

RESEARCH ARTICLE

Beyond subsistence? The role of rural cooperatives in driving smallholder commercialization in Ethiopia

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Abstract

The transition from subsistence to market-oriented agriculture holds the potential to boost rural economic progress and improve the well-being of the rural poor in developing countries. Despite this potential, there is limited understanding of the key drivers for smallholder commercialization. In this study, we utilize comprehensive three-wave panel data collected from three major maize-producing regions in Ethiopia to examine the role of agricultural cooperatives in promoting smallholder commercialization. Employing a double-hurdle model, we model smallholder commercialization as a two-step decision process involving market participation and the extent of participation (sales quantity), conditional on market participation. Unobserved heterogeneity is accounted for using a correlated random effect procedure, and the potential endogeneity of cooperative membership is addressed through a control function approach. The findings reveal that cooperative membership

Abbreviations: 2SLS, two-stage least squares; ADLI, agricultural development led industrialization; AEU, adult-equivalent units; APE, average partial effect; AQ, asset quartile; ATA, agricultural transformation agency; CF, control function; CIMMYT, International Maize and Wheat Improvement Center; CREs, correlated random effects; CSA, Central Statistics Agency of Ethiopia; CSP, Cooperative Societies Proclamation; EIAR, Ethiopian Institute of Agricultural Research; EPRDF, Ethiopian People's Revolutionary Democratic Front; ETB, Ethiopian-Birr; FAO, Food and Agriculture Organization; FAOSTAT, Food and Agriculture Organization Statistics; FGT, Foster-Greer-Thorbecke; ha, hectares; IV, instrumental variable; kg, kilograms; LQ, land quartile; MoA, Ministry of Agriculture; MoFED, Ministry of Finance and Economic Development; SIMLESA, Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa; SNNP, Southern Nations, Nationalities, and Peoples; SSA, sub-Saharan Africa; TLU, total livestock units; UNDP, United Nations Development Program.

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increases the probability of market participation and the intensity of sales. However, further analysis demonstrates a heterogeneous relationship between cooperative membership and commercialization, underscoring the importance of targeted interventions to boost the contribution of cooperatives to rural development through commercialization. The main findings highlight that promoting smallholder commercialization through farmer groups necessitates implementing policies to increase cooperative membership, coupled with allocating resources that enhance the contribution of agricultural cooperatives [EconLit Citations: Q12, Q13, Q18].

KEYWORDS

agricultural commercialization, cooperative membership, Ethiopia, market participation, panel data

1 | INTRODUCTION

In the face of global development challenges, such as poverty, food insecurity, and growing inequality, agricultural transformation can serve as a key policy instrument (Carletto et al., 2017). The transition from subsistence agriculture to more market-oriented commercial agriculture is one of the key steps in this transformation (Barrett, 2008; Ogotu & Qaim, 2019; von Braun, 1995). This transition is particularly significant in sub-Saharan Africa (SSA), where smallholder farmers dominate the agricultural sector (Tabe-Ojong et al., 2022; Woldeyohanes et al., 2016). At the early stage of agricultural transformation, increasing productivity and production of marketable surpluses of staple food crops is key for agricultural commercialization as it links farmers with output markets (Pingali & Rosegrant, 1995). While promoting intensive farming of staple food crops and improving smallholders' access to markets have been overarching rural development strategies in many SSA countries over the past three decades (Ariga et al., 2019), smallholders are often unable to exploit the potential gains from commercialization. This is mainly due to a lack of an enabling institutional environment and market barriers, including market inefficiencies and high transaction costs that significantly reduce the incentives for market participation (Barrett, 2008; Bernard & Spielman, 2009; Fischer & Qaim, 2012).

Thus far, a relatively large body of literature on food crop commercialization generally focuses on the relationship between commercialization and various aspects of farmers' welfare in developing countries (Cazzuffi et al., 2020; Geffersa & Tabe-Ojong, 2024; Ochieng et al., 2019; Ogotu & Qaim, 2019; Rabbi et al., 2019). Given the associated welfare implications of agricultural commercialization, the question then is how to drive commercialization and ensure that farmers escape semi-subsistence poverty traps. While the answer may lie in getting prices right based on various trade and price policies, this may not be sufficient to push households into markets (Barrett, 2008). To drive households more sufficiently to markets, it is crucial to create strong institutions and rural public infrastructure that may induce broad-based market development. However, in SSA countries where the formal institutions facilitating this process are still developing (Di Falco et al., 2019; Krishnan & Patnam, 2014; Tessema et al., 2016), exploiting such potential gains from commercialization is often challenging.

In this regard, the emergence of agricultural cooperatives has been extensively viewed as a potential institutional arrangement that can help promote smallholder commercialization by reducing supply-side constraints (Abate et al., 2016; Barrett, 2008; Chagwiza et al., 2016; Fischer & Qaim, 2012). Agricultural cooperatives and similar forms of collective action can address supply-side constraints by providing market information, serving as avenues to reduce high transaction costs, and potentially offering better market prices (Abebaw & Haile, 2013; Bernard & Spielman, 2009; Bernard et al., 2008) and providing credit for their members. Furthermore, collective action can help pooling various resources, such as financial credit and labor among members, which would help create economies of scale for enhanced production and marketable surplus (Geffersa, 2023b; Wossen et al., 2017). Well-established cooperatives can also yield significant social benefits, such as improving social networks that enhance collaboration and economic engagement among their members (Wollni & Zeller, 2007; Wrede, 2023).

A growing body of literature has provided empirical evidence that collective action and institutional support can boost smallholders' participation in output markets (Bernard & Taffesse, 2012; Fischer & Qaim, 2012; Narrod et al., 2009). For example, studies focusing on tomato farming (Bhanot et al., 2021) and horticultural production (Roy & Thorat, 2008) in India found a significant role of farmer producer organizations in facilitating the markets for high-value crops by reducing transaction costs and enhancing the bargaining position of smallholders. Other related studies demonstrated the role of farmer cooperatives in facilitating marketing among small-scale banana farmers in Kenya (Fischer & Qaim, 2012), coffee growers in Costa Rica (Wollni & Zeller, 2007), and dairy producers in Ethiopia (Holloway et al., 2000). In most cases, these studies have demonstrated a positive association between agricultural cooperatives and smallholder commercialization. However, the main focus of such studies has been on the commercialization of high-value export-oriented and cash crops, despite the fact that traditional food crops are also frequently marketed to a considerable extent (Barrett, 2008; Fischer & Qaim, 2012; von Braun, 1995). A few exceptions include some studies on cereal marketing in SSA (e.g., Mazengia, 2016; Meshack et al., 2023; Mihretie, 2020).¹

Adding to this body of work, here we examine the role of agricultural cooperatives in promoting smallholder commercialization, focusing on maize, which is a significant crop in rural SSA relative to other cereal crops. Despite the significant contributions of previous studies, there is limited empirical evidence on the role of agricultural cooperatives in promoting the commercialization of food grains, which can be argued to be inclusive as opposed to the commercialization of high-value chains. This is particularly the case in the context of SSA, with a few exceptions, including Bernard and Taffesse (2012), Bernard and Spielman (2009), and Bernard et al. (2008), who examined the role of cooperatives in promoting commercialization among smallholder grain producers. Ethiopia's maize sector is an interesting case to address our research question, given that the country is the second-most populous country in Africa and has made significant strides in implementing various agriculture-led development and growth policies over the past few decades. Given that transforming smallholder farming into more market-oriented intensive farming remains Ethiopia's policy priority, agricultural cooperatives are expected to play an instrumental role. Despite significant efforts in stirring the transformation of the smallholder maize sector in Ethiopia, there is a dearth of information on the role of agricultural cooperatives on the path towards commercialization. Although a few recent studies in Ethiopia (e.g., Mazengia, 2016; Meshack et al., 2023; Mihretie, 2020) have made important contributions, they have been limited to specific regions or districts and have relied on cross-sectional data and are thus plagued by unobserved farm heterogeneity concerns, which could thus preclude the generalizability of the findings.

On the basis of comprehensive panel data analyses, we provide new insights into the role of cooperative membership in boosting smallholder commercialization. For modeling the farmers' marketing decisions, we use Cragg's (1971) double-hurdle model, which allows estimating the market participation decision (a dichotomous choice) and the degree of commercialization (i.e., intensity of sale) simultaneously. We estimate the double-hurdle

¹Staple or traditional food crops are predominantly cultivated for human consumption, encompassing essentials like rice, wheat, corn, and vegetables which play a crucial role in fulfilling global dietary requirements. High-value crops, on the other hand, are cultivated to generate revenue, typically being sold in markets for profit instead of being consumed directly by farmers or local communities.

model using a correlated random-effects framework and a control function (CF) approach to address the endogeneity of cooperative membership in marketing decisions. Our analysis adds to the existing literature on smallholder commercialization in three ways. First, we improve learning on the relationship between cooperative membership and commercialization by utilizing comprehensive panel data spanning three production seasons and covering three major maize-producing regions in Ethiopia. The existing analyses have mostly relied on one-period cross-sectional datasets. While this is not much of a problem given that multiperiod data are not easy to come by, it potentially limits learning about farmers' marketing decisions, which is often a dynamic process that may, at best, be understood under different periods. Second, by examining whether cooperative membership has a varied impact on maize commercialization among its members, we provide deeper insights into the direction and commercialization gains from farmers' participation in cooperatives. This has significant policy implications, especially as it indicates where targeting efforts should be placed for optimal results. We also uncover various potential mechanisms through which cooperative membership can contribute to smallholder commercialization, ranging from production to financial and marketing performance indicators.

The remainder of this article is organized as follows: Section 2 provides the contextual background, while Section 3 outlines the analytical approach. Section 4 describes the data and variables, while Section 5 presents our empirical results and accompanying discussion. Section 6 concludes the paper with some policy implications.

2 | MAIZE PRODUCTIVITY AND THE ROLE OF AGRICULTURAL COOPERATIVES IN ETHIOPIA

Ethiopia stands as one of the most populous agriculture-dependent nations in Africa. In SSA, the country is among the countries that prioritize agricultural-led growth and development in their rural development policies. Agriculture is Ethiopia's dominant sector and mainstay, contributing about 35% of the country's gross domestic product and over 70% of the employment opportunity (World Bank, 2021). Over 83% of the country's population derives its livelihood from smallholder agriculture (Central Statistics Agency of Ethiopia [CSA], 2019). Since the early 1990s, the Ethiopian government has implemented agricultural development policies consistent with the country's main long-term growth strategy—agricultural development led industrialization (ADLI). The ADLI strategy emphasizes accelerating the growth of the agricultural sector to achieve sustained economic growth, enhanced agricultural contribution, and poverty reduction with a major strategic direction of enhancing the productivity and commercialization of the smallholder agricultural sector (Ministry of Agriculture [MoA], 2010). In the past two decades, the government has focused on formulating policies that promote smallholder commercialization and has made the necessary efforts to pursue its development programs in the context of the commercialization of smallholder agriculture (MoFED, 2012). Such policy initiatives adopted several agricultural development policy instruments, including constructing farm-to-market roads, developing agricultural credit markets, and providing specialized extension services for commercializing smallholder agriculture (MoFED, 2012; Gebremedhin et al., 2009). The government placed great emphasis on improving the productivity of major food crops, such as maize.

Maize is predominately a subsistence food crop in Ethiopia, and household food security is mainly defined in terms of access to maize, as in most SSA countries. The country's maize production includes subsistence farmers, smallholder commercial farmers, large-scale commercial farmers, and a few state-owned and private commercial farms. Subsistence farmers are the major actors as maize producers in the country, with landholding considerably varying from less than 0.5 ha to over 10 ha (CSA, 2019). Given the growing economic importance of maize in Ethiopia, the policy initiatives so far have placed great emphasis on enhancing the productivity of maize through expanded access to improved farm inputs (fertilizers, improved seeds, and pesticides) to smallholders (Abate et al., 2015; Sheahan & Barrett, 2017; Geffersa et al., 2022). Over the past two decades, the Ethiopian government has taken significant steps to enhance the productivity of maize (Geffersa, 2023a). This includes increasing the

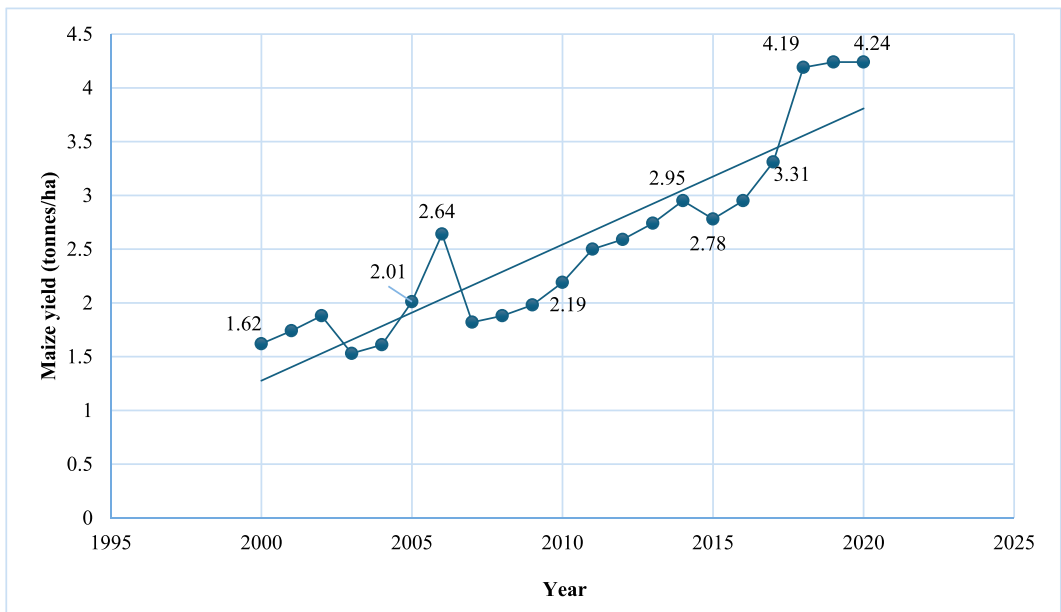


FIGURE 1 Annual maize yield in Ethiopia (2000–2020). Source: Authors' construction based on FAOSTAT (2022).

extension agent-to-farmer ratio to 1:476, which is substantial compared with the extension agent-to-farmer ratio of other SSA countries—such as Kenya (1:1000), Malawi (1:1603), and Tanzania (1:2500) (Abate et al., 2015).

Consequently, in the past two decades, maize has taken a prominent role in Ethiopia's agriculture, leading in terms of production scale, volume, use of improved inputs, farmer participation, and household consumption (CSA, 2016, 2019, 2021). These achievements in enhancing smallholder maize productivity in Ethiopia have played a pivotal role in the country's rapid agricultural output growth through a more than doubled agricultural output over the past two decades (Abate et al., 2015; Bachewe et al., 2018; Geffersa, 2023a). Notably, the national maize yield rose from 1.62 tonnes/ha in 2000 to 4.24 tonnes/ha in 2020 (Figure 1). Regarding household consumption of the top five major cereal grains produced in Ethiopia, maize became the single most important cereal in terms of calorie intake and the cost of purchasing (FAO, 2014; World Bank, 2018). While various factors, including improved research-extension linkages, have contributed to productivity improvements in the maize sector, agricultural cooperatives are considered key institutional contributors to this remarkable success (Abate et al., 2015). However, there is a scarcity of empirical evidence on the role of agricultural cooperatives in Ethiopia's smallholder maize sector.

Ethiopia's agricultural transformation policies over the past two decades have consistently emphasized agricultural cooperatives' central role in enhancing smallholder farmers' productivity and well-being. Agricultural cooperatives were formally established in Ethiopia as a form of agricultural collectives or cooperative production for co-producing commercial and industrial crops (e.g., coffee) during the Ethiopian imperial regime (1930–1974). Following the economic liberalization policies implemented by the Ethiopian People's Revolutionary Democratic Front (EPRDF) in the mid-1990s, cooperatives received significant policy attention in Ethiopia (Getnet & Anullo, 2012; Tefera et al., 2016). In 1994, the EPRDF government enacted a new cooperatives proclamation (Proclamation No. 85/1994), later revising it in 1998 to reassess the activities of farmers' cooperatives. This revision was prompted by the withdrawal of governments from rural development programs and was formalized through the Cooperative Societies Proclamation (CSP) No. 147/1998 (Abebaw & Haile, 2013; Getnet & Anullo, 2012;

Tefera et al., 2016). The CSP defines agricultural cooperatives as farmer organizations founded by individuals voluntarily and controlled democratically by their members (Getnet & Anullo, 2012; Tefera et al., 2016).

Recognizing the increasing significance of maize in household food consumption and the pursuit of food security, such policy initiatives have focused on fostering rural farmer cooperatives, along with improving access to extension services to smallholder maize farmers (Abate et al., 2016; Tefera et al., 2016). In 2010, the government established the agricultural transformation agency to coordinate targets in collaboration with the MoA, responsible for developing and implementing cooperative policies. Agricultural cooperatives have been pivotal in providing essential inputs (fertilizers, improved seeds, and pesticides) to smallholder maize farmers in Ethiopia (Geffersa, 2023b; Tefera et al., 2016). Agrodealers and traders occasionally provide farm inputs to smallholder farmers in Ethiopia as cooperative unions are often the main distributors of key inputs, such as fertilizers, at the regional level (Abate et al., 2015; Tefera et al., 2016; Wossen et al., 2018). Farmer cooperatives have also played a substantial role in alleviating liquidity constraints by providing seeds (Geffersa, 2023b). By engaging in collective purchasing of inputs and outputs, cooperatives facilitate marketing options at reasonable prices. Despite the government's efforts, reaching rural populations, especially in remote areas, remains a challenge. While the Farmers' Cooperative Agency aimed to establish at least one primary cooperative at the *kebele*² level, with the goal of providing cooperative services to two-thirds of the rural population, coverage remains below 40% of the targeted *kebeles* (Abate et al., 2014; Tefera et al., 2016). Continued efforts are essential to expand the reach of cooperative services and further enhance their impact on rural development in Ethiopia.

3 | ANALYTICAL APPROACH

3.1 | Conceptual framework

To guide the understanding of the relationship between cooperative membership and commercialization, we employ insights from the nonseparable agricultural household model with missing markets (de Janvry et al., 1991). Given that these models have been well developed and adapted with many tweaks on transaction costs (Key et al., 2000; Renkow et al., 2004; Tabe-Ojong et al., 2022), we prefer to not repeat this but explore and more fully conceptualize this for the case of maize farmers in Ethiopia. The crucial insight from these theoretical perspectives is that market access is not uniform. Various forms of transaction costs act as barriers, influencing households' participation in markets. These transaction costs can lead households to either engage in markets or choose self-sufficiency. Additionally, they may result in heterogeneous commercialization, with some households selling different portions of their harvest while others opt not to participate in markets. Fixed transaction costs may encompass various expenses incurred during market interactions, including the expenses linked to seeking the most favorable prices, the costs involved in negotiation and bargaining when there is information asymmetry about prices, and the costs associated with preparing outputs to meet market standards, which involve significant time investments.

Cooperative membership can play a significant role by reducing fixed transaction costs associated with participating in markets (Key et al., 2000; Renkow et al., 2004; Tabe-Ojong et al., 2022) and can stimulate market participation through various other mechanisms (Figure 2). Most directly, agricultural cooperatives can reduce transaction costs by enhancing access to modern supply chains and potentially offering better market prices for their members (Abebaw & Haile, 2013; Bernard & Spielman, 2009; Bernard et al., 2008). Beyond reducing fixed transaction costs, cooperative membership can influence the members' marketing decisions by improving farm production and productivity by easing access to modern inputs and financial credit (Lin et al., 2022). Moreover,

²A *kebele* is the smallest administrative unit in Ethiopia that is smaller than a *woreda* (or district), but larger than a village.

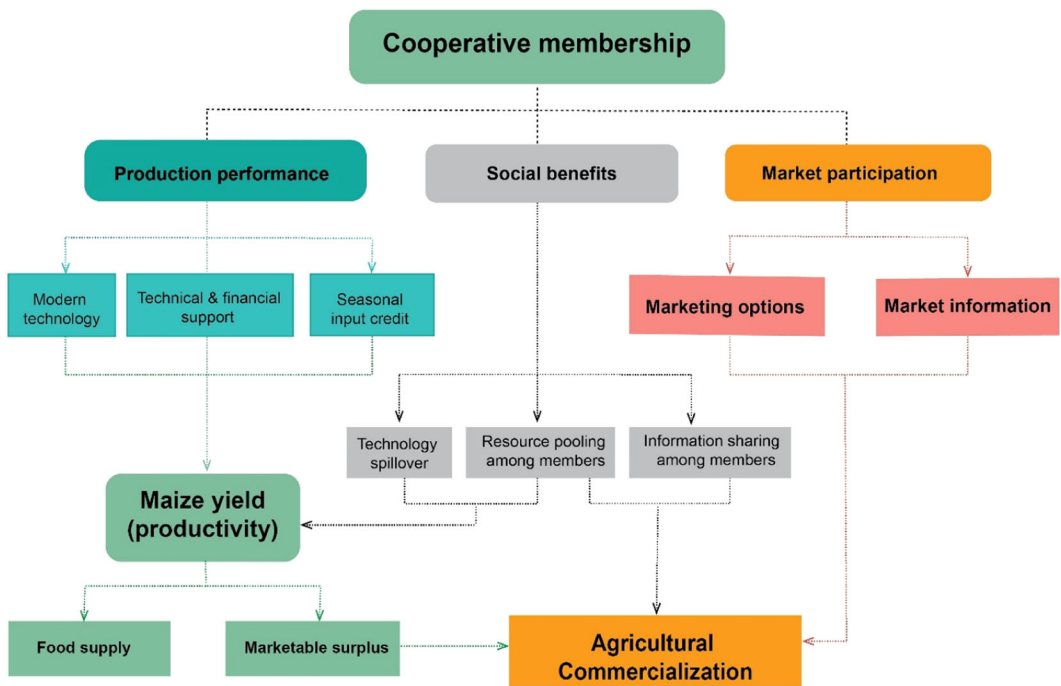


FIGURE 2 Linking cooperative membership with smallholder commercialization. Source: Authors' illustration.

cooperatives can facilitate agricultural innovation by promoting efficient information flows (Fischer & Qaim, 2012). More established cooperatives can also generate considerable social benefits, including the role they play in creating strong social networks that facilitate collaboration and economic activities among members (Wollni & Zeller, 2007; Wrede, 2023). For instance, members gain advantages such as resource pooling among themselves and reduced transaction costs through information sharing, which would subsequently improve their ability to compete effectively with powerful market players (Wrede, 2023). Furthermore, collective action that helps pooling various resources, such as financial credit and labor among members, would help create economies of scale for enhanced production and marketable surplus (Gefferesa, 2023b; Wossen et al., 2017). More inclusive cooperatives can play a crucial role in commercialization by empowering marginalized and economically weak smallholder farmers by enhancing their collective bargaining power (Ahmed & Mesfin, 2017; Wanyama et al., 2009). Commercialization gains can also be achieved through membership-induced agricultural innovation via spillover effects from the collective use of technology, which would boost agricultural production (Chagwiza et al., 2016; Manda et al., 2020).

To further understand such potential mechanisms through which cooperatives can stimulate farmers' marketing decisions, we extend our conceptualization by using a random utility framework (Abebaw & Haile, 2013; Fischer & Qaim, 2012; Wollni & Zeller, 2007). As the assumption of separability between production and consumption decisions is unlikely to hold in developing countries like Ethiopia, which are characterized by market failures, we assume that household (i)'s maize production and consumption decisions are nonseparable (Singh et al., 1986). This means that, while producing maize for home consumption and sale, a household drives utility from cooperative membership, where a household chooses to be a member of a cooperative if the expected benefits (utility gains) from membership (U_i) are larger than the expected benefits of not belonging to a cooperative (U_0). As utility gains from cooperative membership are unobservable, we use a latent variable C_i^* that captures the benefit from membership, which can be ultimately reflected through commercialization gains:

$$C_{it}^* = f(Z'_{it}) \quad \text{for} \quad \begin{cases} C_{it} = 1 & \text{if } \theta Z'_{it} > 0, \\ C_{it} = 0 & \text{otherwise,} \end{cases} \quad U_i - U_0 > 0, \quad (1)$$

where C_{it} is a binary variable measuring household's cooperative membership, which is a function of exogenous variables (Z), captured by a vector Z'_{it} , α is a vector of parameters to be estimated.

To establish a mathematical relationship between cooperative membership and smallholder commercialization, we specify a simple theoretical maize commercialization model (M_{it}) as a function of cooperative membership (C_{it}) and a set of variables representing the socioeconomic characteristics of a farm household (Z'_{it}):

$$M = f(C_{it}, Z'). \quad (2)$$

In line with the theoretical predictions of market surplus, our theoretical smallholder commercialization model follows a two-staged process (Key et al., 2000; Tabe-Ojong et al., 2022). Maize farmers first choose whether to sell before they decide how much maize to sell (conditional on participation).

3.2 | Empirical strategy

3.2.1 | Empirical model specification

In line with our theoretical model, we use Cragg's (1971) flexible double-hurdle model to accommodate a two-staged marketing decision process in our empirical model. We have chosen a double-hurdle model as it allows for the possibility that factors determining market participation and those influencing the intensity of sales may be different (Burke, 2009). As such, our empirical double-hurdle model for farmers' marketing decisions involves two steps. In the first step (*Hurdle 1*), farmers decide whether to participate in the maize market, which is a binary choice that helps determine the probability of market participation. We estimated *Hurdle 1* using the probit model. Once *Hurdle 1* is crossed, farmers choose how much quantity of maize to sell (*Hurdle 2*), which is the second step representing the extent or the intensity of the sale, estimated using a truncated normal (Tobit) regression.

In estimating our double-hurdle model, the choice of the empirical panel data model is influenced by the assumptions we make about the error term. Typically, a potential econometric issue that would affect the estimation is a possible endogeneity problem due to unobservable household heterogeneity because farmers' marketing decision is likely influenced by unmeasurable farm household characteristics, such as skills, risk behavior, or individual perceptions, which could potentially correlate with the idiosyncratic error term. Applying a household fixed-effects estimator can help control unobservable heterogeneity in linear models. However, using fixed-effects to a nonlinear model (e.g., double-hurdle model) could lead to biased and inconsistent estimates due to the potential incidental parameters problem, which often arises when the length of the panel is small compared with the number of observations (Greene, 2004). Consequently, we employed the correlated random effects (CREs) approach to control unobservable heterogeneity in our empirical estimation of the double-hurdle model. The CRE framework, first proposed by Mundlak (1978) and relaxed by Chamberlain (1982), is a parametric approach that addresses the incidental parameter problem of a fixed-effects estimator by allowing dependence between exogenous variables and time-invariant, unobserved factors (Wooldridge, 2013). Following Wooldridge (2013), we implement the CRE strategy by adding the time-average values of the time-varying explanatory variables ($\bar{x}_{it}$) as additional controls in the double-hurdle model.

More formally, the two-step decision process in our CRE double-hurdle model is specified as:

Hurdle 1: Decision to participate in maize market (a binary choice):

$$M_{it1}^* = \gamma + \Phi_1 C'_{it} + \beta_1 Z'_{it} + \rho_1 \bar{x}_{ji} + u_{it} \quad \text{for } M_{it1} = \begin{cases} 1 & \text{if } M_{it1}^* > 0, \\ 0 & \text{otherwise.} \end{cases} \quad (3a)$$

Hurdle 2: Decision on the quantity of maize to sell conditional on market participation:

$$M_{it2}^* = \alpha + \Phi_2 C'_{it} + \beta_2 Z'_{it} + \rho_2 \bar{x}_{ji} + \varepsilon_{it}, \quad (3b)$$

where M_{it1}^* and M_{it2}^* are the latent variables denoting the probability of the household's decision to sell maize output and the extent or intensity of sale, respectively, with the observed quantity of sale of M_{it} ; C_{it} denotes a dummy variable for cooperative membership; Z'_{it} is a vector of variables explaining the market participation decisions; β_1 and β_2 are the parameters associated with the factors determining the market participation decision and intensity of sale, respectively. u_{it} and ε_{it} are the respective error terms. The term $\bar{x}_{ji}$ denotes the time averages of the time-varying covariates for each j th covariate for the i th-farm household. Each hurdle defined above is conditioned by the household's socioeconomic characteristics, including the cooperative membership status of the farm households. In addition, we included the same set of exogenous variables that may affect farmers' marketing decisions in both hurdles. All variables used in the analysis are defined in Section 4.2.

3.2.2 | Identification strategy

In addition to controlling for unobserved heterogeneity, identification of the causal effects of cooperative membership (C_{it}) on marketing decisions (M_{it}) is not trivial because a farmer's cooperative membership is not a random decision. This means that farmers' decision to participate in cooperatives may depend on households' socioeconomic characteristics, which is likely to correlate with unobserved, time-varying factors, which would cause a potential endogeneity problem. One way of reducing this concern is using instrumental variable (IV) estimators. The two common IV estimators are the two-stage least squares (2SLS) method and the two-stage CF approach (Wooldridge, 2015).

In this analysis, we use the CF approach to address the potential endogeneity of cooperative membership decisions in the double-hurdle marketing decision model. While the CF approach is technically like the standard 2SLS method, we use it because of the nonlinear nature of our outcome variable. The CF approach is more efficient than the standard 2SLS when estimating nonlinear models (Tadesse & Bahiigwa, 2015; Wooldridge, 2015). Moreover, the CF approach is efficient even for weak instruments (Tadesse & Bahiigwa, 2015), and it can easily be combined with the CRE model. The CF approach is also argued to be more flexible with respect to functional form than the 2SLS procedure (Ogutu & Qaim, 2019; Geffersa et al., 2022). Our CF approach to test endogeneity involves two stages (Wooldridge, 2015). In the first-stage we estimate a reduced-form probit model for cooperative membership to obtain the generalized residual. We estimate the reduced form (cooperative membership) equation as a function of exogenous variables used in the double-hurdle commercialization equation along with a variable we used as an IV. We employed the CRE approach to control unobservable heterogeneity in estimating this reduced-form equation, which is specified as:

$$C_{it} = \theta_0 + \theta_1 Z'_{it} + \theta_2 \bar{x}_{ji} + \theta_3 IV_{it} + e_{it}, \quad (4)$$

where IV_{it} is a relevant instrumental variable with an associated parameter θ_3 . The term $\theta_2 \bar{x}_{ji}$ denotes the time averages of the time-varying covariates (i.e., each j th covariate for the i th-farm household) with the associated parameters θ_2 . θ_0 and e_{it} are the intercept and the error terms, respectively.

In the second-stage, we stored the generalized residual from the reduced-form cooperative membership equation and included it along with the actual variable measuring cooperative membership in the double-hurdle

CRE commercialization model to test the potential endogeneity of cooperative membership (Wooldridge, 2015). Using a CF approach to estimate the reduced form equation for cooperative membership (Equation 4) requires at least one IV that is strongly partially correlated with cooperative membership (C_{it}) but is uncorrelated with the unobservable that affects the commercialization decision. We use the non-self-proportion of cooperative members in a *kebele* as an IV in the cooperative membership equation, which is then excluded in the estimation of the commercialization model. The IV was constructed by counting the number of households that were cooperative members in each respective *kebele*. This was then divided by the total number of surveyed households in the *kebele*, after excluding the household of interest. The use of this instrument is consistent with earlier studies on cooperative membership (Ma et al., 2022; Tabe-Ojong, 2022) and motivated by the literature on social learning and neighborhood effect (Krishnan & Patnam, 2014; Tessema et al., 2016).

As suggested by recent studies in SSA (Ogotu et al., 2019; Tabe-Ojong et al., 2022), incorporating insights from social networks and peer effects provides a strong IV in examining smallholder decision-making. It has been established that households in rural areas interact regularly and often make decisions based on the choices of their neighbors and peers, especially in SSA countries where the public agricultural extension systems and formal institutions are still developing (Di Falco et al., 2019; Krishnan & Patnam, 2014; Tessema et al., 2016). For example, previous studies in Ethiopia (see Krishnan & Patnam, 2014; Tessema et al., 2016) revealed that farmer-to-farmer interactions and peer effects enhanced technology diffusion among rural farming communities. Thus, it may be the case that households that cooperative members surround would likely also become members, given significant social learning and neighborhood effects in Ethiopia. This all implies that our IV may be strongly correlated with the cooperative membership indicator, making it possibly relevant. For the case of exogeneity, it is not trivial to prove this condition from an empirical perspective. The lone way is to motivate why it may be exogenous to error terms of the outcome equations. From the way the IV is constructed, it is hard to expect any direct influence of this variable on marketing decisions except through cooperative membership, especially after controlling for other important institutional variables and time-constant unobserved heterogeneity via the CRE procedure. The IV is constructed at a higher geographical scale, and the particular reference household is excluded from the construction, which may impose some form of exogeneity. That said, it is important to mention that getting strong and valid instruments is not trivial in most cross-sectional analyses, but given that we have panel data, controlling for time-invariant unobserved heterogeneity could significantly absorb most of the endogeneity concerns.

4 | DATA AND VARIABLES

4.1 | Farm household survey data

The paper relies on a comprehensive three-wave panel farm household survey data from three major maize-producing regions of Ethiopia. The surveys were conducted as part of the Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) program and a collaborative regional project implemented by the Ethiopian Institute of Agricultural Research (EIAR) and the International Maize and Wheat Improvement Center (CIMMYT). The SIMLESA surveys covering 2009/10, 2012/13, and 2014/15 cropping seasons were carried out on selected maize-producing areas from nine districts located in three regional states of Ethiopia: namely, Oromia, Benishangul-Gumuz and the Southern Nations, Nationalities, and Peoples (SNNP) regions.

Multistage sampling was employed to identify sample farm households (Marennya et al., 2016). In the first stage, nine districts (five from Oromia, three from SNNP, and one from Benshangul-Gumuz regions) were purposely selected based on the maize production potential and agroecological suitability. In the second stage, a total sample of 69 *kebeles* were selected using probability proportional to size sampling technique. Finally, in the selected *kebele*, probability proportional to size sampling procedure was also used to identify total sample households to increase

the odds of households in high population *kebeles* being sampled. The baseline survey covering the 2009/10 production season consists of a total of 898 sample households, while the second wave covering the 2012/13 production season elicited information from 874 farm households with a success rate of 97.3%.

The SIMLESA surveys generated rich information at the household, farm, and village levels. The household and farm level data include information on maize production, input use, and information related to the socioeconomic status of the farm households, including membership in farmer cooperatives. The cooperative membership status of sample households was recorded based on whether the husband/wife is a member of a farmer cooperative. The survey also obtained information on self-reported environmental variables (plot fertility, slope, depth, and plot size) and village-level information on access to institutions.

4.2 | Definition of variables and descriptive statistics

Table 1 describes the key variables used in the regression analysis. As highlighted earlier, we conceptualize commercialization as a two-step process involving market participation and the extent of participation. Market participation is defined as a dummy taking the values of 1 and 0 for sellers and nonsellers, respectively. The extent of market participation refers to the quantity of maize that is sold in markets (kg). Our main variable of interest, cooperative membership, is also a dummy variable. We use different household controls capturing the socioeconomic characteristics of farm households. Before running our econometric models, we used natural logarithm to transform the quantity of maize sold, landholding, and household asset variables because of the skewness of their distribution. We applied the inverse hyperbolic sine transformation to address the zero-observation problem when taking the logarithm. This technique transforms variables by approximating a natural logarithm while retaining the zero-valued observations (Bellemare & Wichman, 2019). We control initial differences in capital stock among farm households using initial values of assets (monetary values) and livestock ownership.

Before running our empirical model, we perform basic summary statistics on the key variables over the panel years. As shown in Table 1, market participation is quite high among smallholder farmers and somewhat increasing over time (75%–82%). This is also the case with the quantity of maize that is sold, although there was a slight decrease in 2012, which eventually increased to about 1485 kg. The insights here corroborate high market participation rates in Malawi, Tanzania, and Uganda (Carletto et al., 2017). Households' membership in cooperatives has likewise varied over the three waves. Households are middle-aged with about 3 years of primary education and have household sizes of about 5 (adult-equivalent units). Households have high access to extension services and have to walk for about 80 min to the market. Households have farm sizes of about 2 ha. Compared with the initial survey, mobile ownership has significantly increased, with the majority (over 50%) of farm households owning a mobile phone during the two earliest surveys. We also observe considerable differences in market participation (Figure 3) and some socioeconomic characteristics between sample farm households based on their cooperative membership status (Table 2). Specifically, members of cooperatives were relatively younger, male, married, more educated, and had better access to mobile phones. Cooperative members had a significantly higher family size and were in a better position in terms of access to physical resources, such as assets, livestock, and land. Moreover, cooperative members reside in *kebeles* with a significantly higher proportion of cooperative members.

5 | RESULTS AND DISCUSSION

5.1 | Preliminary analysis

As highlighted earlier, we followed the CF approach in testing and controlling for endogeneity of cooperative membership equation (Equation 4). In this first-stage regression, which involves estimating a reduced form of the

TABLE 1 Descriptive statistics of variables used in the analyses by year.

Variables	2009/10 Mean	2012/13 Mean	2014/15 Mean
<i>Farmers' commercialization decision</i>			
Hurdle 1: Market participation (yes = 1)	0.76 (0.43)	0.82 (0.38)	0.82 (0.38)
Hurdle 2: Quantity of maize sold (in kg) ^a	1183.24 (2022.31)	1157.73 (1575.45)	1484.60 (3166.45)
<i>Independent variable of interest</i>			
Cooperative membership [C _{it}] (yes = 1)	0.222 (0.416)	0.240 (0.427)	0.224 (0.417)
<i>Socioeconomic characteristics</i>			
Age of the household head (years)	41.25 (13.19)	43.87 (13.13)	46.71 (13.11)
Male-headed household (yes = 1)	0.91 (0.28)	0.92 (0.27)	0.92 (0.28)
Marital status (married = 1)	0.92 (0.27)	0.90 (0.29)	0.91 (0.28)
Education level of the household head (years)	3.26 (3.39)	3.16 (3.38)	3.04 (3.34)
Family size (AEU)	4.94 (2.25)	5.04 (2.22)	4.93 (2.01)
Landholding (ha) ^a	2.25 (1.95)	1.72 (1.46)	2.17 (1.77)
Initial level of livestock ownership (TLU) ^b	4.16 (4.61)	4.16 (4.61)	4.16 (4.61)
Initial level of asset ownership (ETB) ^{a,b}	9380.47 (29,558.53)	9380.47 (29,558.53)	9380.47 (29,558.53)
Mobile phone ownership (yes = 1)	0.24 (0.42)	0.53 (0.49)	0.60 (0.49)
Extension service (walking minutes)	30.74 (26.59)	30.74 (26.59)	30.74 (26.59)
Distance to the main market (walking minutes)	75.13 (108.03)	121.74 (103.52)	79.23 (96.68)
Instrumental variable in reduced form equation: Non-self-proportion of cooperative members in a <i>kebele</i>	0.22 (0.16)	0.18 (0.13)	0.19 (0.13)

Note: Standard deviation in parentheses.

^aBefore running the empirical models, we used natural logarithmic to transform the quantity of maize sold, landholding, and household asset variables because of the skewness of their distribution. We applied the inverse hyperbolic sine transformation when taking the logarithm to address the zero-observation problem.

^bWe used initial values of assets (monetary values) and livestock ownership (total livestock units [TLUs]) to control initial differences in capital stock among farm households. The conversion factors used to compute TLU and adult-equivalent units (AEUs) are given in Table A1 in the Supporting Information Appendix. Ethiopian-Birr (ETB) is a local currency, where 1 USD was equivalent to 17.01 ETB in 2009/10, 20.50 ETB in 2012/13, and 20.68 ETB in 2014/15 cropping seasons.

cooperative membership equation (Equation 4), we include the IV along with all the control variables we use in the double-hurdle commercialization model (i.e., the structural equation). The results from this first-stage estimation shown in Table A2 (in the Supporting Information Appendix) indicate that the variable used as an IV was statistically significant, suggesting its statistical validity (Wooldridge, 2015). Following this, we stored the generalized residual

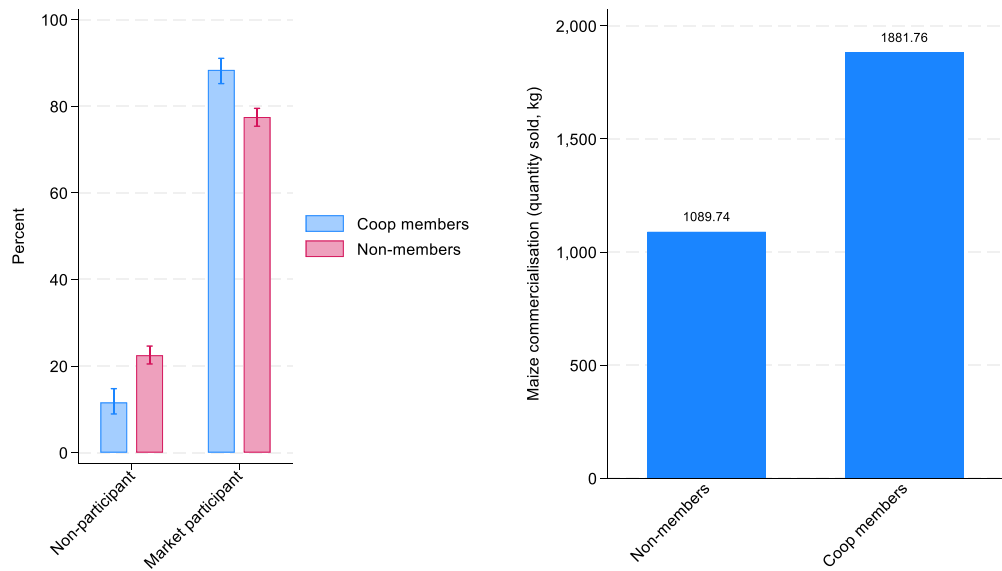


FIGURE 3 Market participation and commercialization between cooperative members and nonmembers.

TABLE 2 Descriptive statistics of the variables used in the analysis by cooperative membership status.

Variables	Members	Nonmembers	t Test
Market participation (yes = 1)	0.88	0.78	0.10***
Quantity of maize sold (in kg)	1881.77	1089.74	792.03***
Age of the household head (years)	43.94	43.93	0.01
Male-headed household (yes = 1)	0.95	0.91	0.04***
Marital status (married = 1)	0.96	0.89	0.07***
Education level of the household head (years)	3.86	2.94	0.92***
Family size (adult-equivalent unit)	5.36	4.84	0.52***
Landholding (ha)	2.38	1.94	0.44***
Initial level of livestock ownership (total livestock unit)	6.74	4.93	1.81***
Initial level of asset ownership (Ethiopian-Birr)	12,396.17	8487.63	3908.54**
Mobile phone ownership (yes = 1)	0.50	0.44	0.06**
Extension service (walking minutes)	30.10	31.02	-0.92
Distance to the main market (walking minutes)	13.04	14.69	-1.65
	0.28	0.17	0.11***

Notes: The significance of the mean differences (t tests) are presented as * $p < 0.10$. Other notes as in Table 1;

** $p < 0.05$; *** $p < 0.01$.

from the reduced-form cooperative membership equation and included it along with the actual variable measuring cooperative membership in the double-hurdle CRE commercialization model to test the potential endogeneity of cooperative membership. We follow Wooldridge (2015) to test the null hypothesis that cooperative membership is exogenous in the double-hurdle model. According to Wooldridge (2015), the significance of the generalized residual in the structural model suggests the presence of endogeneity. The results presented in Table 3 indicate that the residual term is significant in both hurdles, suggesting that we reject the null hypothesis of cooperative membership being exogenous in the farmer's market participation decision and the sales intensity.

5.2 | The effect of cooperative membership on commercialization decisions

Table 3 shows the relationship between cooperative membership and commercialization estimated using a CRE double-hurdle model. We report both the estimated coefficients as well as the average partial effects (APEs) to facilitate the interpretation of the results. As anticipated, the positive and statistically significant coefficient associated with cooperative membership was observed in both hurdles, suggesting that being a cooperative member increases both the probability of maize market participation and the quantity of maize sold. The statistically significant APE estimate for cooperative membership in the first hurdle (*Hurdle 1*) indicates that cooperative membership is associated with an increase in the likelihood of market participation by 0.063 (Table 3). Similarly, the APE estimate for cooperative membership in the second hurdle (*Hurdle 2*) indicates that cooperative membership increases the maize output sale intensity by 0.056. These findings provide evidence that agricultural cooperatives may play a crucial role in promoting commercialization among maize farmers in Ethiopia and other comparable developing countries in SSA, where maize remains one of the important staple crops cultivated by rural households.

The result is consistent with the prediction of our conceptual model and provides evidence supporting the notion that rural cooperatives can boost commercialization by reducing transaction costs and mitigating market risks by strengthening the collective bargaining power of economically disadvantaged farmers (Holloway et al., 2000; Trebbin, 2014). The positive implication of cooperative membership on the marketing behavior of farmers aligns with the growing literature that has established a significant association between cooperative membership and commercialization (e.g., Bernard & Spielman, 2009; Markelova & Mwangi, 2010). Specifically, we found evidence supporting earlier literature that has demonstrated a significant role of agricultural cooperatives in shaping farmers' bargaining power in the market and influencing output prices, serving as a crucial incentive for farmers to boost production, enhance productivity, and boost the marketing surplus that would enable exploiting the marketing opportunities. Cooperative member farmers have a high chance of accessing pertinent information regarding market prices and marketing channels, aiding them in achieving higher price margins (Ma & Abdulai, 2017; Michalek et al., 2018). This holds particular importance in SSA, where farmers are often dispersed across extensive and isolated rural regions (Wanyama et al., 2009). In addition, farmers' participation in both formal and informal associations can facilitate access to inputs and high yield-enhancing improved technological innovations, such as improved seeds and fertilizers (Geffersa, 2023b; Wossen et al., 2017).

Our additional descriptive results reported in Figure 4 and Table 4 provide suggestive evidence of the potential mechanisms through which cooperative membership enhances commercialization behavior among its member farm households. As shown in Table 4, there is a significant difference between cooperative members and nonmembers in terms of variables representing access to information on the quantity of maize seed from external sources, chemical fertilizer applied, improved seed used, access to output and input markets, information, and average maize price. Results presented in Figure 4 likewise show that cooperative members have, on average, achieved higher maize production and yield per hectare than nonmembers, which has ultimately improved farmers' marketable surplus and financial performance, as reflected through their farm income and profit.

TABLE 3 CRE double-hurdle model for cooperative membership effect on maize commercialization.

	Hurdle 1: Probability of market participation		Hurdle 2: Intensity of sale	
	Coefficient	APEs	Coefficient	APEs
Cooperative membership (yes = 1)	0.368*** (0.049)	0.063*** (0.031)	0.548*** (0.116)	0.056*** (0.009)
Generalized residual	-0.097*** (0.021)	-0.015*** (0.009)	-0.211*** (0.045)	-0.021*** (0.003)
Age of the household head (years)	-0.007 (0.009)	-0.001 (0.002)	-0.001 (0.008)	-0.001 (0.0001)
Male-headed household (yes = 1)	-0.093 (0.109)	-0.062 (0.046)	0.301*** (0.055)	0.003*** (0.013)
Marital status (married = 1)	-0.130 (0.113)	0.000 (0.047)	-0.493*** (0.120)	-0.028*** (0.014)
Education level of the household head (years)	0.028** (0.014)	0.006** (0.003)	0.010 (0.018)	0.002 (0.001)
Family size (AEU)	-0.012 (0.036)	-0.005 (0.007)	0.068*** (0.011)	0.002*** (0.002)
Landholding (ha) ^a	0.255** (0.105)	0.041** (0.034)	0.670*** (0.046)	0.036*** (0.010)
Initial level of livestock ownership (TLU)	0.009 (0.006)	0.000 (0.003)	0.008 (0.012)	0.002 (0.001)
Initial level of asset ownership (ETB) ^a	0.172*** (0.020)	0.041*** (0.009)	0.122*** (0.033)	0.012*** (0.003)
Mobile phone ownership (yes = 1)	0.166 (0.109)	0.044 (0.026)	0.274*** (0.102)	0.020*** (0.007)
Extension service (walking minutes)	0.002 (0.002)	0.0004 (0.000)	0.001 (0.001)	0.0003 (0.0001)
Distance to the main market (walking minutes)	-0.001 (0.001)	-0.0002 (0.0001)	-0.001*** (0.000)	-0.0001*** (0.0001)
Region dummies	Yes		Yes	
Year dummies	Yes		Yes	
Time averages (CRE) ^a	Yes		Yes	
Model summary				
Constant	0.393 (0.150)			

(Continues)

TABLE 3 (Continued)

	Hurdle 1: Probability of market participation	APEs	Hurdle 2: Intensity of sale	
	Coefficient		Coefficient	APEs
Number of households	674			
Log-likelihood	-2907.8288			

Note: Significance level $*p < 0.1$. Robust standard error in parentheses (under coefficients). Standard errors in parentheses under the average partial effects (APEs) are obtained by bootstrapping using the delta method.

Abbreviations: AEU, adult-equivalent unit; CRE, correlated random effect; ETB, Ethiopian-Birr; TLU, total livestock unit.

^aAll results were estimated under a CRE framework where time averages of all time-varying explanatory variables were used as additional regressors, but the estimates for the time averages are not reported here to save space.

** $p < 0.05$; *** $p < 0.01$.

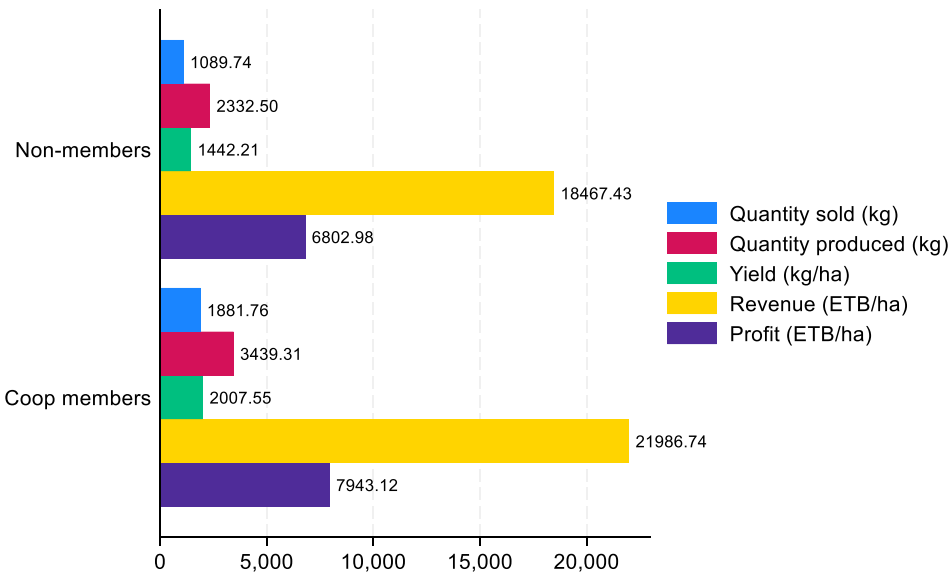


FIGURE 4 Maize farmer's financial and marketing performance by cooperative membership. ETB, Ethiopian-Birr.

5.3 | Effect heterogeneity of cooperative membership

While our double-hurdle model estimates (Table 3) indicate that cooperative membership enhances smallholder commercialization, it is essential to explore potential heterogeneity among members. To probe this, we analyze maize commercialization across various socioeconomic groups of cooperative member farm households. Specifically, we categorize households based on the education status of the household head (educated or uneducated) and wealth status determined by landholding and asset ownership quartiles (LQ1, LQ2, LQ3; AQ1, AQ2, AQ3). We further distinguish cooperative member farm households as *poor* or *better-off*, using the Foster–Greer–Thorbecke (FGT) income poverty index estimated with real household income per capita per day as a

TABLE 4 Potential mechanisms for cooperative membership effect on commercialization.

Variables	Cooperative members	Nonmembers	t Test
<i>Technical support and input accessibility</i>			
Access to information on new maize varieties (yes = 1)	0.811	0.672	0.139
Quantity of maize seed from external sources (kg)	24.286	16.747	7.539***
Quantity of pesticide used (kg)	0.870	0.798	0.072
Chemical fertilizer applied (kg/ha)	104.871	58.281	46.59***
Total improved seed applied (kg)	27.592	22.142	5.45
Improved seed applied (kg/ha)	15.191	13.078	2.113**
<i>Linkage to output and input market</i>			
Constrained access to output markets and information (yes = 1)	0.039	0.098	-0.059**
Constrained access to input markets and information (yes = 1)	0.020	0.065	-0.045**
Average maize price (Ethiopian-Birr/kg)	6.737	5.618	1.119***
Fertilizer price (Ethiopian-Birr/kg)	13.198	12.584	0.614

Note: All values are pooled across all observations and periods. The significance of the mean differences is presented as * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

measure of household well-being.⁴ Initially, we compare member farm households by the share of maize output that is sold (the ratio of maize sales to production) to enable absolute comparison between member households (Carletto et al., 2017; Geffersa & Tabe-Ojong, 2024). Figure 5 illustrates that better-off households, in terms of education, poverty status, landholding, and asset ownership, have commercialized maize above the median, suggesting potential heterogeneity.

To empirically test whether there is an effect heterogeneity of cooperative membership on smallholder maize commercialization, we conduct separate regressions, allowing the cooperative membership coefficient to vary with socioeconomic groups (Figures 6 and 7). While less heterogeneity was observed concerning the membership effect on market participation (Figure 6), there is considerable effect heterogeneity in terms of its effect on the extent of market participation. As shown in Figure 7, the quantity of maize sold significantly differs among cooperative members across different socioeconomic groups. Notably, we found significant variations in sales corresponding to education status, as well as among individuals in the highest quartiles of land and asset. This result suggests that the influence of cooperative membership on commercialization is more pronounced among member farm households led by educated household heads, potentially indicating that knowledge and information-sharing mechanisms within cooperatives are more effective among educated members. Our findings that show significant effects of membership in the highest quartiles of land and asset ownership, suggest that cooperative membership tends to enhance commercialization more substantially among wealthier members. Interestingly, we did not find evidence

⁴The estimated FGT index was specified as (Foster et al., 1984) $p_\alpha = \frac{1}{N} \sum_{i=1}^q \left[\frac{z - l_i}{z} \right]^\alpha$, where N is the total number of sample households, q denotes the number of poor households, l_i is a measure of household well-being, α is a parameter of inequality aversion, and z is the international poverty line (US \$1.90/day, at 2011 purchasing power parity).

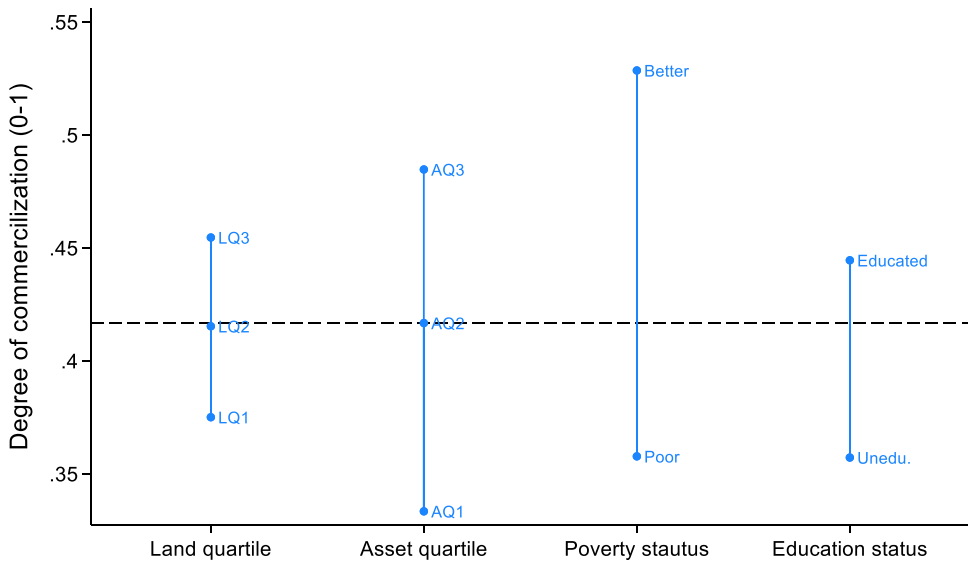


FIGURE 5 Differences in the degree of commercialization among cooperative members.

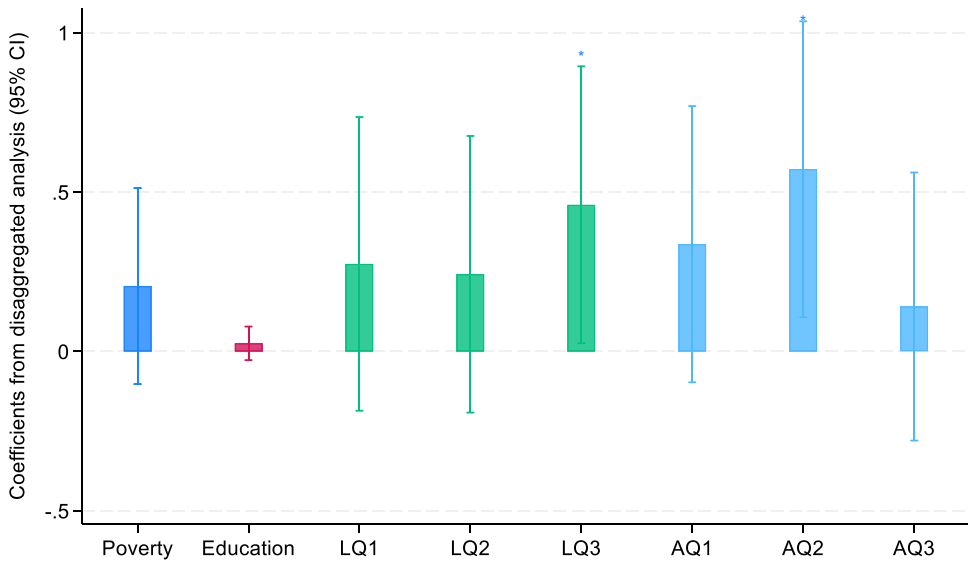


FIGURE 6 Effect heterogeneity of cooperative membership on market participation. The significance of the mean differences is presented as * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

suggesting any conditional effects of cooperative membership on commercialization based on the income poverty status of the members.

This additional analysis generally demonstrates a heterogeneous relationship between cooperative membership and commercialization, revealing that the impact is conditional on the socioeconomic status of member farmers, particularly their education status and physical resource endowments, such as land and assets. The finding aligns with our expectations, as those with greater physical resource endowments are better positioned to capitalize on cooperative

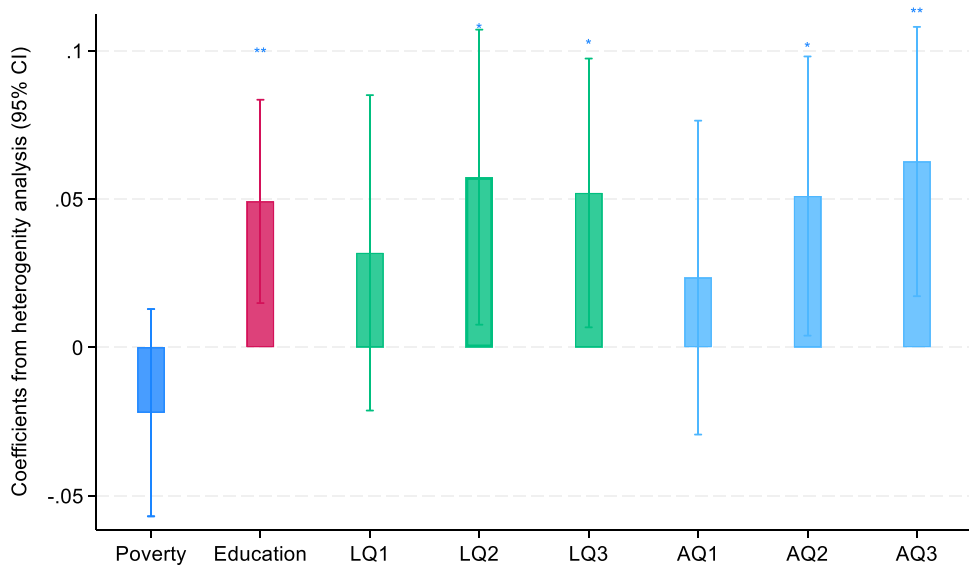


FIGURE 7 Effect heterogeneity of cooperative membership on the degree of commercialization. The significance of the mean differences is presented as * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

resources and opportunities. The finding also aligns with earlier studies in SSA (e.g., Chagwiza et al., 2016; Fischer & Qaim, 2012), supporting the notion that the benefits of collective action are more substantial for middle-size landholders due to potentially high transaction costs for extremely small-scale farmers. Nevertheless, our result contradicts the findings of prior studies, such as Ito et al. (2012) and Fischer and Qaim (2012), which observed that cooperative membership in China and Kenya predominantly benefited farmers with smaller holdings.

5.4 | Robustness check

So far, we have estimated the double-hurdle model to understand the relationship between cooperative membership and commercialization. In estimating the double-hurdle model, we relied on nonlinear estimation strategies given the nature of our outcome variable, which can be argued to follow the form of a nonlinear corner solution model. Specifically, we applied the probit model and the truncated regression model, both of which might be considered constrained in terms of identification. Nonlinear models often rely on identification through functional form, making them challenging to interpret. As a robustness check, we estimate standard linear models, which are easy to interpret and usually avoid identification by functional form (Angrist & Pischke, 2008). Additionally, we relaxed the dependency assumption in the double-hurdle model, using the linear probability model in the first stage and ordinary least squares in the second stage. The results, which are presented in the Supporting Information Appendix (Table A3), are similar in direction and statistical significance to the original estimates, giving credence to the estimation and the findings of the analyses.

6 | CONCLUSION AND POLICY IMPLICATIONS

The emergence of agricultural cooperatives has been extensively viewed as a potential institutional arrangement that can facilitate rural development. However, empirical findings remain mixed regarding the role of cooperative membership in the context of smallholder farming in SSA. Exploiting the panel nature of the data we used, along

with alternative specifications and robustness checks, we investigate the relationship between cooperative membership and smallholder commercialization in Ethiopia. We model smallholder commercialization as a two-step decision process involving market participation and the extent of participation (sales quantity), conditional on market participation. We also identify several potential mechanisms, including production, financial, and marketing performance indicators, through which cooperative membership can influence smallholder commercialization. The main findings highlight that improving farmers' participation in cooperatives has the potential to enhance smallholder commercialization by improving both market participation and the extent of participation. The findings support the widely held notion that rural cooperatives are an important institutional vehicle to boost the smallholder farm sector. However, further analysis demonstrates a heterogeneous relationship between cooperative membership and commercialization. As implied by our conceptual framework, our findings pinpoint the possibility of cooperatives driving smallholder commercialization by reducing various aspects of search, bargaining, and negotiation costs.

From a policy perspective, the findings underscore the necessity for effective implementation of policies that enhance farmers' engagement in cooperatives. Particularly in Ethiopia and other comparable SSA countries where transitioning smallholder farming to a more marketoriented state remains a policy priority, agricultural cooperatives have the potential to play a pivotal role in facilitating this transformation. However, efforts to improve rural development through mobilizing farmers' collective action require policy options that ensure an improved level of formal education and strengthen rural and market infrastructures, as they may limit the potential gains of commercialization. The findings relating to the heterogeneous relationship between cooperative membership and commercialization underscore the importance of targeted interventions to boost the contribution of cooperatives to rural development via commercialization. Specifically, the effect of membership is skewed to favor those with relatively better education and physical resource endowments, such as extended landholding and asset ownership. This highlights the need for designing 'best-fit' strategies rather than "one-size-fits-all" interventions. In this regard, it is worthwhile to implement policies that create expanded access to land and assets to enhance the role of cooperatives among resource-poor farmers. The first policy direction that could help achieve this is empowering marginalized farmers through cooperative land acquisition and cluster-based development initiatives. Furthermore, it is important to focus on enhancing the resource mobilization capacity of cooperatives by providing incentives, subsidies, and financial credit services through collective collateral. Additionally, implementing robust skills training programs through collaboration with educational institutions and vocational training centers can help equip resource-poor farmers with the necessary agribusiness management and marketing skills to ensure they can capitalize on market opportunities effectively.

We conclude by highlighting some limitations that should guide the interpretation of our work, along with suggesting potential areas for future research. Our comprehensive panel data analysis provides valuable policy implications, accounting for various confounding factors that could influence the relationship between cooperative membership and smallholder commercialization. Although our findings offer insights that can be applied broadly, we caution against absolute generalizations. The farming system and socioeconomic conditions in Ethiopia may be similar to those in other comparable developing countries in Africa, yet further work in this line of research in a different geographical context may be needed to enhance the external validity of our findings. Finally, although we have used panel data and other estimation strategies to establish robust associations between cooperative membership and commercialization, we refrain from claiming strict causality due to the observational nature of our data. Encouraging future studies with more rigorous designs, such as experimental approaches, would build the external and internal validity of our findings.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in CIMMYT Research Data & Software Repository Network at <https://data.cimmyt.org/dataverse/cimmytdatadvn>.

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PEER REVIEW

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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