with theory and existing empirical evidences in showing that transaction cost is indeed a binding constraint. We found that farmers' crop market participation increases with access to information and decreases with distance from district center. Thus, investment on road, communication infrastructure, and public transportation is likely to reduce transaction cost and

improve market participation of farmers. In addition, such investment will also contribute to farmers' access to cheaper and improved inputs which will enhance their productive capacity and productivity.

Our finding on the negative effect of cooperatives on local food markets is a policy concern. Recent years have seen increased appreciation for producer cooperatives as a means to strengthening farmers' capacity to produce more and receive a better price for their produce (WB, 2007). While many studies assess the impact of cooperatives on their members (see for example the especial issue in Food Policy, 2009), the unintended consequences of cooperatives on non-members and the overall market activity have not been given as much attention. Several studies show that members of producer and marketing cooperatives are typically the better off farmers in the village (Thorp, Stewart et al. 2005; Bernard and Spielman 2009). This suggests that any negative effect of cooperatives on local market activities will have disproportionate effect on the poor since the negative effect from the market will not be compensated by other positive effects from membership.

Our findings also have specific policy implications for Tanzania. The country is now at a turning point. The recent discovery of natural gas reserve triggered an extensive policy discussions and debate about resource extraction in Tanzania and benefiting citizens from the resulting economic activity (Lee and Dupuy, 2018; Ellis and McMillan, 2018; Lange and Kinyondo, 2016). While a local content policy is designed to involve as many Tanzanians as possible in the extractive and associated industries, this will not be relevant for the majority of Tanzanians. Two-third of Tanzanian's are engaged in agriculture and 70% of the population currently live in rural areas. If the majority of Tanzanian's are to benefit from the new economic opportunity, agriculture has to be linked to the rest of the economy through market. Farmers will then be able to benefit from a higher food demand and price from the urban sector. Our findings suggest that in addition to transaction cost, households are constrained by their resource endowment which affects marketed surplus. The government can enhance the sectoral and rural-urban linkage by investing on infrastructure, information and productivity enhancing technologies. Access to credit will relax resource constraints of farmers enabling the most efficient farmers to produce and supply

the desired amount of food. In addition to facilitating structural transformation, this will also contribute to urban food security.

In terms of agricultural cooperatives in Tanzania, there is an urgent need for further exploration of the role and impacts of marketing cooperatives. The monopolistic power of the agricultural cooperatives is a potential risk that needs to be balanced with the benefits of cooperatives in enhancing bargaining power of members. The recent standoff between marketing cooperatives and traders and the subsequent direct intervention of the government in buying up cashew-nut using military vehicles to collect crops highlight the risk of creating a marketing cooperative that function as a monopolist supplier of produce even if less than half of the farmers are members.

7 Conclusion

Tanzania could be at a turning point where a recent discovery of large gas reserve created an opportunity for economic growth and development. While there is an extensive policy discussion to ensure participation of Tanzanians in the extractive industry (such as through Local Content Policy), the economic activity and benefit generated in this sector will not reach the majority as long as the sector that employs two-third of the labour force is not well integrated into the market. Active agricultural market is central to structural transformation and enable farmers to receive the gains from growth in other sector of the economy. Currently, the majority of farmers in Tanzania are subsistence oriented smallholders and are not likely to benefit meaningfully from the new opportunities generated in other sectors of the economy.

This study examines the determinants of crop market participation among smallholder farmers in Tanzania. The study is based on a survey data of more than 1000 households in Lindi and Mtwara regions of Tanzania. We analyse crop market participation decision using Cragg's double-hurdle model that produces separate estimates for the decision to sell (or not) and the amount sold. We control for potential endogeneity of cooperative membership using the Smith and Blundell (1986) approach for controlling endogeneity in a corner solution model. We found that factors that influence the cost of transacting crops

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are important for marketing decision of farmers, for both food and cash crops. Distance to market negatively influence cash crop sales while better access to information and communication encourage both food and cash crop marketing. Farmers who belong to a marketing cooperative have higher likelihood of selling food crops and sell more food and cash crops than non-members. However, we found that marketing cooperatives in Southern Tanzania potentially stunt food market. The estimation result shows that having a cooperative branch reduces both the likelihood of selling food crops and the amount sold. It did not affect cash crop marketing decision.

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Table A 1 Probit model estimation of AMCO membership

	Coeff.		Robust Std. Err.
Age of landholding (years)	0.015	***	0.004
Share of land not titled	-0.232	*	0.121
Trust in institution	0.089		0.100
Age of household head	-0.002		0.007
Farm experience of household head	0.006		0.006
Household head is male	-0.062		0.090
Education (years) of household head	0.001		0.015
Consumer-worker ratio	-0.062		0.048
Number of adult labor	0.096		0.065
Land holdings (acres)	0.017	***	0.006
Ln(Value of livestock owned)	0.021	***	0.007
Ln(Value of farm asset owned)	0.045		0.055
Distance to district center (KM)	0.000		0.000
Share of households with phones	-0.655	***	0.213
Nanymbu district (reference Ruangwa)	-0.285	*	0.155
Tandahimba district (reference Ruangwa)	0.386	**	0.178
There is AMCO branch in the village	0.203		0.149
Constant	-1.118	**	0.464
Log likelihood	-563		
Number-observation	1072		

Table A 2 Determinants of smallholder crop market participation decision in Southern Tanzania: DH model, Maize vs. Cashew

| | Probability of selling | | | | | | Amount sold | | | | | |
| | Maize | | | Cashew | | | Maize | | | Cashew | | |
	Coeff.		Robust Std.Err	Coeff.		Robust Std.Err	Coeff.		Robust Std.Err	Coeff.		Robust Std.Err
Age of household head	0.005		0.007	0.002		0.006	0.004		0.011	-0.001		0.004
Farm experience of household head	-0.008		0.006	0.010	***	0.005	0.012		0.011	-0.006		0.004
Household head is male	-0.155		0.126	0.222		0.121	0.633	***	0.193	0.339	***	0.092
Education (years) of household head	0.016		0.026	0.004		0.017	0.075	**	0.037	0.026	*	0.015
Consumer-worker ratio	0.041		0.071	0.079	*	0.043	-0.020		0.089	0.000		0.037
Number of adult labor	0.012		0.044	-0.001		0.077	-0.033		0.070	-0.008		0.050
Land holdings (acres)	-0.002		0.009	0.059	***	0.014	0.038	**	0.018	0.034	***	0.010
Ln(Value of livestock owned)	0.009		0.015	0.001		0.010	0.011		0.015	-0.023	**	0.012
Ln(Value of farm asset owned)	0.040		0.055	0.177	***	0.036	0.494	***	0.096	0.230	***	0.048
Distance to district center (KM)	0.000		0.000	-0.001		0.000	0.000		0.001	-0.001	**	0.000
Share of households with phones	-0.362		0.526	2.453	***	0.796	-1.068		0.779	0.188		0.197
There is AMCO branch in the village	-0.292	*	0.166	0.059		0.250	-0.392	**	0.192	-0.134		0.236
Household is member of AMCO	2.103	***	0.591	1.098		0.845	-0.475		1.742	2.452	***	0.854
Residual(test of endogenous AMCO)	-1.263	***	0.372	-0.552		0.511	0.402		1.071	-1.264	**	0.527
Constant	-1.277	**	0.626	-3.569	***	0.474	2.694	***	0.461	3.436	***	0.492
Sigma							1.128	***	0.100	0.978	***	0.034
Log likelihood							-636			-1466		
Number-observation							1072			1072		

The model includes district dummies (not reported here). Standard errors are clustered at Ward level. We also used bootstrapping to adjust standard errors for the two-stage estimation.

***, **, * indicate significance at 1%, 5% and 10% level respectively

This paper assesses determinants of crop market participation among smallholder farmers in Tanzania, with a focus on transaction cost, asset endowment and cooperatives. The study is based on household survey data from Southern Tanzania where cooperatives play a significant role in the cash crop market. We analyse market participation using Cragg's double-hurdle model and account for potential endogeneity of cooperative membership using control function approach. We find that distance to market negatively influences cash crop sales while better access to information and communication encourages both food and cash crop marketing. Among asset endowments, only agriculture-specific resources have significant impact. The study shows that marketing cooperatives enhance crop market participation of their members as the cooperatives improve the productive capacity of farmers. However, we also found that marketing cooperatives appear to stunt local food market activities. Having a marketing cooperative branch in the village reduces both the likelihood of selling food crops and the amount sold by residents of the village. It does not affect cash crop marketing decision.