Smallholder Crop Market Participation in Tanzania: The Influence of Transaction Cost, Asset Endowment and Producer Cooperatives

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Abstract

This paper assess the determinants of crop market participation among smallholder farmers in Tanzania, with a focus on the role of 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 control 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 while cooperatives improve market participation among members, they also appear to stunt local food markets. Having a marketing cooperatives branch in the village reduces both the likelihood of selling food crops and the amount sold. It does not affect cash crop market participation.

Key Words: market participation, commercialization, Cash Crops, Food Crops, Tanzania, Africa

Smallholder Crop Market Participation in Tanzania: The Influence of Transaction Cost, Asset Endowment and Producer Cooperatives[1]

1 Introduction

A recent discovery of large natural gas reserves in Tanzania created high expectations for economic growth and development in the country. It is expected that Tanzania will become one of the world's biggest exporters of natural gas in the coming decades (Lange and Kinyondo 2016). There is extensive policy discussions and new laws to ensure that extraction of the newly discovered natural gas and existing mineral resources benefit Tanzanians (Lange and Kinyondo 2016, Ellis and McMillan 2018, Lee and Dupuy 2018). However, 70 percent of Tanzania's population live in rural areas, often engaged in agriculture (NBS 2017). While the extractive industry has the potential to generate economic growth, 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 2018). Agricultural markets are central both for structural transformation and for transmitting gains from growth in other sectors of the economy. Currently, the majority of farmers in Tanzania are subsistence oriented smallholders (NBS 2017) and are not likely to benefit from the 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 (Heltberg and Tarp 2002, Boughton, Mather et al. 2007, Alene, Manyong et al. 2008, Barrett 2008, Morris, Binswanger-Mkhize et al. 2009, Jayne, Mather 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 costs of purchased food crops (Barrett 2008). In other words, price is not the primary driver of market participation decision for smallholders. This is recognized when the market liberalizations measures of the 1980s and 1990s failed to generate significant supply responses. Research on commercialization in developing countries then identified transaction cost and production capabilities as major constraints to smallholder market participation (de Janvry, Fafchamps et al. 1991, Omamo 1998, Omamo 1998, Renkow, Hallstrom et al. 2004, Boughton, Mather et al. 2007, Barrett 2008, Mather, Boughton et al. 2013).

A separate strand of literature on smallholder market access focused on producer cooperatives (eg. the special issue of Food Policy journal in 2009, Stringfellow, Coulter et al. 1997, Stockbridge, Dorward et al. 2003, 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, Collion et al. 2008, Shiferaw, Obare et al. 2008, Markelova, Meinzen-Dick et al. 2009, Markelova and Mwangi 2010). Overall, the

[1] We would like to thank the Royal Norwegian Embassy in Dar es Salaam for generous financial support under the project *Tanzania as a Future Petro-State: Prospects and Challenges.*

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 market access and technological constraints faced by smallholders, the literature on cooperatives does not pay as much attention to the conceptual and empirical link with transaction cost. The literature also largely ignored the potential negative effect of large cooperatives on local market conditions and on non-members.

This study contribute 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. The study also examines the potentially negative effect of producer cooperatives on local markets.

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 increase the cost of transacting crops 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. Asset endowment, especially agricultural land and farm asset, are positively correlated with participation in crop market. Farmers who belong to a marketing cooperatives 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 local food markets. 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.

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 link this with access to producer cooperatives and how cooperatives potentially help solve some of the constraints households face.

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, Fafchamps 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 1998, Key, Sadoulet et al. 2000, Renkow, Hallstrom 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 transaction 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, Hallstrom 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, Sadoulet et al. 2000). Another empirical study from Kenya estimate that the fixed transaction cost is equivalent to a 15% ad valorem tax (Renkow, Hallstrom 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 1998, Cadot, Dutoit 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, Mather et al. 2007).

In theory, farmer organizations such as farmer 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, Stewart et al. 2005, Markelova, Meinzen-Dick et al. 2009, Shiferaw, Hellin 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 (Devaux, Horton et al. 2009, Kaganzi, Ferris et al. 2009, Shiferaw, Hellin et al. 2011, Fischer and Qaim 2012, Ma, Renwick 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 crop market in general evolve if buyers of cash crops are not allowed to directly transact with farmers? 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 2018), it employs 66% of the labor force (NBS 2018). 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, and even a smaller share sell food crops. 64% of maize producers in Tanzania do not sell their crop (NBS 2017).

Our study is conducted in coastal regions of Lindi and Mtwara. Like the rest of the country, these two southern regions are primarily agricultural. Lindi is the least populated region in Tanzania while Mtwara has above average density among the 30 regions of the country (NBS 2013). Crop production is the main activity in these two regions. Almost all households were engaged in crop production while 90% of farmers in Lindi and 93% in Mtwara identify crop farming as the main source of livelihood (NBS 2012, NBS 2012). Although there are two growing seasons in Tanzania (the short rainy season and the long rain season), almost all crop production is undertaken during the long rainy season in Mtwara and Lindi (NBS 2012, NBS 2012).

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, groundnuts, 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 2012, NBS 2012). In fact, these two regions are among the leading producers of cashew nuts in mainland Tanzania, accounting for 82 percent of production (NBS 2018).

3.2 Agricultural Marketing Cooperatives (AMCOs)

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[2] and cooperatives play significant role. Agricultural marketing cooperatives (AMCOs) are the second most common type of cooperative in the country, next to

[2] In a dramatic escalation of government intervention in export goods pricing in late 2018, the President of Tanzania, John Magufuli, threatened (and later carried out the threat) that if traders do not buy cashew nut at an approved price of 3000 TZS/Kg, the government will buy up all the country's cashew nut stock and 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 .

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 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 (Bezu et al., 2018).

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 an 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 but complain 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 rural household survey data from Southern Tanzania. The survey was conducted in Lindi and Mtwara regions in the summer of 2017 and 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].

4.2 Estimated Model

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

[3] This survey was conducted primarily to provide a baseline data for an impact evaluation of food value chain development project in the Lindi and Mtwara region.

M = f (**L, K, T**, **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 marketed surplus and can spend more 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. The vector **A** include two variables that capture the different effects of AMCO as they play key role in marketing of crops in Southern Tanzania. The first AMCO variable is a dummy indicating membership in the agricultural cooperative. We expect that AMCO members are more likely to engage in crop market as the cooperatives facilitate their market access and improve their capacity to produce marketed surplus. Markets will have lower cost of transacting because the marketing cooperatives carry out product aggregation, price bargaining and buyers search on their behalf. AMCOs also offer other services to their members including training, input supply and access to tractor and agricultural equipment. 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. 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 while in non-AMCO villages it is more likely that some cash crop transaction will happen outside of the AMCO channel. This could be because of lack of interested party to monitor transaction as well as because of an incentive for farmers to sell to intermediaries instead of transporting their produce to another village with AMCO office. Including to AMCO variables in the analysis allows us to capture both the effect of being a member in AMCO and that of having an AMCO branch in the village. 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 food crops and more likely to sell cash 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 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). So, we write market participation decision of the household as:

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

Where the latent variable M refers to a linear specification of the market participation equation:

$$M^* = \beta_0 + +\beta_1 \boldsymbol{L} + \beta_2 \boldsymbol{K} + \beta_3 \boldsymbol{T} + \beta_4 A + \beta_5 \boldsymbol{Z} + \varepsilon$$

The term $\boldsymbol{\varepsilon}$ 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 to be independent in this model. To be able to aggregate sales of multiple crops, we use value sold instead of quantity sold in the amount equation. 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.

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 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 and test 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: age of landholding in years (how long the household owned the farm land), the proportion of land holding that is not titled and a dummy for general trust in institution[4].

5 Results

5.1 Descriptive Statistics

5.1.1 Crop Production and Marketing in Lindi and Mtwara

We find that almost all households in the sample (98%) are crop producers. Table 1 shows major crops produced in the study area, ranked by the share of farmers producing it. A few crops dominate crop production in this area. Pigeon pea is the most dominant crop followed by maize and cashew nuts. Cereal crops such as rice, sorghum and millet are produced by less than 15% of the farmers. The ranking of crops here is similar to the national level importance of these crops, except for pigeon pea[5]. Nationally a much lower percentage of farmers produce pulses, and the leading pulse crop is bean (NBS 2018). The higher percentage of pigeon pea production in Southern Tanzania is a recent phenomenon and is partly related to an increase in demand for pigeon peas, especially from the export sector. 70% of pigeon pea produced in Southern Tanzania is exported and 41% of pigeon pea in the country is grown in Lindi and Mtwara (Mponda, Kidunda et al. 2014).

Table 1 Major crops produced in Lindi and Mtwara

Major crops produced	Producer farmers (%)
Pigeon pea	86
Maize	76
Cashew nuts	58
Cowpeas	49
Sesame	33

Source: own sample

Table 2 shows the market participation of farmers, disaggregate 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 2017). This seems to be mainly due to the fact that Lindi and Mtwara are among the leading export crop producing regions in the country.

[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.

[5] The sample districts are in pulse producing areas.

Table 2 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

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 3 shows the distribution of the 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 3 Extent of market participation among crop producers

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

Source: own sample

5.1.2 Crop Revenue by Wealth

Previous studies indicate that the crop supply of smallholder farmers is dominated by the better-off farmers (Barrett 2008, Mather, Boughton 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 earning from food and cash 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, sales continue to 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, Fafchamps et al. 1991).

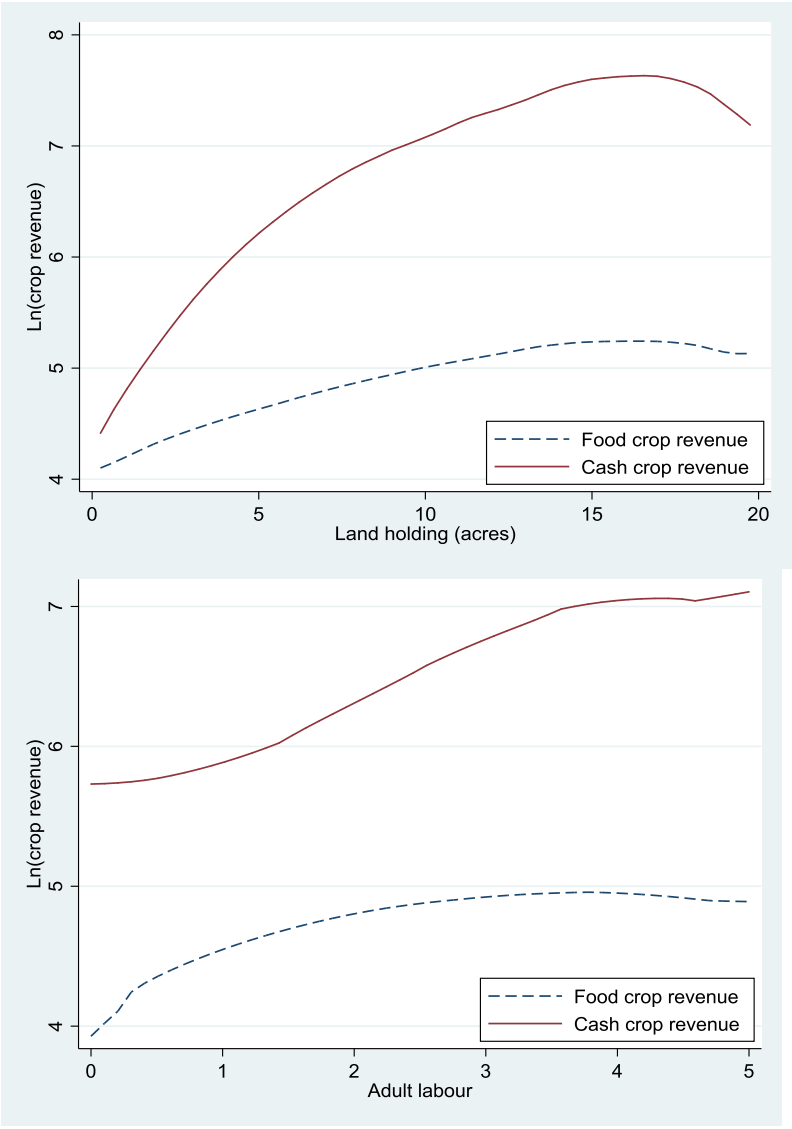

Figure 1 Non-parametric regression of household sales revenue over resource endowment (Local polynomial smoothing)

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 cash crops from all farmers in the village. But other AMCO services, such as training, are provided only to their members. In Table 4 we show revenue from crop marketing for AMCO members and non-members.

Table 4 Revenue from crop sells for AMCO members and non-members

Crop revenue in '000 TZS	Not AMCO member		AMCO member		Difference in Mean		Total	
	Mean	SD	Mean	SD			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.

****, ***, ** indicate significance at 0.1%, 1% and 5% level respectively

AMCO members earn higher sales revenue from both food crops and cash crops. However, the difference in crop revenue is larger for cash crops. Compared to non-members, AMCO members earn 85% more from sale of cash crops. The difference is statistically significant at 0.1% level.

5.2 Econometric estimation results

5.2.1 Determinants of Food and Cash Crop Marketing Decision among Smallholders

Table 5 shows the results from the double hurdle model for market participation in cash crop and food crop. The results are largely 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, Boughton 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% level in the participation equation and at 5% level 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 inconclusive 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, Boughton et al. 2013). Chamberline and Jayne (2013) show challenges of selecting appropriate market access varialbes. They found that there is in fact low correlation between alternative indicators of market access and it significantly vary widely over time and space.

Table 5 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
Houshold 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

Among resource endowments, the significant variables refer to those resources that are primarily used for farming: farm assets and farm land. Larger land holding is associated with more crop supply. This holds for both food and cash crops. Similarly, farmers with more farm asset supplied more food and cash crops. While the coefficient on land holding is not significant in the probit equation for both crops, the coefficient of farm asset holding is positive and statistically significant for food crop producers indicating that non-land farm asset influences food market participation decision. 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 (Heltberg and Tarp 2002, Markelova, Meinzen-Dick et al. 2009, Mather, Boughton et al. 2013, Olwande, Smale et al. 2015). Labor endowment was not found to be significant for crop market participation.

We now come to the impact of agricultural marketing cooperatives (AMCOs) on crop marketing in the study area. As indicated earlier AMCOs in Southern Tanzania are likely to reduce the transaction cost of marketing cash crops in the study area since the AMCOs absorb the cost of search and negotiation by taking the responsibility of contacting traders and negotiating price for cash crops. In addition, AMCOs facilitate training and input supply to their members thereby improve the marketed surplus capacity of their members through better productivity. However, because AMCOs function as the only agent for marketing cash crops, they are likely to depress marketing activities in the area. To test for these opposing effects we included two AMCO variables. One is a dummy variable that takes one if there is an AMCO branch in the village. The other one is a dummy variable capturing households' AMCO membership, which could be endogenous. We control for endogeneity of membership using a control function approach[6].

We find that being a member of an AMCO increases both the likelihood of selling food crops and the amount of food crops sold. This finding indicate that AMCO improves food crop market participation among members in Southern Tanzania. AMCOs are more likely to provide members with better price information and connection with traders for food crop, and facilitate training and input purchase to their members which will enable farmers to produce more marketable surplus. On the other hand, AMCO membership did not influence probability of participating in cash crop market. This is to be expected. Since AMCOs are formally designated as primary agents for cash crop marketing, all farmers are expected to sell their cash crops through AMCOs regardless of their membership status. And as such, with regard to

[6] We include the generalized residual from the reduced form model for AMCO membership in the market participation equation. The inclusion of the residual test and control for endogeneity. 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.

cash crops members and non-members have similar access to price information and local market access. However, members sold more cash crops than non-members. Similar to the case for food crops, this suggests that AMCO membership improved the productive capacity of farmers.

Designating AMCOS as the only channel for selling cash crops may stunt the crop market. If cash crops are not 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. The dummy variable *there is AMCO branch in the village* is included to test for this effect of AMCO. As hypothesized, the results show 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 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 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. 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 The Opposing Effects of AMCO on Food Market Participation Decision

As we have seen earlier, membership in AMCO improves the likelihood of selling food crops. In this section we report the predicted probability of market participation for AMCO members and non-members in villages with and without AMCO branch. This will allow us to assess the opposing effect of cooperatives. Keeping all other variable at the mean, AMCO members are 65% more likely to participate

in food markets[7]. On the other hand, having an AMCO branch in the village reduces the likelihood of participating in food market by 13%. Table 6 tabulates the predicted probability of food market participation for an average farm household (all variables kept at the mean except the two AMCO related variables). The table shows that AMCO members are highly likely to participate in food crop marketing, while non-members have significantly lower probability. In terms of the effect of having an AMCO in the village, it is clear that AMCO branch in the village reduces the predicted probability of both AMCO members and non-members. However, the reduction in predicted probability of non-members is much larger (13 percentage points) than for members (3 percentage points) indicating that the negative impact of AMCO on food crop marketing is stronger for non-members who have already low participation rate. This has distributional implication since AMCO members are also more likely to be better off farmers.

Table 6 Predicted food crop market participation in villages with and without AMCO- by AMCO membership

	Predicted probability of food crop market participation	
AMCO branch in the village	Not AMCO member	AMCO member
No	0.45	0.97
Yes	0.32	0.94

Source: predicted from estimated model

5.2.3 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 crops to compare with the disaggregated results reported above. However, 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.

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

Table 7 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					

Both models include district dummies (not reported here). Standard errors are clustered at Ward level. In the DH model, we also used bootstrapping to adjust standard errors for the two stage estimation.
***, **, * indicate significance at 1%, 5% and 10% level respectively

The results from the DH model and the 2SLS model are reported in Table 7. Results from the estimation on crop marketing for 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. But 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.

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 2018). 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 2018). As these estimations were on single crops, we used quantity instead of sales value in the amount equation. Since the results are consistent with what is reported for the aggregates, we discuss the output here only briefly. The table with results is given 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 sells but not cashew sells decision. On the other hand, being an AMCO member 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 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 meaningfully benefit 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 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 cooperatives 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 distric (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		

Source: Own model estimation

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