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Analysis of the economic and social performance of newly created farmers' groups in transition countries: Evidence from Georgia, Moldova and Mongolia

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Ing. BSc Samuel Ahado

Principal Supervisor: doc. Dr. RNDr. Tomáš Ratinger

Co-supervisor: Ing. Jiří Hejkrlík, PhD

Prague, 2021

Declaration

This declaration confirms the dissertation thesis titled: "**Analysis of the economic and social performance of newly created farmers' groups in transition countries: Evidence from Georgia, Moldova, and Mongolia**" is the result of my investigation and has not been submitted elsewhere for any other degree or professional qualification.

Prague, 17 December 2021

Ing. BSc Samuel Ahado

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Abstract in English

Rural cooperation can be an essential strategy for smallholder farmers to remain competitive and efficient in rapidly changing markets. The reintroduction of cooperatives is part of many governments' new rural development policy supported by several international donors to enable small farmers' participation in the modern value chains and international markets. However, in post-Soviet transition countries, many farmers seem to show psychological resistance or lack sufficient trust in others and motivation to join any collective action. Such adverse attitudes have their roots to a large extent in the Soviet-type communist regime in the early 1990s. Understanding farmers' participation incentives and evaluating the economic and social impact of cooperative membership can provide stakeholders with significant evidence in their efforts to design policies aimed at promoting agricultural and rural development. The study aims to contribute to the existing literature by providing a first-hand analysis of the economic and social impact of cooperation of smallholders in different post-Soviet transition countries through a counterfactual design. The empirical analysis uses a dataset collected from 210 farmers in Georgia, 205 farmers in Moldova, and 251 farmers in Mongolia. The study first examines the factors that drive smallholder participation in cooperative organisations and the impact of collective membership on Georgian farmers' net returns and farm revenue using a treatment effects model that accounts for potential selection bias and endogeneity of cooperative membership. Second, the study examines the impact of cooperative membership on farm revenue among orchard farmers in Moldova using endogenous switching regression that accounts for sample selectivity bias. Finally, the study analyses the impact of cooperative membership on yield, farm revenue, and technical efficiency of potato farmers in Mongolia using sample selection stochastic production frontier and stochastic meta-frontier approaches that address selection bias due to observed and unobserved factors.

The empirical results show that agricultural cooperative membership exerts a positive and statistically significant impact on farm outcomes. Specifically, new collectives in Georgia obtain higher farm revenues and net returns compared to their non-member peers. Similarly, Moldovan cooperative members have higher farm revenues than their non-member counterparts. The results also reveal that Mongolian potato farmers obtain higher yields and farm revenue and are more technically efficient than non-member cohorts. Regarding the factors that influence smallholder participation in cooperatives, the findings show that human capital, distance to market, extension visits, participation in off-farm work, social network, trust, and perceived economic benefits from cooperation significantly affect farmers' decisions to join cooperatives. The findings generally suggest that policymakers and stakeholders should continue with incentives to encourage smallholder participation in cooperatives and other forms of collective action since participation in cooperative organisations directly contributes to higher farm outcomes.

Keywords: Agricultural cooperatives, Counterfactual analysis, Farm performance, Smallholder farmers, Rural development, Transition countries

Abstract in Czech

Spolupráce může být vhodnou strategií pro drobné zemědělce, aby zlepšili svoji konkurenceschopnost a efektivitu na rychle se měnících trzích. Oživení družstevnictví v moderním smyslu je proto součástí politiky rozvoje venkova mnoha vlád a je také podporováno také řadou mezinárodních organizací. Cílem je umožnit malým farmářům rovnocennou účast v moderních hodnotových řetězcích ovládaných velkými často nadnárodními potravinářskými a maloobchodními firmami. Zdá se však, že přetrvává u mnoha zemědělců v postsovětských transformujících se zemích vůči kolektivním akcím psychologický odpor nebo jim chybí dostatečná důvěra v ostatní zemědělce a tak motivace se zapojit. Tyto nepříznivé postoje mají do značné míry kořeny v komunistickém režimu a kolektivizaci zemědělství sovětského typu. Pochopení motivace členství a vyhodnocení ekonomického a sociálního dopadu kolektivních akcí ale může zúčastněným stranám poskytnout významný nástroj pro jejich úsilí navrhnout účinné politiky zaměřené na podporu rozvoje zemědělství a venkova. Cílem studie je proto přispět k existujícím poznatkům poskytnutím analýzy ekonomického a sociálního dopadu spolupráce drobných zemědělců v družstvech v různých postsovětských transformujících se zemích prostřednictvím kontrafaktuálního evaluačního designu. Empirická analýza této práce využívá datový soubor shromážděný od 210 farmářů v Gruzii, 205 farmářů v Moldavsku a 251 farmářů v Mongolsku. Studie nejprve zkoumá faktory, které determinují účast drobných zemědělců v organizacích producentů (družstvech), a vliv tohoto členství na čisté výnosy a příjmy gruzínských farmářů pomocí ekonometrického modelu, který zohledňuje potenciální zkreslení dané sebevolbou v členství a endogenitu. Dále práce zkoumá vliv členství v družstvech na příjmy farem mezi farmáři pěstující sadové kultury v Moldavsku pomocí endogenní regrese, která řeší zkreslení selektivity výběru. V poslední části práce analyzuje vliv členství v družstvech na výnosy, příjmy farem a technickou efektivitu pěstitelů brambor v Mongolsku pomocí stochastické

hraniční analýzy a stochastického meta-hranice, které řeší zkreslení (vychýlení odhadu) způsobené pozorovanými i nepozorovanými faktory.

Empirické výsledky ukazují, že členství v zemědělských družstvech má statisticky významný pozitivní dopad na výsledky farmy. Konkrétně, členové nově vzniklých organizací producentů (družstev) v Gruzii dosahují vyšších zemědělských příjmů a čistých výnosů ve srovnání se zemědělci, kteří nejsou členy. Podobně mají moldavští družstevníci vyšší příjmy než zemědělci, kteří do družstev nevstoupili. Výsledky také ukazují, že mongolští družstevní pěstitelé brambor dosahují vyšších výnosů a příjmů a jsou technicky efektivnější než ostatní pěstitele brambor. Pokud jde o faktory, které ovlivňují účast drobných zemědělců v družstvech, zjištění ukazují, že lidský kapitál, vzdálenost od trhu, přístup k poradenství, příjmy mimo farmu, sociální síť, důvěra a vnímané ekonomické výhody ze spolupráce, významně ovlivňují rozhodnutí farmářů vstoupit do družstev. Zjištění obecně naznačují, že tvůrci politik a další zúčastněné strany by měli pokračovat v podpoře účasti drobných zemědělců v družstvech a jiných formách kolektivních akcí, protože tyto přispívají k jejich lepším ekonomickým výsledkům.

Klíčová slova: Zemědělská družstva, Kontrafaktuální analýza, Výkonnost farem, Drobní zemědělci, Rozvoj venkova, Transformační ekonomiky

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List of Abbreviations

ADAC	Agency for Development of Agricultural Cooperatives
ANOVA	Analysis of Variance
ATE	Average Treatment Effect
ATT	Average Treatment Effect on the Treated
ATU	Average Treatment Effect on the Untreated
ENPARD	European Neighbourhood Programme for Agriculture and Rural Development
ESR	Endogenous Switching Regression
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross Domestic Product
LR	Likelihood Ratio
MTE	Meta-technical Efficiency
MTR	Meta-technology Gap Ratio
NAMAC	National Association of Mongolian Agricultural Cooperatives
OLS	Ordinary Least Squares
PSM	Propensity Score Matching
SDC	Switzerland Development Cooperation
SPF	Stochastic Production Frontier
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USD	United States Dollar
USSR	Union of Socialist Soviet Republics

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1. Chapter 1 Introduction

Smallholder farmers in most developing countries face various challenges regarding agri-food production and marketing, such as lack of infrastructure and market information, high transaction costs and poor access to farm inputs (Fischer & Qaim 2012; Mojo et al. 2017). Governments programmes and policies have thus, emerged to address these problems and improve smallholder farmers' production and marketing conditions. Among them, rural institutions, including farmer organisations, cooperatives, and other forms of collective action, have been promoted and gained new popularity in the agri-food system and are perceived as business models aimed at improving the performance of smallholder farmers in agricultural production (Valentinov 2007; FAO 2012a; Rao et al. 2012). Agricultural cooperatives and other forms of collective action offer their members a wide range of services and opportunities, including market information, offering access to farm resources, and improving smallholder farmers' bargaining power (FAO 2012a; Zheng et al. 2012).

Many researchers consider the cooperation of farmers as essential for communities to reduce poverty in rural areas and as an important policy tool for developing countries to achieve agricultural and rural development (Wanyama et al. 2008; Altman 2015; Abate 2018). Interest in both - developing and developed countries in the cooperative movement has also grown recently, as cooperative organisations are deemed more flexible than corporations, more responsive to local social and environmental challenges, and more resilient in times of economic crisis (Birchall & Ketilson 2009; Delbono & Reggiani 2013).

However, while some authors focus on the positive aspects of cooperation, others document the significant disadvantages of farmers' groups, such as freeriding, low trust, higher control costs, and problems related to ownership rights and inefficiency of the lead agent (Nilsson 2001). Even within one region or country, there are sectors in which cooperative

organisations grow and serve as efficient enterprises for small and medium-sized farmers. In contrast, they find it difficult to survive or operate in other sectors (Ahado et al. 2021a).

Furthermore, studies indicate that smallholder farmers can also economically benefit from high-value markets through collective action, benefiting from institutional group arrangements, which would not be available when they operate individually (Narrod et al. 2009). For instance, Wollni and Zeller (2007) show that cooperatives in Costa Rica facilitate a niche market for small scale coffee growers with higher prices. In another study, Roy and Thorat (2008) demonstrated that marketing cooperatives for grapes in India reduced transaction costs and contributed significantly to the better bargaining position of smallholders amidst market intermediaries. Other studies in the literature have also highlighted the positive impact of collective action on the performance of their members (e.g., Fischer & Qaim 2012; Mojo et al. 2017; Abdul-Rahaman & Abdulai 2018).

Evidence from empirical studies has shown that cooperatives also act as mechanisms for adopting technology and facilitating commercialisation (Fischer & Qaim 2012; Chagwiza et al. 2016; Ma et al. 2018). Several studies (see Table 2) from different geographical locations have demonstrated the impact of agricultural cooperatives and other forms of collective action on the productivity and technical efficiency of farmers (e.g., Ito et al. 2012; Mojo et al. 2017; Abdul-Rahaman & Abdulai 2018; Ma et al. 2018; Ahado et al. 2021b).

In the post-Soviet bloc of transition countries, the legacy of the Soviet agricultural model of the 20th century left an indelible mark on the cooperative movement, with many farmers still reminiscing forced collectivisation, which ended in chaotic privatisation and restitution in the 1990s (Hagedorn 2014; Lerman et al. 2016). This historical development also led to changes in the agricultural structures with current land-use fragmentation and complex land ownership (Hartvigsen 2014). As a result, most farmers cannot reach a sufficient level of production and therefore cannot benefit from new opportunities in the domestic and

international markets (Lerman et al. 2016; Wolz et al. 2019). Lack of resources and knowledge, increased transaction and production costs, and low bargaining power in the market explain why small farmers still struggle to improve their businesses.

The Eastern European and post-Soviet transition countries are significantly lagging in rural cooperative movements compared to the rest of the world (Millns 2013; Lerman & Sedik 2014). For example, evidence from Armenia shows that cooperatives are not yet beneficial and sustainable because farmers from the Soviet kolkhozes[1] era remain oblivious to the benefits of cooperation based on democracy and self-help, self-sustainability and self-responsibility (Movsisyan 2013).

Nevertheless, in many developing and transitional countries, the concept of cooperation among small farmers has recently gained new attention from policymakers and other stakeholders, calling for a revival of the cooperative movement to address sustainable development challenges and poverty reduction (Hagedorn 2014; Wedig & Wiegratz 2018). While there are clear theoretical arguments for backing up the effort to promote cooperatives, the question is if the expectations are achievable. Thus, the study seeks to contribute to the evidence of the success or failure of modern cooperatives in countries with negative cooperative experience from the socialist regimes. In particular, the study employs an innovative approach that combines impact evaluation techniques and econometric approaches to analyse the impact of new collective actions and cooperation on smallholder farmers' economic and social performance in post-Soviet transition countries. In addition, the study examines the factors that affect participation in agricultural cooperatives. The findings of the study will provide stakeholders, development practitioners, and policymakers with insight into

[1] Kolkhozes refer to large collective farms

the role of collective action in achieving policy goals, which in turn will help them to design appropriate policies to mobilize smallholder farmers to achieve strategic objectives of food self-sufficiency. Furthermore, evidence on the impact of cooperation on the performance of smallholder farmers in the post-Soviet transition countries is scarce, justifying further assessment.

1.1. Significance of the study

The study is among the first attempts to provide a comprehensive understanding of the relationship between the cooperative organisation and smallholders' economic and social performance in different post-Soviet transition countries. The results can contribute to the literature on the impact of cooperative organisations on farm performance in transition and other developing countries.

The resurgence of cooperatives is part of many governments' new rural development policy to encourage small farmers' participation in modern value chains and international markets and supported by international donors. However, in the post-Soviet transition countries, the concept of rural cooperation is still under the pressure of the experience from the Soviet "kolkhoz" model and its abandonment in the privatisation and restitution of farmland and collective properties. These historical turbulences resulted in the agricultural structures of small farmers being unable to increase their productive capacity and benefit from the new opportunities in recovering domestic and international markets. To this day, many farmers in the region do not understand well the model of cooperation, lack sufficient trust and motivation to participate in any collective activities. Thus, understanding smallholder participation incentives and evaluating the economic and social impact of cooperative membership can provide governments, NGOs, and international donors with significant evidence in their efforts to design policies aimed at promoting agricultural and rural development. The outcomes of

such an analysis can also enhance farmers' understanding of the objectives and benefits of cooperation and improve the status quo of rural cooperation in post-Soviet transition countries and the world at large.

1.2. Organisation of the study

The study has seven chapters. Chapter 1 includes a general introduction and highlights the significance of the research in the study region. Chapter 2 provides a background of farmers' cooperation and the agricultural sectors in the three countries. It also discusses the literature on the benefits of cooperation and their related causes and the factors that affect farmers' decisions to participate in collective action, and the concept of farm performance. The objectives, hypotheses and conceptual and empirical framework of the study are in chapter 3. Chapter 3.1 discusses the study areas, research design, and analytical framework and econometric strategies used. In addition, it discusses the data and descriptive statistics of the variables used in the analysis. Chapter 3.1 also presents information on secondary statistics of the analysed sectors in the three countries. The empirical results are detailed in chapter 0, while chapter 6 discusses the empirical results, review of econometric analysis methods, the study's goals fulfilment, and its limitations. The last chapter presents the study's main findings and their policy implications and suggestions for further studies.

2. Chapter 2 Literature review

2.1. Introduction

Chapter two covers the necessary background related to farmers' cooperation and an overview of the agricultural sector in the three countries. It also covers the literature review on the potential benefits of cooperation, their internal and external causes and the factors that influence smallholder participation decisions in collective action and the concept of farm economic performance.

2.2. Background

2.2.1. The agricultural sector in Georgia

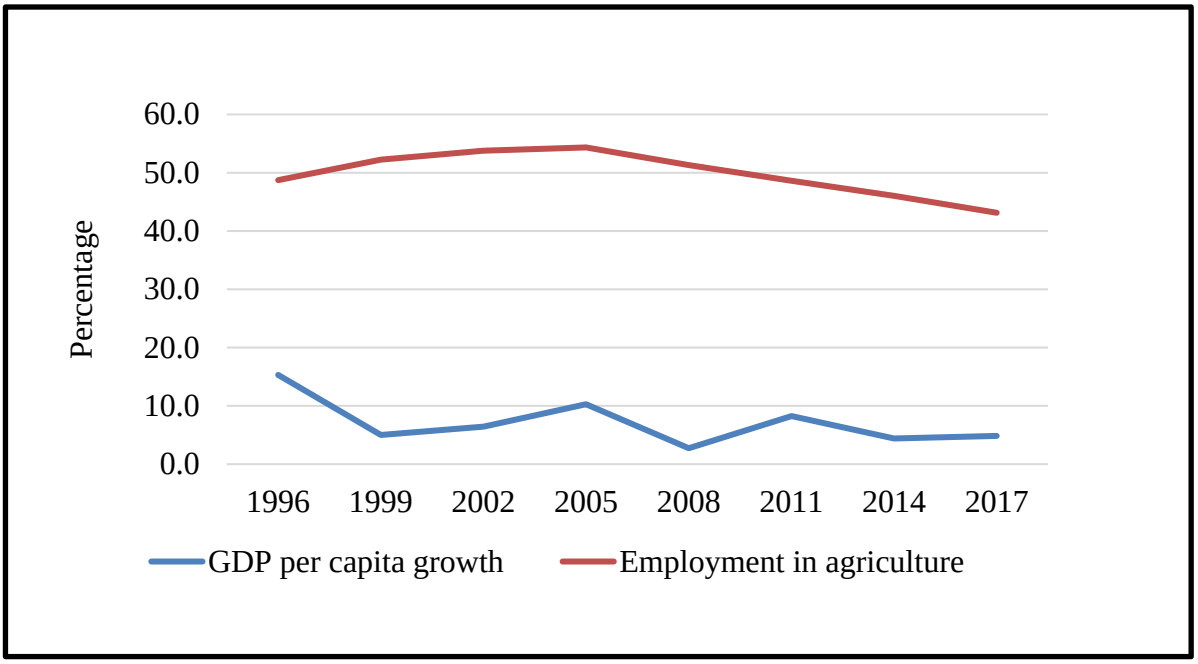
After the disruption of the Soviet Union and following the civil war and economic regress, Georgia is again a predominantly agricultural country with almost half of the population living in rural areas (FAO 2012b). Arable land covers more than three million hectares (about 43%) of the country's territory. Subtropical climate dominating a significant part of the territory creates excellent conditions for producing various subtropical crops (Bondyrev et al. 2015; Ministry of Agriculture of Georgia 2015). However, since the independence from the Soviet Union at the beginning of 90's the economy went through severe shocks bringing a decrease of productivity by more than two-thirds (Millns 2013). Reduction of the sown area and the decrease of overall agricultural production caused a dependency on imports, which exceeded one billion USD in 2013, and a decline of self-sufficiency ratio of almost all types of products (Ministry of Agriculture of Georgia 2015).

Examining economic development over the last two decades in Georgia following the privatisation regime shows that the agricultural sector still plays a pivotal role in the Georgian economy. Since the late 1990s and early 2000s, the sector has employed more than 50% of the

country's labour force. However, the second part of the new millennium indicates a slightly declining trend (less than 50%) of employment in agriculture (see Figure 1). To some extent, this trend has its root in the lack of appropriate policies and limited agricultural funding (FAO 2012b).

Georgia's GDP per capita growth generally shows a fluctuating trend over the last two decades. This development indicates an unstable economic situation. The highest (15.3%) GDP per capita was in the mid-1990s. Compared to other post-Soviet transition countries, such as the Republic of Moldova and Mongolia, Georgia's GDP per capita is higher (see later). A World Bank report showed that Georgia's poverty rate fell from 35% in 2006 to 21% in 2016, with the poor benefiting considerably from government social policies and new economic opportunities (The World Bank 2018).

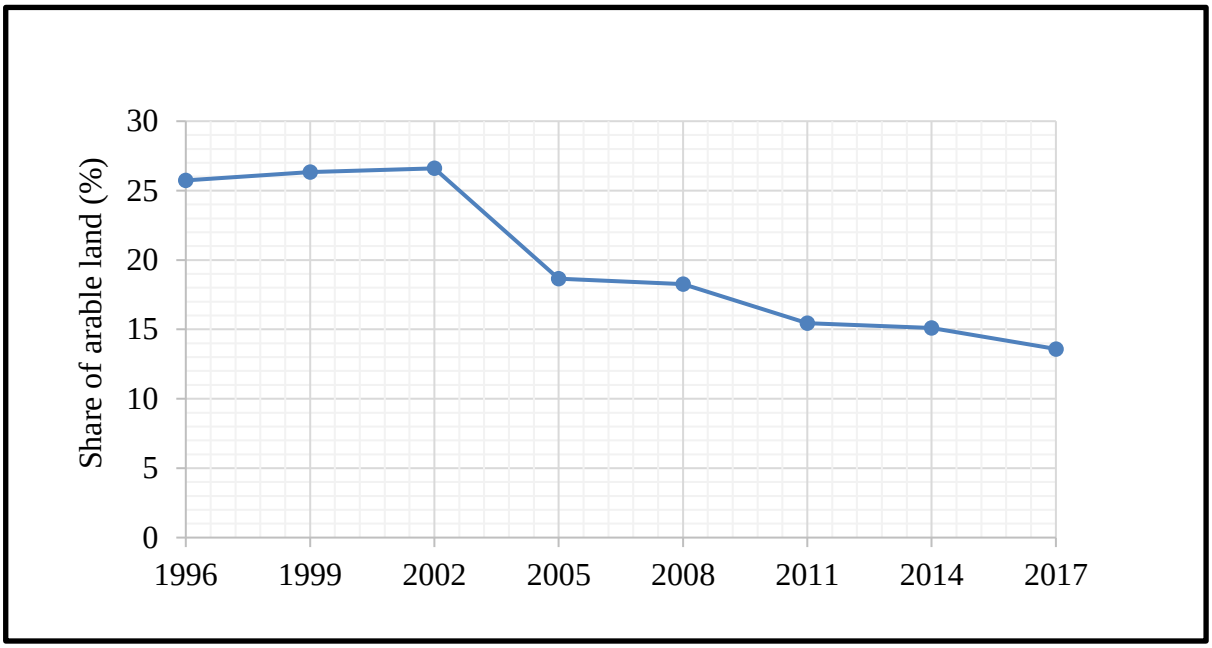
The EU alliance with post-Soviet transition countries, for example, Georgia (through ENPARD), has created conditions for entrepreneurship and collective development to ensure inclusive economic growth in rural areas. Notwithstanding, the influence of Soviet institutions from the past has impeded the development of productive entrepreneurship among small farmers in terms of their attitudes towards innovations, which could have promoted economic growth and stability (Sauka & Chepurenko 2017).



Source: Compiled from the data of the World Bank

Figure 1. The pattern of economic development over the last two decades in Georgia.

In recent years, the amount of arable land for crop production has been decreasing in Georgia. Perhaps, this phenomenon is due to an increase of grasslands or abandoned land. The highest share (26.6%) of arable land for crop production was in 2002 (see Figure 2). Compared to other post-Soviet transition countries like Moldova and Mongolia, their share of arable land for crop production has been increasing since the beginning of the new millennium.



Source: Compiled from the data of FAO

Figure 2. Share of arable land in total agricultural land in Georgia.

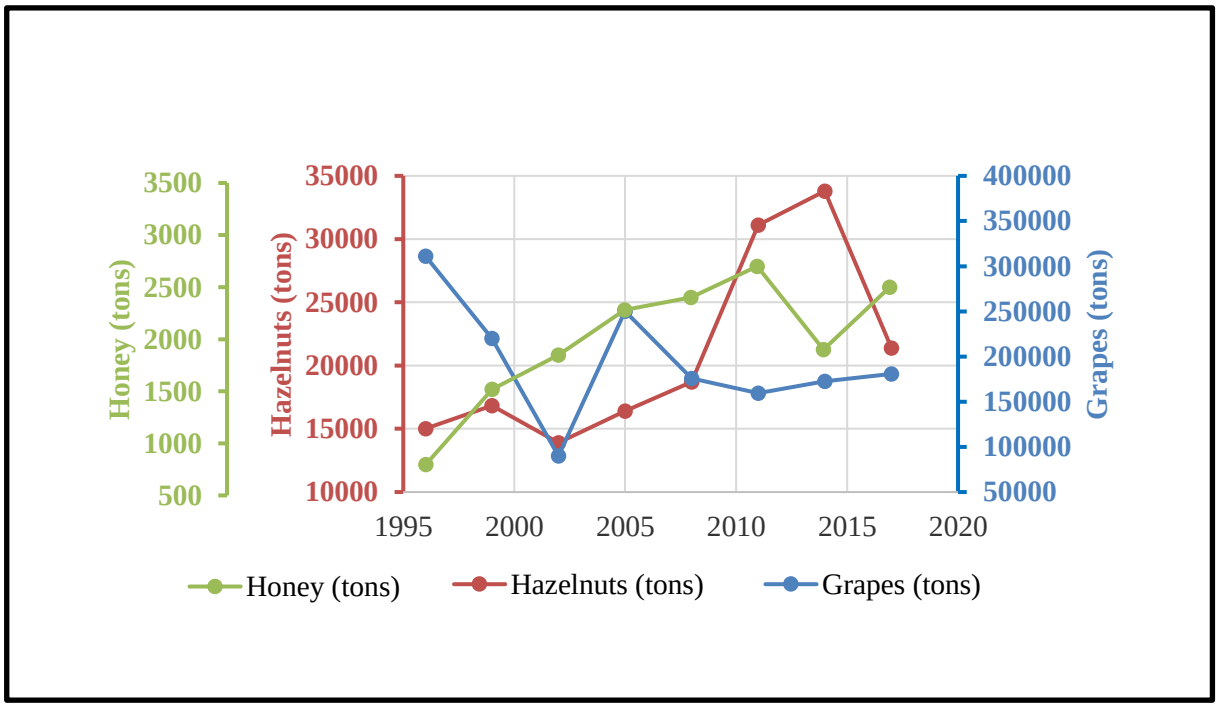
2.2.2. Grape, hazelnut and honey sector in Georgia

In Georgia, the grape crop is one of the vital fruit crops for wine production. Although cultivated in various regions, the Kakheti region in eastern Georgia has the highest concentration of vineyards because of its unique climate and conditions suited to different species of grapes. The highest production of grapes was in the late 1990s. However, in the early 2000s, total production decreased substantially to less than a hundred thousand tons. Until then, there has been a fluctuation in the total production of grapes in the country (Figure 3).

Georgia is one of the most important producers of hazelnuts in the world. The western Georgian climate is optimal for hazelnut production, and Samegrelo-Zemo Svaneti, Guria and Imereti are major regions for cultivation. Smallholder farmers dominate farming systems for hazelnut production. Despite Georgia being among the top hazelnut producers worldwide, the total production of hazelnuts in 2017 was relatively low compared to 2014 (Figure 3). Farmers

attributed this change in production trend during the field survey to the infestation of the "BROWN marmorated stink bug" that limited the volume and quality of the nut.

Apiculture has a long history in Georgia and is predominant among smallholder farmers who produce honey on their homesteads and typically sell it at the farm-gate. The typical regions for honey production include Adjara, Guria, Kakheti and other mountainous regions. The apiculture sector is now gaining ground in the Georgian agriculture sector. Compared to the mid and late 1990s, with low honey production (less than a thousand tons), honey production in the last ten years has seen some improvement (Figure 3).



Source: Compiled from the data of FAO

Figure 3. The total output of fruits and honey sectors in Georgia

2.2.3. Policies and farm cooperation in Georgia

As in other countries of the Commonwealth of the Independent States and Central and Eastern Europe states, Georgia has a long tradition of spontaneous farmers' cooperatives from the 19th and the beginning of the 20th century. However, during the Soviet era, the original idea of bottom-up self-help small farmers associations dramatically changed from voluntary marketing, service, or credit cooperatives to state-controlled production collective farms (Lerman & Sedik 2014).

The recession of the Soviet Union in the 1990s resulted in the collapse of the collectivised agricultural system when cooperatives of any type in Georgia almost ceased to exist (Ministry of Agriculture of Georgia 2014; ENPARD 2015). As a result, several authors already showed (for example, Gardner & Lerman 2006; Lampi 2012; ENPARD 2015) that until today cooperatives continue to be negatively associated with the Soviet-era collective farms and farmers, and the general public still feels distrust and "mental block". Gardner and Lerman (2006) write: "The use of the word "co-operative" in Central and Eastern Europe will not only create the wrong impression, but it will also create barriers to progress."

Nevertheless, traditional grassroots organisations and informal institutions developed spontaneously in Georgia before the socialist Soviet times. Solid social cohesion exists until today in parallel to any formal institution. For example, Lampi (2012) analysed farmers' cooperation and demonstrated that Georgian society typically consists of solid informal networks, such as the common herding Naghin system, which has a long history in hilly pasture areas. Buschmann (2008) or USAID Georgia (2011), provides an analysis of bonding and bridging social capital constructs in the Georgian environment. Their findings show robust bonding ties in Georgia, which indicate close relationships among family, relatives, and friends. On the other hand, bridging capital representing willingness to cooperate with strangers

is relatively low. This phenomenon predetermines a tendency to rely on small businesses rather than cooperation with members of the broader society.

The first organised efforts to revive the cooperative sector and boost modern agricultural cooperatives in Georgia appeared in 2012 with the external assistance of international organisations and the donor community. The first organisations to support the horizontal integration of farmers include the USAID, OPTO International, the Swiss Agency for Development and Cooperation, Denmark's Development Cooperation, or the Czech Development Agency. These organisations started broader programmes and individual projects focused on rural livelihood improvement by promoting producers' groups (FAO 2012a; Millns 2013). Only a few modern functional cooperatives were established spontaneously without any donor support. The most significant recent programme for agricultural sector development with a cooperation component was the European Neighbourhood Programme for Agriculture and Rural Development (ENPARD), launched in 2013. A total EU budget of 52 million EUR was for the direct support of cooperatives' formation, national agricultural budget, technical assistance, and strengthening national and regional state institutions (FAO 2012b; Millns 2013; ENPARD 2015).

The Deep and Comprehensive Free Trade Area, recently established between the European Union and Georgia (also with Moldova and Ukraine), covers agricultural and food products. This trade forum between the EU and these post-Soviet transition countries can provide some opportunities for farmers if they cooperate. For example, the coming together of farmers to collectively market their products will assist in addressing some structural problems – particularly the weak position and capacity of the atomised farming sectors resulting from abrupt privatisations of state enterprises in the 1990s (FAO 2012b). The importance of horizontal integration of small farmers in cooperatives, recognised by the Georgian government, took several necessary steps toward developing an enabling environment. The

Ministry of Agriculture of Georgia adopted the Strategy for Agricultural Development for 2014-2020, which provided a basic framework for promoting cooperatives within the specific strategic measure 1.6 "Support the development of farmer group organisations". The strategy initiated revision and update of legislation, creating a campaign on awareness-raising, provision of specialised extension services, and facilitation of special incentive tools, including matching grant contributions and possibilities for tax exemptions (Ministry of Agriculture of Georgia 2014). In 2013, based on the recommendation of FAO and EU, the Georgian National Parliament adopted the Law of Georgia on Agricultural Cooperatives, which, together with the older Law on Entrepreneurs, created a basic legal framework. At the same time, the Agency for Development of Agricultural Cooperatives (ADAC) was established (ENPARD 2015).

Joint efforts of international donors and national government led to an unprecedented increase in the number of agricultural cooperatives in the country. While in the mid of 2014, only 100 agricultural cooperatives registered at the ADAC, the number was ten times higher in the subsequent year (Misheladze 2015). However, one of many challenges of the sound and sustainable rebirth of the Georgian agricultural cooperatives' sector is the number of members per cooperative. The average number decreased during the 2014-2015 period from 10 to 6. This low number for efficient business-oriented organisations are supposed to enable economies of scale and reduce the cost of transactions for small farmers.

Moreover, some authors (e.g., Millns 2013), together with development specialists, concluded that most cooperatives have about 50% of passive members who register to fulfil the obligatory quotas on the number of members set by the government and donors. Key founding members sometimes take over the management and control of cooperatives, which leads to limited compliance with democratic principles, non-transparent decision-making and creation of individual investor-owned firms masked as cooperatives (Fulton & Giannakas 2007; Lampi 2012). Organisational problems faced by Georgian cooperatives, such as lack of

management competencies and experiences among members of the Board of directors or poorly developed governing principles, are also documented in Baramidze (2005) or Millns (2012, 2013). FAO (2012b) concluded that less than 20% of cooperatives established with heavy guidance and dependence on donors showed significant activity after project termination.

Newly (ENPARD) cooperatives were established, especially in the traditionally vibrant agricultural sectors with export potential – Apiculture (honey), Viticulture (grapes and wine) and Hazelnuts. However, most cooperatives still serve only short local value chains or reach exports through local intermediaries. They sell their products mostly directly in villages at the farm gate to local consumers and intermediaries or regional markets in close cities to wholesalers and processing companies.

2.2.4. The agricultural sector in Moldova

Moldova has one of the highest shares of territory covered by permanent crops and high-quality arable land globally, with agriculture being traditionally the most important economic activity. During the USSR, the country was a net exporter of agricultural products (mainly wine and fresh products like fruits and vegetables) with destinations within the union.

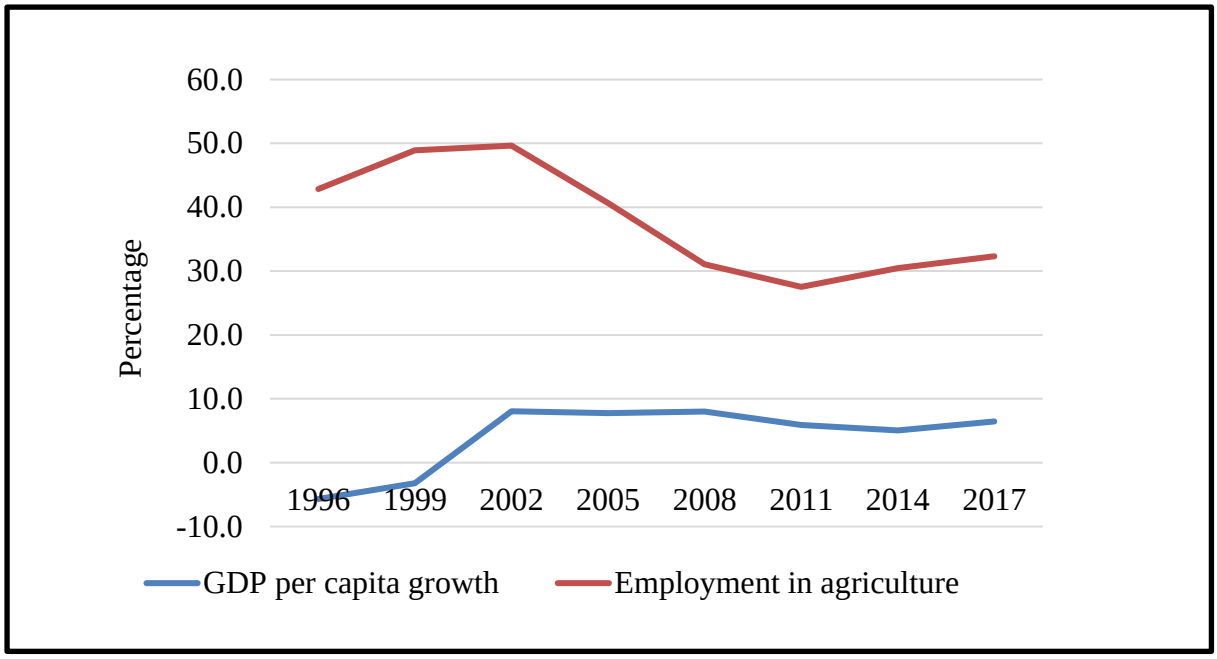
About two-thirds of agricultural lands are in the hands of farms larger than 50 ha that produce low-added crops like cereals, oilseed and sugar beet. In contrast, small farmers grow high value-added crops like grapes, fruits, and vegetables (including potatoes). Nevertheless, they generate only a limited market surplus (Moroz et al. 2015; FAO 2016). The agricultural sector has played an essential role in the Moldovan economy, but its relative economic importance has recently declined. Although the sector serves as the primary source of income for the rural population, its contribution to GDP in 2015 was only 12 % (The World Bank 2019).

In Moldova, perennial orchard production is the backbone of smallholder most profitable production. Currently, there is about 65,000 ha of orchards with a high but unexplored potential of production. Even though some 60 new wineries established high-productivity grape farms, only about one-quarter of Moldovan vineyards have productivity higher than 8 tons per ha (Moroz et al. 2015). In comparison with the neighbouring countries of Romania and Ukraine, Moldovan farmers get the lowest prices for their fruit products. At the same time, they have to face high volatility of the agrochemical input prices needed for more intensive production (Moroz et al. 2015). In terms of distribution, the fruits are still sold mainly on traditional markets, including three wholesale agricultural markets in Chisinau and Balti and a few regional agricultural markets. Supermarkets have occurred only in larger cities so far. Around 80% of fruit processing remains with a handful of large companies and goes to export markets. The rest comprises some 80 small and medium canneries mainly serving the domestic market. Together, these firms process from 150,000 to 200,000 tons of raw material, mainly apples, plums, and vegetables, with concentrated apple juice, fruit, tomato paste, canned fruits, and vegetables being the main processed products. However, Moroz et al. (2015) argue that the potential of the fruit and vegetable processing industry is only at one-third of its capacity.

In Moldova, as in other post-Soviet transition countries, developments after the post-Soviet regimes indicate that majority of the inhabitants were involved in business and labour migration (the former refers to the trading of products) to other neighbouring countries (Mosneaga 2017). This migration incident is evident in the low turnout and wavy employment trend in the agricultural sector, which is considered the most important economic activity in the country. As Figure 4 shows, the only compelling turnout in agriculture as an occupation was in 2002, when the employment rate in the sector was about 49.7%. After 2002, the country has been experiencing fluctuation in agricultural employment. Lack of investment interest in

agricultural production in Moldova is one of the causes of this development (de Zwager & Sintov 2014).

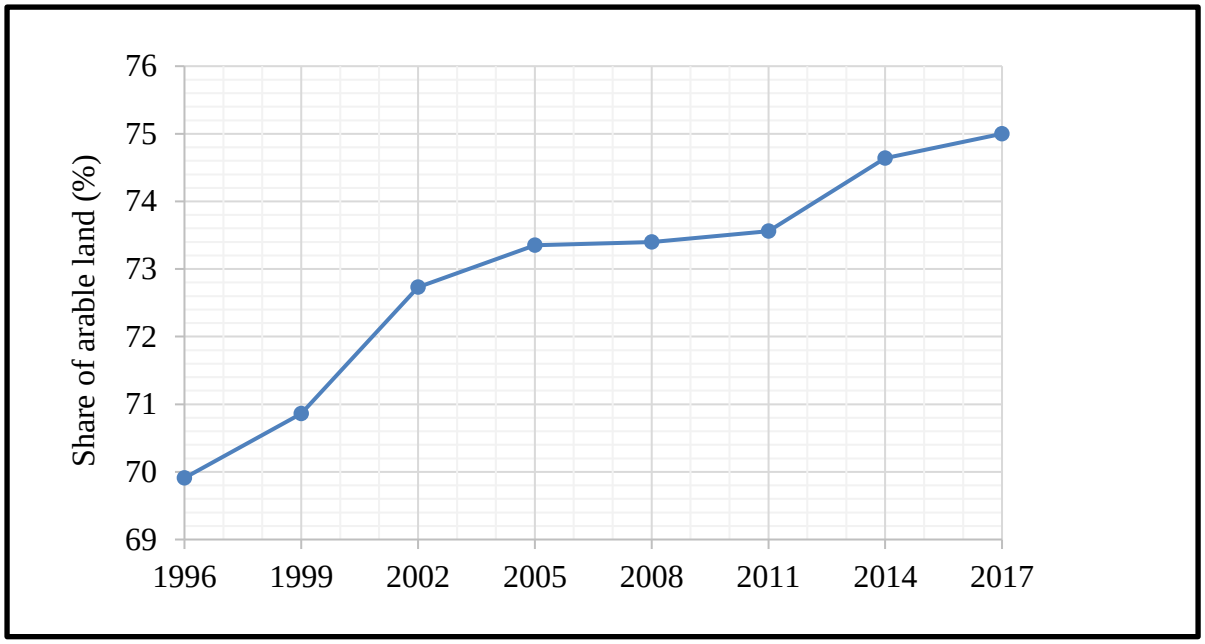
GDP per capita growth, which measures a country's economic performance, is not doing better because it reflects a similar trend to employment in agriculture discussed earlier. As Figure 4 shows, Moldova's lowest GDP per capita growth was in the mid-1990s. The global financial crisis and the Russian Federation crisis in the late 1990s affected the Moldovan economy and triggered large spikes in migration (Vanore & Siegel 2015).



Source: Compiled from the data of the World Bank

Figure 4. The pattern of economic development over the last two decades in Moldova.

In Moldova, the share of arable land in total agricultural land has increased over the last two decades (Figure 5). Given the soil quality and the good climatic conditions suitable for fruits and vegetables, the amount of arable land for growing temporary and permanent crops will continuously increase.



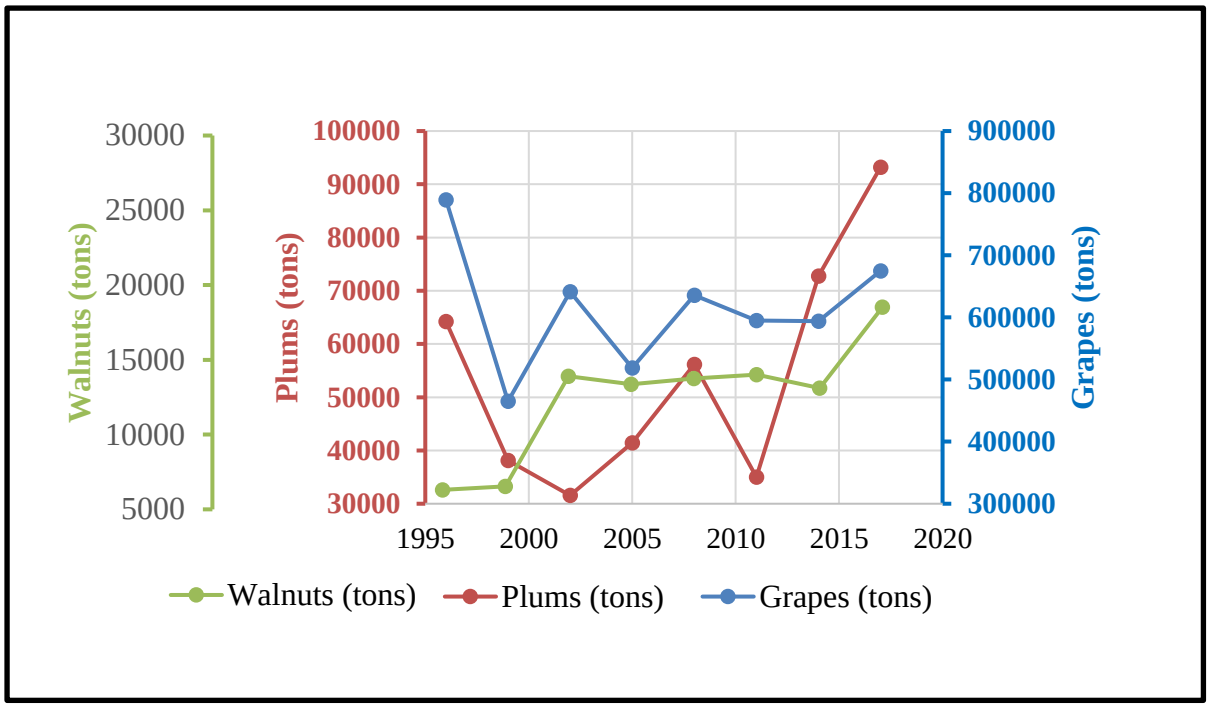
Source: Compiled from the data of FAO

Figure 5. Share of arable land in total agricultural land in Moldova

2.2.5. Grape, plum and walnut sector in Moldova

In Moldova, likewise, other post-Soviet transition countries such as Georgia, the production of grapes has had a track record since the mid-1990s. However, production has been fluctuating, hovering around an average of over 500 thousand tons per annum in the last decade (Figure 6). The high-quality chernozem soils may be one of the factors for the successful cultivation of fruits and nuts in the country.

Similarly, the production of plums in Moldova has been fluctuating over the past two decades. The highest production (about 96 000 tons) of plums was in 2017. Walnut production shares a similar trend as hazelnut and plums, with the highest (about18,000 tons) production occurring in 2017 (Figure 6).



Source: Compiled from the data of FAO

Figure 6. The total output of the fruits and nut sectors in Moldova

2.2.6. Policies and farm cooperation in Moldova

As in most post-Soviet transition countries, economic reforms, including privatisation of agricultural land and the restructuring of state and collective farms, occurred shortly after the country's independence in 1991 (Cimpoies et al. 2008; Lerman 2013). The transformation process encouraged various forms of farming. However, primarily it resulted in small individual farming (Csaki & Lerman 1997). The land distribution ended in 2001 with more than one million new owners receiving one or two parcels of arable land, one parcel of an orchard, and one parcel of a vineyard (NBS 2011). In total, each person received an average of about 1.56 ha distributed in 3–4 physical parcels, which resulted in current extremely high land fragmentation (Hartvigsen 2014).

To resolve the high land fragmentation and consolidate small family farms with the EU market, the Moldovan government has embarked on a strategic framework (e.g., legal support and production subsidies) to farmer cooperatives and enterprises that support various agricultural and rural cooperation (Millns 2013). However, the interest of farmers and the number of agricultural cooperatives grows and shrinks according to the current support provided by the national government or international donors. One of the first collective forms was an "Asociatia de Gospodarii Taranesti" English "Association of Peasants Farms" that emerged from 1994 to 1997 when the number of members reached 100 enterprises but then disappeared again by 2001. During the beginning and second half of the millennium, the number of registered agricultural production cooperatives increased due to the strong state financial support. For example, in 2009, about 204 agricultural production cooperatives were registered (Moraru et al. 2018). Despite the heavy state budgetary support, many state-supported and top-down created "cooperatives" proved their unsustainability and were gradually transformed into limited liability companies (IFAD 2016).

New legislation, policies and government subsidies support the new role of modern cooperatives (O'Connell & Kiparisov 2018; Wolz et al. 2019) in many developing countries, including Georgia. Law No. 73 on Business Cooperatives and the Small Enterprise Sector (issued already in 2001 and 2006) was accompanied in 2013 by Law No. 312 on Agricultural Producer Groups and their Associations (Millns 2013; Moraru et al. 2018). This new law targets explicitly organised farmers and sets out their potential targeted support. However, most agricultural cooperatives are still registered under older cooperative legislation and not as agricultural cooperatives.

Despite the perceived economic necessity, new legislation, and government support, cooperation among farmers remains hindered by the mentality that links the notion of cooperation with former Soviet kolkhozes. Farmers lack essential trust and social skills needed

for joining the producers' groups, while potential leaders lack managerial skills and the capacity of convincing people to collaborate (IFAD 2016).

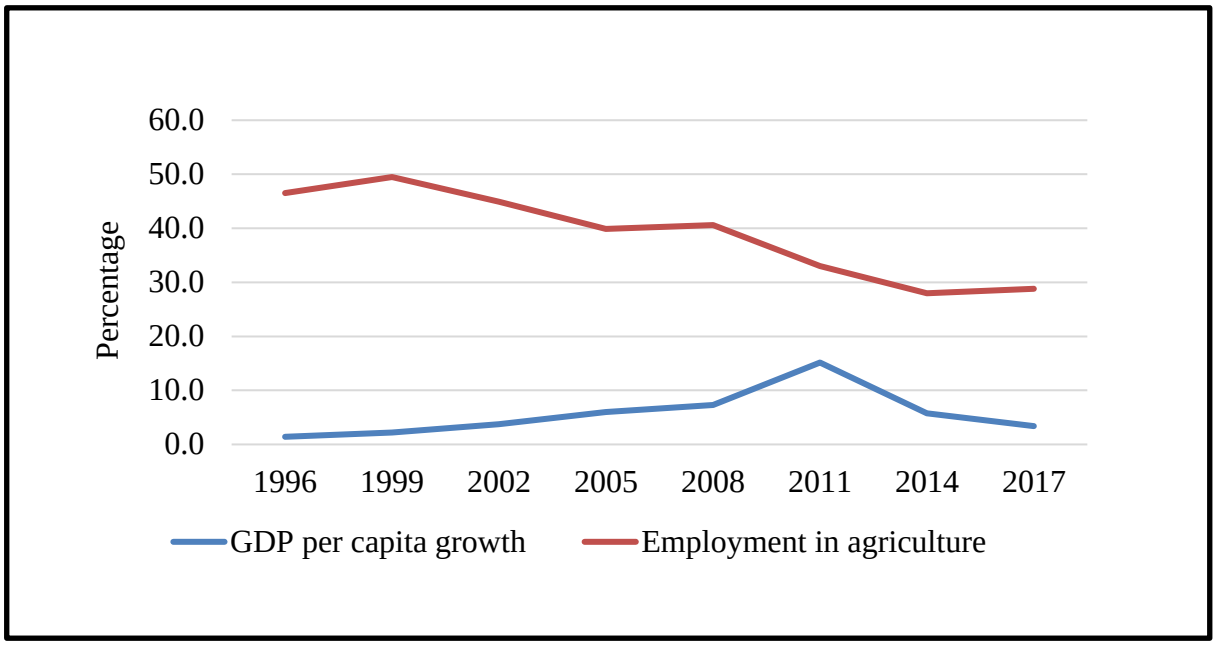
2.2.7. The agricultural sector in Mongolia

Before the transition to a market economy in Mongolia in the early 1990s, the agricultural sector was the country's mainstay, providing over 35% gross domestic product (GDP) and 45% of employment to the population (Rasmussen & Annor-Frempong 2015). After the transition from collective socialism to a market economy, agricultural output has dropped drastically, and today, the sector contributes just 15 % to the GDP. However, it provides the largest share (about 34 %) of employment (Rasmussen & Annor-Frempong 2015). Until today, Mongolia's agriculture sector is dominated by extensive livestock production, with a smaller segment focused on cultivating wheat, potatoes, and vegetables.

Among the crops cultivated in Mongolia, potato is the second most important staple crop after wheat, with a total cultivated area of about 12,511 ha and an average annual production of 116.88 thousand tons (FAO 2017). It is grown in the central and northern regions of the country in proximity to larger urban centres of Ulaanbaatar and Darkhan-Uul. On the contrary, from the wheat sector with limited potential for collective actions of small farmers, the potato sector is mainly dominated by small farmers, who cultivate less than three hectares of potatoes on average. The per capita consumption of potatoes is about 40.60kg (ADB 2020). Despite its importance in the Mongolian diet and food security status among rural and urban dwellers, potato yield per unit of land is relatively low and highly variable. For example, the yield between 2017 and 2012 varied between 9.34 tons/ha and 14.62 tons/ha (FAO 2017).

As Figure 7 shows, the mid-1990s reflect the period of high participation of Mongolians in the agricultural sector as one of the country's main occupational sectors. Nearly 50% of the people were in the agriculture sector (Figure 7). However, in the first half of the new millennium, employment in agriculture fell sharply. Since then, employment rates in

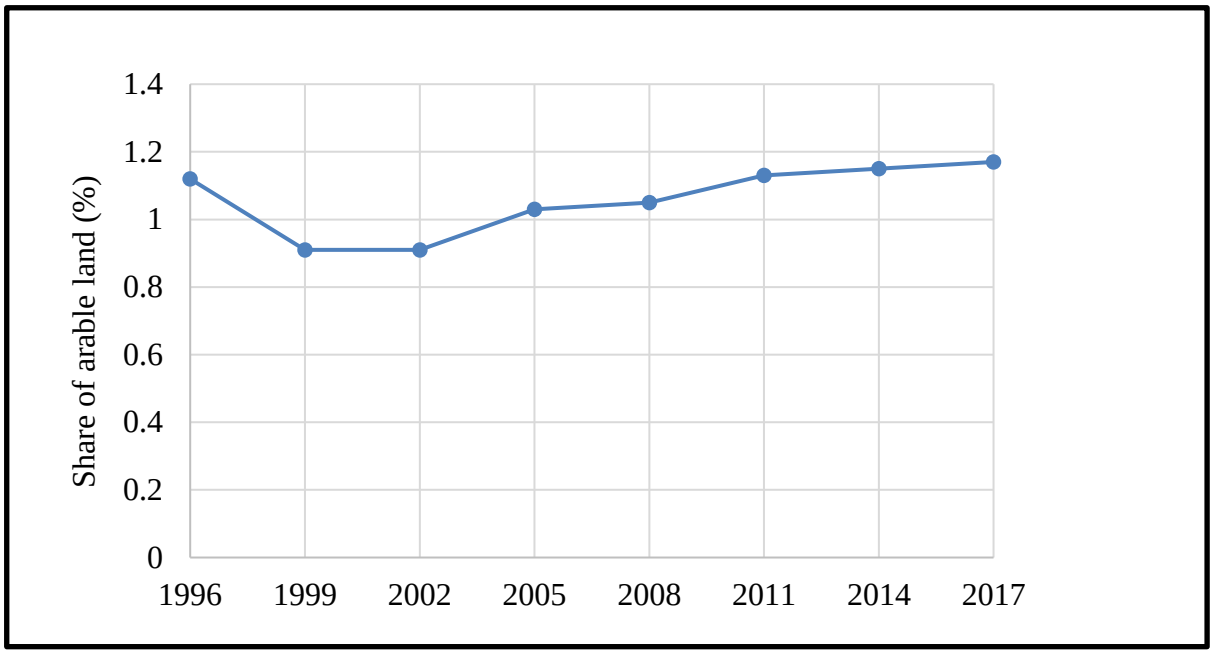
agriculture have fluctuated. Regarding economic growth, GDP per capita increased from the later part of the 1990s until 2014, when it fell to 3.4% in 2017.



Source: Compiled from the data of the World Bank

Figure 7. The pattern of economic development over the last two decades in Mongolia.

By far, Mongolia has one of the lowest shares of arable land for crop production compared to other post-Soviet transition countries. This disparity may be due to the topography and climatic conditions in Mongolia. Despite this, the share of arable land in the country has been increasing gradually in recent years, which shows signs of more intensive agriculture locally (Figure 8).



Source: Compiled from the data of FAO

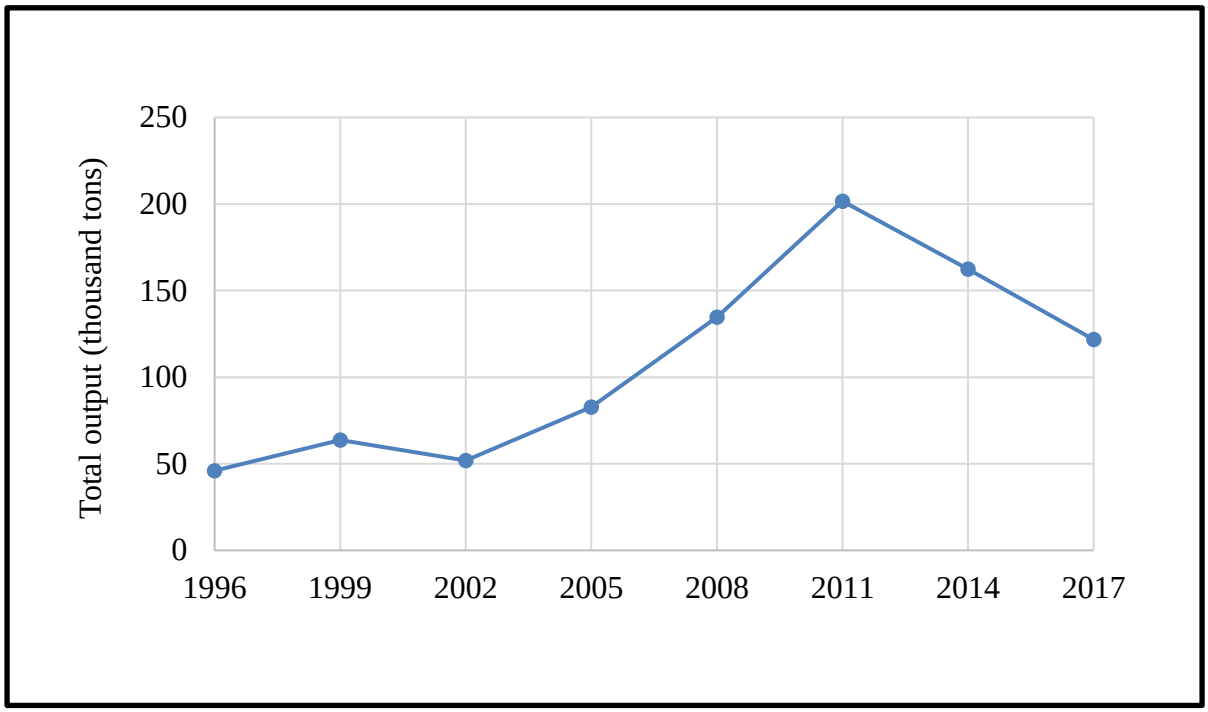
Figure 8. Share of arable land in total agricultural land in Mongolia

2.2.8. Potato sector in Mongolia

Mongolia's agriculture sector is dominated by extensive livestock production, with a smaller segment focused on cultivating wheat, potatoes, and vegetables. Among the crops cultivated in Mongolia, potato is the second most important staple crop after wheat, with a total cultivated area of about 12,511 ha and an average annual production of 116.88 thousand tons (FAO 2017). It is grown in the central and northern regions of the country in proximity to larger urban centres of Ulaanbaatar and Darkhan-Uul. On the contrary, from the wheat sector with limited potential for collective actions of small farmers, the potato sector is mainly dominated by small farmers, who cultivate less than three hectares of potatoes on average. The per capita consumption of potatoes is about 40.60kg (ADB 2020).

As one of the most significant food security crops in Mongolia, the production of potatoes has kept rising since the beginning of the new millennium. This increase in the

production of potatoes is because of market preference for locally grown potatoes and vegetables (FAO 2017). Despite its importance in the Mongolian diet and food security status among rural and urban dwellers, potato yield per unit of land is relatively low and highly variable, for example, there was a sharp decline in total output in 2017, compared to 2011 (Figure 9), which calls for appropriate policies towards sustainable production of stable food crops in the country.



Source: Compiled from the data of FAO

Figure 9. The total output of potatoes in Mongolia

2.2.9. Policies and farm cooperation in Mongolia

After the collapse of the Soviet Union in 1991, many agricultural cooperatives in Mongolia transformed into individual and investor enterprises. In 1990, nearly 70% of livestock owners were in collectives. The livestock sector is one of the dynamic forces of the Mongolia cooperative sector. In the late 1980s, interventions from the state led to the

interference of cooperative properties and controlling of product prices, thus changing the function of the cooperatives from their original intentions (Worden & Savada 1989). Nevertheless, the initial stages in 1991 of the transition from a centrally planned economy to a market-oriented economy resulted in a free transfer of livestock to private ownership (mainly cooperative members). The transition to the market economy, together with a decline in productivity and challenging economic conditions of the new market, led to the resurgence of cooperatives as feasible institutions for improving the livelihoods of rural people (Hilliova et al. 2017).

The introduction of the new "Cooperative Law" in 1995 by the Mongolian government gave a new birth and targeted support to the re-establishment of cooperatives in Mongolia (Bayartsaikhan 2012). In addition, the government declared 2003 as the "year of cooperatives", which led to the adoption of several national programmes, for example, the "Mongolian Livestock Programme", "National Cooperative Development Movement", and "Third National Crop Rehabilitation Drive". These legislations encouraged the development of modern cooperatives and provided subsidies and other financial help to producer groups. In addition to the enabling legal environment for cooperatives, the Mongolian government paid particular attention to developing a market structure and setting up financial and practical extension services for the cooperative sector.

As a sequel to the above, several organisations have developed an interest in the cooperative sector and various forms of collective action and, as such, provide support to smallholder farmers. For example, the Mongolia Women Farmers Association supports farmer groups in planting, training, and business development (Chuluunbaatar et al. 2017). This phenomenon provides new opportunities for farmers in the agricultural sector and enhances the participation of farmers, particularly women, in new forms of collectives in Mongolia.

On the other hand, the perception of farmers and society regarding cooperatives is still somewhat negative in Mongolia. Many farmers have neither a good understanding of cooperatives' values, principles and benefits nor sufficient trust in others and motivation to join (Rasmussen & Annor-Frempong 2015). Such adverse attitudes have their roots to a large extent in the Soviet-type communist regime in the late 1980s, when the agricultural systems were dominated by poorly performing large collective farms (called "Negdels")and controlled by the central government (Worden & Savada 1989). These aversions blocked the development of voluntary cooperatives (Worden & Savada 1989; Chuluunbaatar et al. 2017) after the first two decades of political changes in 1990. However, the strong aversion has melted with the government's continuing interest in cooperatives and strengthening their role and the efforts of cooperative unions to promote a positive perception of collective market operations.

2.3. Commonalities and differences in cooperatives development in the three countries

Table 1 describes the commonalities and differences in the development of cooperatives in the three post-Soviet transition countries.

Table 1. Commonalities and cooperatives development in the three countries

Country	Privatisation strategy	Legislation	Cooperative emergence	External support
Georgia	Equal distribution of assets using voucher system among farmers without any payment	Law on agricultural cooperatives (July 2013) (Lerman & Sedik 2014)	Appeared in 1909	ENPARD
Moldova	Equal distribution of assets using voucher system among farmers without any payment	Law on cooperation (Jan 1992). Law on production cooperatives in 2002; updated 2010 (Lerman & Sedik 2014)	Appeared in 1994	World Bank
Mongolia	Distribution of assets using the voucher system	Law on cooperatives in 1995 and updated in 2011 (Chuluunbaatar et al. 2017)	Appeared in 1921	UNDP, SDC

2.4. Review of empirical studies

The study seeks to analyse smallholder farmers' decisions to participate in collective action and analyse their economic and social performance. Therefore, the study reviews studies that have examined the determinants of participation in collective activities, the potential benefits of cooperation and its internal and external causes, and the relationship between agricultural cooperatives and farm performance.

2.4.1. Factors affecting farmers participation in cooperatives

Before assessing the impact of cooperatives on the performance of farmers in post-Soviet transition countries, it is necessary to identify the factors that are likely to influence farmers' decisions to participate in collective actions, given that these farmers have a negative cooperative experience from socialist regimes. Findings from previous empirical studies indicate that education (Wollni & Zeller 2007; Zheng et al. 2012; Verhofstadt & Maertens 2014; Abate 2018), Age (Mojo et al. 2017; Abdul-Rahaman & Abdulai 2018) significantly affect smallholder farmers' decision to participate in collective action.

In identifying why some farmers become members of agricultural cooperatives while others do not, Nugussie (2010) identified exposure visits, training access, male household head, access to credit, information access, and family size as significant determinants of cooperative membership. In another study, Fischer and Qaim (2014) observed that participation in cooperative is a function of farm size, group size, type of crop cultivated and distance from the farm. Karli and Bilgic (2006) also confirmed that human capital, farm size, and income affect farmers' decisions to participate in agricultural cooperatives in the Mediterranean region.

Evidence of farmers' willingness and intention to join cooperatives and other forms of collective action in the post-Soviet transition countries shows that expectation for better prices

and access to capital are the main drivers of smallholder farmers intention to cooperate (Möllers et al. 2017).

Similarly, Bakucs et al. (2012) found trust, farming contracts and flexibility to be motivational factors that influence smallholder Hungarian farmers decision to participate in collective activities. In the context of small Croatian farmers, economic motives such as business risk reduction, access to government support and grants and reduction in production cost were recognised as farmers' intents to cooperate (Nedanov & Zutinic 2018).

2.4.2. Potential economic and social benefits of cooperation and their related causes

Smallholder farmers produce a minimal output, hence their inability to obtain economies of scale and market power compared to their trading partners. Moreover, smallholder farmers face many obstacles when acquiring the required resources to improve farm productivity and market commercialisation (Herbel et al. 2012). However, collective group action can create new opportunities to overcome these obstacles and help farmers reach production levels that might not be available as independent farmers.

The study adopted the general methodological framework combining several existing theories and hypotheses to operationalise cooperatives' economic and social success. The economic success of cooperatives and positive impact on farm-gate price, income and quality encompasses economies of scale and transaction costs theories. According to North (1987), the transaction cost is the cost incurred on delivering goods or services between two parties. North considered the transaction cost to be one of the most critical barriers to economic growth. Joint forces, combined resources and shared factors of production in rural cooperatives can lead to a higher quantity of produced goods (economies of scale) and to minimising the transaction and production costs of member farmers (Staatz 1987; Valentinov 2007; Valentinov & Iliopoulos 2013; Abate 2018). In addition to the collective organisation of sales, cooperative membership can also reduce the input purchase price for members, as bulk purchases lead to discounts from

input providers (Altman 2015; Abate 2018). Thus, cooperative members can obtain better access to both input and output markets.

Based on theoretical arguments, a growing body of empirical documentation proves the economic benefits of collective action on equitable rural growth and poverty alleviation (Wanyama et al. 2008; Abate 2018). Cooperatives can effectively reach high-quality food standards in modern food value chains and help member farmers obtain bargaining power (Royer et al. 2017). The economic benefits of cooperative membership in China showed that involvement in collective action positively impacts output price, gross income, farm profit, and return on investment (Ma & Abdulai 2017). Similarly, in central Kenya, Fischer and Qaim (2012) reported an increase in acreage, household income, and banana share among cooperative members relative to non-members.

In addition to the potential economic benefits for members, there are also several non-economic benefits. Many of these non-economic benefits are related to the theory of social capital introduced above. A study conducted by Figueiredo and Franco (2018) reveals that co-operators prefer the social aspects and human development over the economic goals of the organisation. Members' training and knowledge transfer play an essential role in promoting the productive agricultural sector transformation by adopting innovation and new approaches and techniques. Moreover, cooperatives play an important social role in rural areas, as these organisations contribute to the unification of rural communities and provide them with employment. The members of cooperatives may benefit from better access to credit service providers and information. Along with members, non-member farmers might sometimes also use the cooperative's services for their farm operations. Together with participative and local decision-making, combined with investments in their community infrastructure (roads, electricity), cooperatives can also be an instrument for local community development with specific "spill-over" effects (Abate 2018).

However, evidence of the benefits of cooperatives is still somewhat mixed, with many authors providing examples of significant challenges and drawbacks, such as freeriding, low trust among members, higher costs of control in larger groups, and problems related to property rights and principal-agent inefficiencies (Nilsson 2001).

Assessing the factors influencing the potential success or failure of cooperatives discussed above has been of interest to many researchers. However, there is still no systematic framework to comprehensively assess the internal or external factors influencing the impact of cooperatives.

Studies show that active participation in cooperatives, loyalty and trust among members (Costa 2003; Huang et al. 2015), the commitment of members, cooperation values (Trechter et al. 1997; Tremblay 2000) and motivation in collective action (Abdelrahman & Smith 1996; Wadsworth 2001) are among the factors that affect cooperatives performance. Besides these factors, personal attributes such as age and education (Wadsworth 2001; Amini & Ramezani 2008; Gimenes et al. 2016), communication and social exchange within members (Wadsworth 2001; Cole et al. 2002) also affect cooperatives' performance. Mills and Davies (2013) considered inter-organisational culture as a vital attribute of the cooperative to strengthen commitment and trust among elements of the organisation. Mazzarol et al. (2013) identified "partner selection" as one of the factors influencing the success of a cooperative, as the individual characteristics of members affect trust and loyalty inside the organisation, which itself comprises social capital.

In another study in Malaysia, Mahazril et al. (2012) demonstrated that sound strategic planning and active member participation influence a cooperative's success. Although the correlation showed a weak relationship among the variables, the authors conclude that these factors still influence a cooperative's performance. Hunnicutt (2002) showed that cooperative size might influence the commitment of members. As membership size increases, investment

size and return on investment for each member decreases. Figueiredo and Franco (2018) showed that cooperatives are attractive because they afford access to decision-making and management and support the local community.

However, studies on the importance of external factors and context on cooperatives' success are somewhat limited. Nevertheless, as Valentinov (2007) highlighted, the emergence and success of agricultural cooperatives are sector-specific. The success of cooperatives in Western European countries is characteristic of European family farms and the nature of their value chains. In addition, Staatz (1987) argued early on that the incentive to form cooperatives based on lower transaction costs and higher countervailing market power is higher in sectors with high immobility of assets in agricultural production. The theory of assets specificity proposed by Williamson (1985) and recent findings by Ahado et al. (2021a) also confirms the findings of Staatz. Markelova and Mwangi (2010) also confirmed this in the African context.

Government policies and targeted support for the establishment and development of cooperatives are also critical external factors influencing the success of cooperatives (Mazzarol et al. 2013). In the case of EU members states, where cooperatives have been thriving for a long time, policies and funds directed at cooperative development have a role to play (Bijman & Iliopoulos 2014; Bošková et al. 2020). However, external support from governments and international donors frequently operates without a precise understanding of the dynamics of a particular value chain and the requirement of adequate structures of potential collective actions. Thus, such approaches affect efficiency and sustainability, resulting in "artificial" cooperation among rent-seeking farmers (Golovina & Nilsson 2011; Michalek et al. 2018).

2.4.3. Cooperative and farm performance

The concept of farm performance is multidimensional; in the case of cooperatives, economic and social goals are the two main facets of cooperative performance (Hendrikse 2007). Usually, financial indicators (e.g., return on equity, return on asset) and economic

efficiency (e.g., farm price, yield, income) are the two most common measures often examined (Grashuis & Su 2018; Liang et al. 2018). Franken and Cook (2015) and Grashuis and Su (2018) provide detailed concepts of the various aspects of cooperatives performance.

Nevertheless, evidence from studies (see Table 2) on the impact of collective action on farm performance is somewhat mixed. For example, Ma and Abdulai (2016) witnessed a positive effect of cooperatives on farm outcomes such as yield, net returns and household income among apple farmers in China. Ito et al. (2012) and Chagwiza et al. (2016) also showed that membership in cooperatives generates higher output prices for members in China and Ethiopia, respectively. The study by Bošková et al. (2020) also reported positive economic benefits of dairy farms in the Czech Republic.

Similarly, Michalek et al. (2018) found that members of the producer groups that emerged spontaneously without any governmental assistance exhibit better economic/income indicators than non-members. However, they found that members of the government-supported producer groups failed to show better performance than non-members. That cooperative can fail to deliver benefits to their members also showed Bernard et al. (2008) on the failure of grain cooperatives in enhancing commercialisation in Ethiopia.

Table 2. List of studies on the benefits and impact of cooperatives/farmer groups

Author and year	Country	Methods	Benefits and impact of membership
Fischer and Qaim (2012)	Kenya	Propensity score matching (PSM)	Higher price for members, increase adoption of innovation
Ito et al. (2012)	China	PSM technique	Higher labour productivity and price margin
Abate et al. (2014)	Ethiopia	PSM, Rosenbaum sensitivity analysis and stochastic production frontier	Participation in cooperatives leads to efficiency gains
Verhofstadt and Maertens (2015)	Rwanda	PSM technique	Cooperative membership increases income and reduces poverty for larger farms and in more remote areas
Chagwiza et al. (2016)	Ethiopia	PSM technique	Cooperative membership increases farm income and technology adoption
Ma and Abdulai (2016)	China	Endogenous switching regression (ESR)	Cooperative members attain higher yields, net returns and household income
Wossen et al. (2017)	Nigeria	PSM and ESR	Membership reduces poverty and increases technology adoption
Ma et al. (2018)	China	PSM, sample selection stochastic production frontier (SPF)	Members of cooperative obtain higher farm revenue and are more efficient than non-members

Table 2. continued

Author and year	Country	Methods	Benefits and impact of membership
Michalek et al. (2018)	Slovakia	Difference-in-difference PSM	Members of producer groups without support performed better than non-members, while members with support failed to show better performance than non-members
Bachke (2019)	Mozambique	Difference-in-difference PSM	Members obtain higher value of agricultural production and household income
Ofori et al. (2019)	Cambodia	PSM approach	Cooperative membership had no impact on gross farm revenue but facilitated technology choice and access to credit among members
Bošková et al. (2020)	Czech Republic	Direct covariate matching	Members of producer groups obtained higher milk yields and profit.
Ahado et al. (2021b)	Mongolia	PSM, sample selection SPF, stochastic meta-frontier and control function approach	Cooperative members were more efficient than non-members and had increased yield and farm revenue
Donkor and Hejkrlik (2021)	Zambia	Endogenous treatment regression	Cooperative members obtained higher gross margin and output price
Olagunju et al. (2021)	Nigeria	PSM, sample selection SPF, stochastic meta-frontier	Members were technically efficient than non-members and obtained higher total value of agricultural production

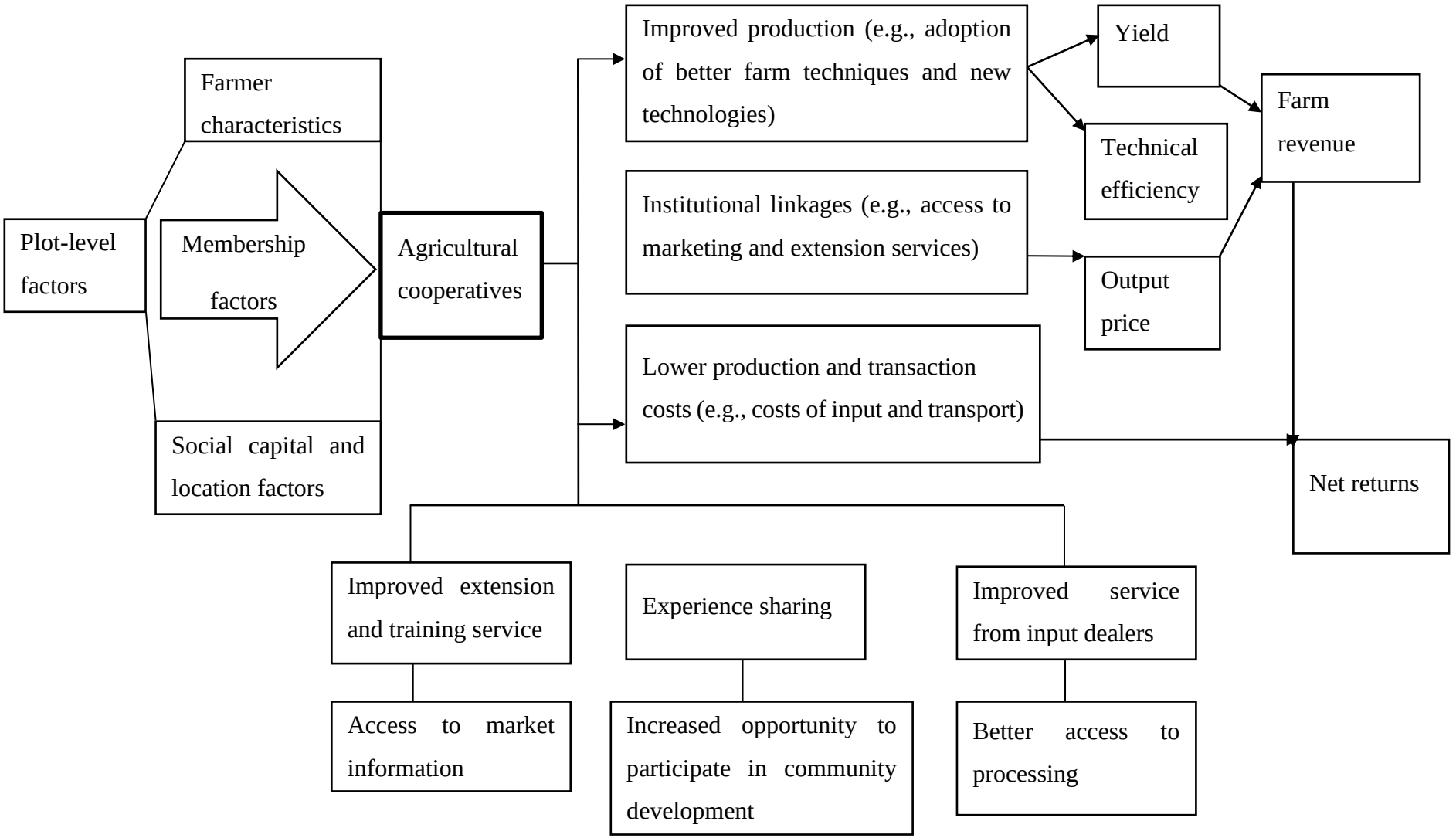
3. Chapter 3 Conceptual framework and objectives of the study

Figure 10 illustrates the synergy between factors affecting farmers' decisions to join cooperatives and economic and social benefits as implied by recent empirical studies (Gedara et al. 2012; Ma et al. 2018; Michalek et al. 2018). Previous studies have shown that participation in cooperative organisations and other forms of collective action is a function of farmer characteristics (e.g., the farmer's age, education and gender), plot-level factors and social capital and location factors.

Cooperatives provide essential links between farmers and the best or most adequate production and processing technologies, as pointed out in previous research (Abebaw & Haile 2013; Verhofstadt & Maertens 2014). Cooperatives also facilitate linkages to institutions such as extension services and training programmes to acquire the necessary know-how and resources for improving the productivity and efficiency of their members. Farmers' stronger input and output markets positions also reinforce this function.

Participation in collective action also has social benefits or implications for smallholder farmers. Through cooperative activities, farmers can improve extension and training advisory services from public and non-governmental organisations. Other important social benefits cooperatives provide for smallholder farmers include access to market information, improved services from inputs dealers, better access to processing and the opportunity to participate in community development projects.

It is important to note that Mongolia survey data was focused on a different industry (potato cultivation), as there were no cooperatives/farmers that cultivate grapes, hazelnuts, walnuts, and plums as in Georgia and Moldova. Therefore, this may affect the overall conclusions of the study. Nevertheless, the results from the Mongolia analysis (also a post-communist country as Georgia and Moldova) can provide insights into the potential benefits of collective action for future policy design.



Source: Author's construct

Figure 10. Conceptual framework – The linkage between the determinants of agricultural cooperatives and economic and social performance

3.1. Research hypotheses

Many national governments have expressed their high expectations that modern agricultural cooperatives and other forms of collective action can enhance farmers' economic market power and the adoption of technologies, resulting in higher income and resilience of the farming sector (Huang & Liang 2018; Ma & Abdulai 2018; Ma et al. 2018). Notably, it has been argued and believed that institutional, input and output market linkages, together with training and advice services provided by agricultural cooperatives, can increase small farmers productivity.

Based on the reviewed literature, the study seeks to examine the impact of cooperative membership in the context of the following hypotheses:

1. *Hypothesis 1*: Personal and social capital factors affect farmers' decisions to join collective action
2. *Hypothesis 2*: Participation in cooperatives is associated with improved economic and social benefits
3. *Hypothesis 3*: Participation in cooperatives positively contributes to increased technical efficiency

3.2. Research objectives

The main objective of the study is to analyse the economic and social performance of newly created farmers' groups in post-Soviet transition countries using different farm performance indicators. The study is motivated by the research question - to what extent new interest of local governments and national donors in the rebirth of spontaneous and bottom-up farmers' groups can generate positive results for small and unorganised farmers.

The contribution of the study to literature is threefold. First, the study employs an innovative approach that combines impact evaluation techniques and econometric approaches

to analyse the impact of new collective actions and cooperation on smallholder farmers' economic and social performance in post-Soviet transition countries. Second, the study uses a control function approach that addresses the potential endogeneity of some variables in the cooperative membership choice model. Third, the study also explores different levels of farm performance indicators to assess the performance of smallholder farmers in the three countries.

3.2.1. Specific objectives

The first objective has a purely explorative character and does not refer to any of the hypotheses stated in the previous paragraph. The rest of the objectives aim at confirming the hypotheses. The specific objectives are to:

1. Describe the characteristics and governance of the various emerging producers' groups (marketing cooperatives) in the selected countries.
2. Analyse the factors that influence farmers' decisions to join cooperatives/farmer groups.
3. Evaluate the benefits of newly established farmers' groups for their members regarding farm profitability and non-economic indicators.
4. Examine the impact of cooperative membership on the technical efficiency of smallholder farmers.

4. Chapter 4 Methodology

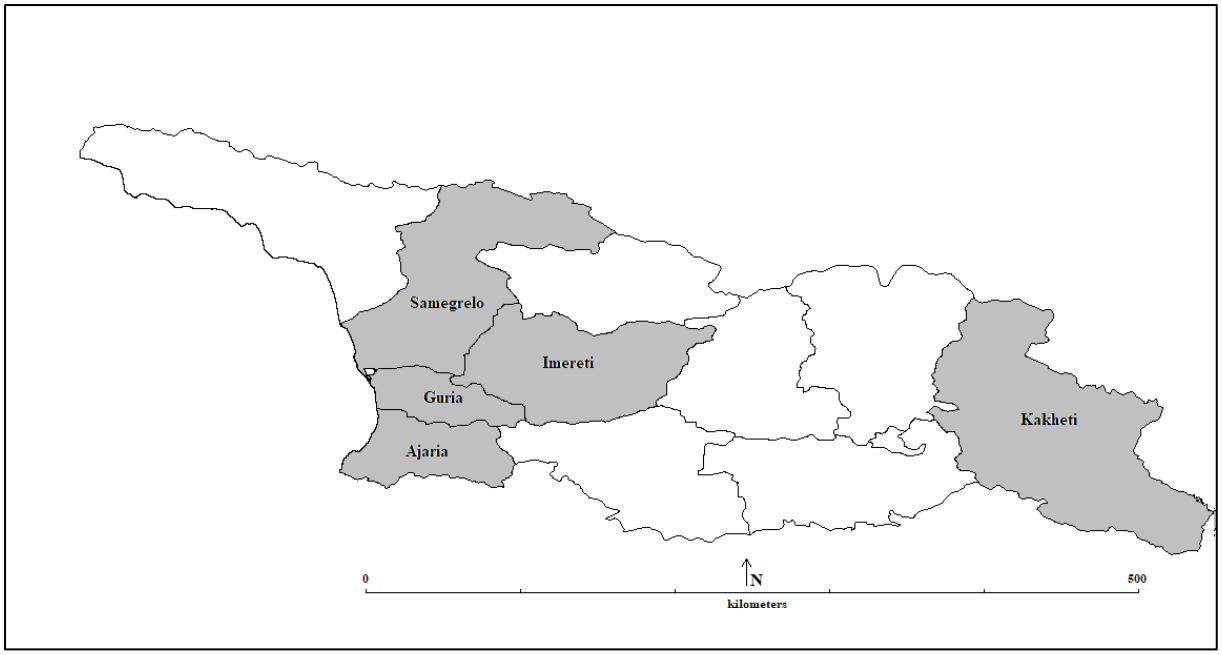
4.1. Introduction

Chapter four first describes the study areas and then concentrates on the research design and implementation (methods). The former discusses the various data collection approaches, sampling techniques, and descriptive data analysis, while the latter concentrates on the analytical framework and econometric approaches employed in each country study. It further describes the variables used in the study and the test of the research hypotheses.

The study uses the probit regression and propensity score matching (PSM) technique to model farmers' decisions to join cooperatives/farmer groups in the three countries and different analytical methods to analyse the impact of cooperation on members' economic and social benefits.

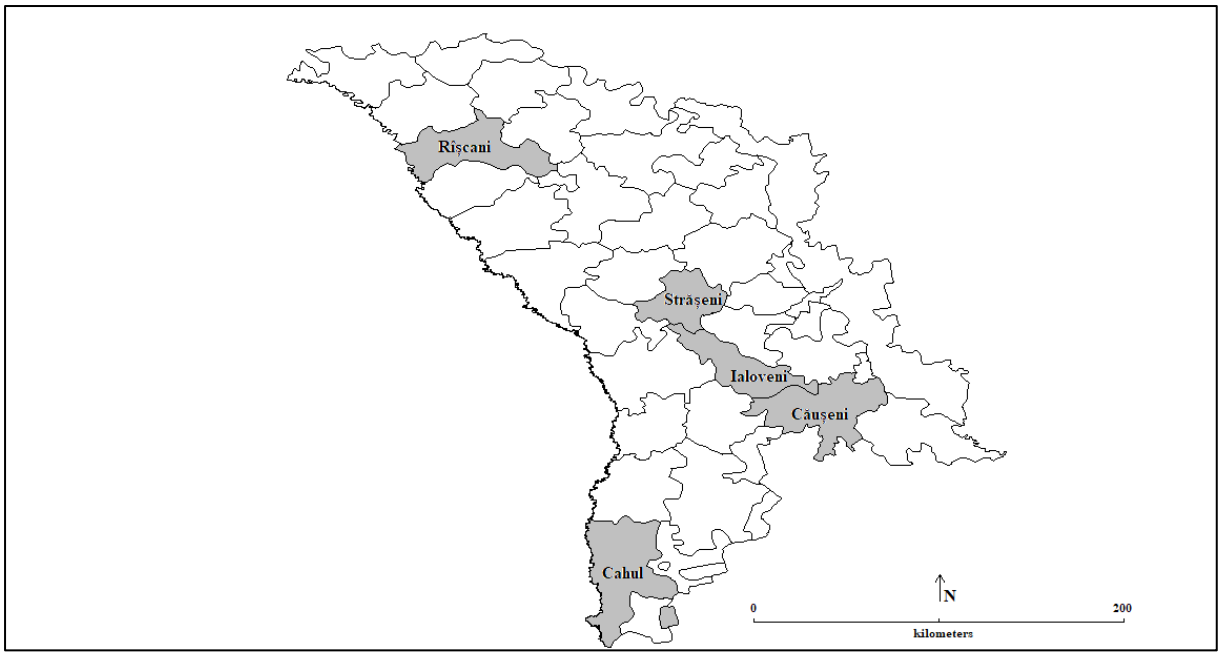
4.2. Study sites

As stated in the introduction of chapter four, the study took place in Georgia, Moldova, and Mongolia. The Georgian farmers' survey occurred in the Western region – Adjara, Guria, Imereti and Samegrelo and Eastern region – Kakheti in Georgia (Figure 11). In Moldova, the data collection took place in the central – Ialoveni, Causeni, Straseni, northwest – Rascani and southern – Cahul (Figure 12). In Mongolia, the survey was in Selenge, Darkhan-Uul and Tuv provinces (Figure 13). These countries were used as case countries because of the similar experiences from the post-Soviet regimes and given the national governments and international donors interests in the rebirth of cooperatives as an essential agricultural development policy for inclusive-economic growth in rural areas. Although Mongolia was not part of the USSR, it was added to the study due to the Mongolian government's sustained interest in collective action to improve national self-sufficiency in the crop sector and the similar cooperation experience as other post-Soviet transition countries.



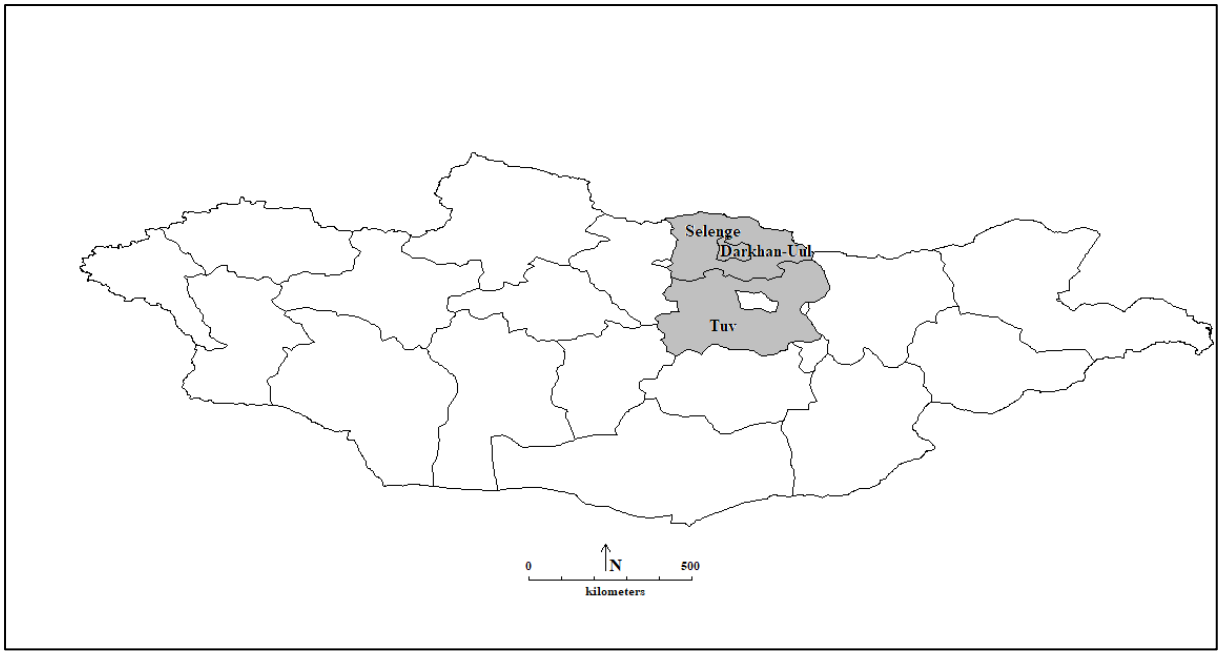
Source: Author's illustration with data from diva-gis.org

Figure 11. Administrative map of surveyed areas in Georgia



Source: Author's illustration with data from diva-gis.org

Figure 12. Administrative map of surveyed areas in Moldova.



Source: Author's illustration with data from diva-gis.org

Figure 13. Administrative map of surveyed areas in Mongolia.

4.3. Research design

Table 3 presents the target groups, data collection instrument, sampling technique and econometric strategies employed in the study.

Table 3. Research design

Indicator/country	Georgia	Moldova	Mongolia
Target group	Viticulture, apiculture and hazelnut cooperative members and non-members	Viticulture, plum and walnut cooperative members and non-members	Potato cooperative members and non-members
Period of survey	September - October 2018	November - December 2018	October – November 2019
Type of data	Cross-sectional data		
Sampling procedure	Multi-stage cluster sampling technique	Multi-stage sampling technique	Multi-stage sampling technique
Sample size	210 (93 cooperative members & 117 non-members)	205 (105 cooperative members & 100 non-members)	251 (115 cooperative members and 136 non-members)
Data collection instrument	Interviews & structured questionnaire administration using nestforms web application		
Econometric approach	PSM and treatment effects model	PSM and endogenous switching regression	PSM, sample selection stochastic production frontier and stochastic meta-frontier

4.3.1. Data collection and sampling technique in Georgia

The field survey took place in September and October 2018 in the Western and Eastern regions of Georgia. These regions were explicitly selected due to their high intensity of newly emerged cooperatives and share in national agricultural production (Kochlamazashvili et al. 2017). The newly created cooperatives also shared similarities (e.g., the assets received from ENPARD 1, short marketing channels, and negotiation position of farmers vis-à-vis buyers) in the value chain organisation.

Using qualitative research based on key informants and focus group discussions with respective farmers, the study examined the context of the value chain of the three sectors to gain a deeper understanding of the interpretation of the results. The key informant interviews covered the entire value chain from suppliers to the local market.

The study employed a multi-stage cluster sampling procedure complemented by structured questionnaire administration to select the sample. Data on registered cooperatives (i.e., 91 cooperatives established between 2013 and 2014 which received material and non-material support from the ENPARD programme) provided by the International School of Economics in Tbilisi, Georgia, were pre-selected to draw the sample of cooperatives from the various administrative regions. In all, 37 cooperatives out of the 91 cooperatives were contacted based on their target products and coverage of the country's agro-ecological zones. Several cooperative members were inactive; only about a quarter of the members produce and use the cooperatives. The issue of inactivity of some cooperative members came up during the key informant interviews with the managers of the cooperatives. As a result, the sampling focused on active farmers that derive their primary income as farmers in a particular sector. The total sample for the study was 210 farmers; of this, 93 were cooperative members (i.e., 35 honey producers, 30 hazelnut producers and 28 grape producers), and 117 were non-cooperative members (30 honey producers, 33 hazelnuts producers and 54 grape producers). The non-

members were randomly selected in consultation with local cooperative support organisations within the same regions as the cooperative members. The farmers interviewed are small producers of grape, hazelnut and honey, mainly engaged in the production and marketing. Specifically, the control group (non-members) was selected in consultation with local cooperative support organisations within the same regions as the cooperative members. The control group sample consisted mainly of 84 non-members from the Western region and 33 non-members from the Eastern part of the country.

4.3.2. Data collection and sampling technique in Moldova

The data collection in Moldova took place between November and December in the Central, Northwest and Southern regions. Farm-level data on household demographic and socio-economic factors and production information were collected through face-to-face interviews using structured questionnaires. The study used a multistage sampling technique to sample the farmers. First, based on a list of 37 cooperatives provided by the National Union of Cooperatives in the national capital-Chișinău, a purposive sampling technique was used to select the three regions due to their geographic accessibility and the intensive cultivation of fruits and nuts (World Bank Group 2016). Second, at least two villages from each region were selected. Finally, a random sample of 30-35 orchard farmers from each selected village followed. In total, 205 respondents, including 105 small-scale orchard cooperative members (i.e., 20 walnut producers, 33 plum producers and 52 grape producers) and 100 non-cooperative members (i.e., 19 walnut producers, 29 plum producers and 52 grape producers) were the sampled farmers. Thus, 113 farmers in the Central region, 51 in the Northwest and 41 in the South region formed the sample. The cooperatives in this study are producer groups that market either walnuts or grapes or plums. According to the key informant interviews with managers of the cooperatives, the majority (about 25) of the included cooperatives were established

spontaneously by family farms to cope with the market, and only some resulted from donor-supported projects (e.g., by the World Bank) that ceased to function after the end other projects.

The three sectors share similarities in terms of group activities, marketing strategies and membership benefits. The primary services that members derive from the cooperatives include the collective supply of inputs and shared labour support during the peak farming seasons.

In the case of the control (i.e., individual farmers who also cultivate and market walnuts, plums and grapes) was contacted randomly within the same regions as the cooperatives through local experts in the communities. The sampling procedure resulted in 55 control groups from the Central region, 25 from the Southern region and 20 from the Northwest region.

4.3.3. Data collection and sampling technique in Mongolia

Data collection took place in Selenge, Darkhan-Uul and Tuv provinces in Mongolia between October and November 2019. According to the National Association of Mongolian Agricultural Cooperatives (NAMAC), most agricultural cooperatives are registered in these three regions and are also known for collective vegetable and potato production (JICA 2017).

The study employed multistage sampling to draw the sample. First, guided by a list of 50 agricultural cooperatives obtained from NAMAC, a purposive sampling technique was used to select the three regions based on the reasons indicated in the previous paragraph. Second, three to four communities from each study province were selected. Finally, a random interview of 20-25 potato farmers in each selected community followed. Forty-two (42) cooperatives out of the 50 cooperatives from the initial list formed the base of the cooperatives. Precisely 110 farmers from Selenge, 61 from Darkhan-Uul and 80 from Tuv province formed the study sample. Thus, 251 smallholder potato farmers comprising 115 cooperative members and 136 non-members were sampled and interviewed using a structured questionnaire with the assistance of locally trained enumerators. Farm-level data on farmer demographic and socio-economic factors and production information were collected. The questionnaire also included

open-ended questions related to farmers experience, external support, farming techniques and practices.

Regarding the selection of non-members (control), individual farmers who cultivate potatoes for consumption and marketing formed the control. A discussion with cooperative members about existing non-members in the same communities led to a random interview and sampling of the control group. Precisely, 73 individual farmers from Selenge province, 30 from Tuv province and 34 from Darkhan-Uul province were the sample for the control group.

4.4. Analytical framework and econometric strategy

4.4.1. Cooperative membership decision

As a first necessary step of the counterfactual analysis, the study employed the random utility framework to model farm household decisions to participate in collective action. It is usually applied to analyse the adoption of innovation under conditions of uncertainty (Feder et al. 1985). Ideally, a farmer will participate in cooperatives if the benefits from participation are more significant than non-participation. The utility gain from cooperation is a function of observed covariates in a latent variable function. Thus, the probability of participating in cooperatives is derived from a probit regression and specified as:

$$D_i^* = K_i\alpha + \varepsilon_i \text{ with } D_i = 1(if\ D_i^* > 0) \quad (1)$$

where D_i^* is an indicator of the latent cooperative membership, α is a vector of parameters to be estimated and ε_i is the error term. D_i is a binary variable equals to 1 if the farmer is a member of the cooperative and equal to 0 for non-members. K_i is the vector of exogenous variables (i.e., farm and household characteristics) believed to influence participation in cooperatives (see Table 5). The choice of these variables and expected causality is informed by previous empirical literature (Benin et al. 2012; Fischer & Qaim 2012; Abebaw & Haile 2013; Mojo et

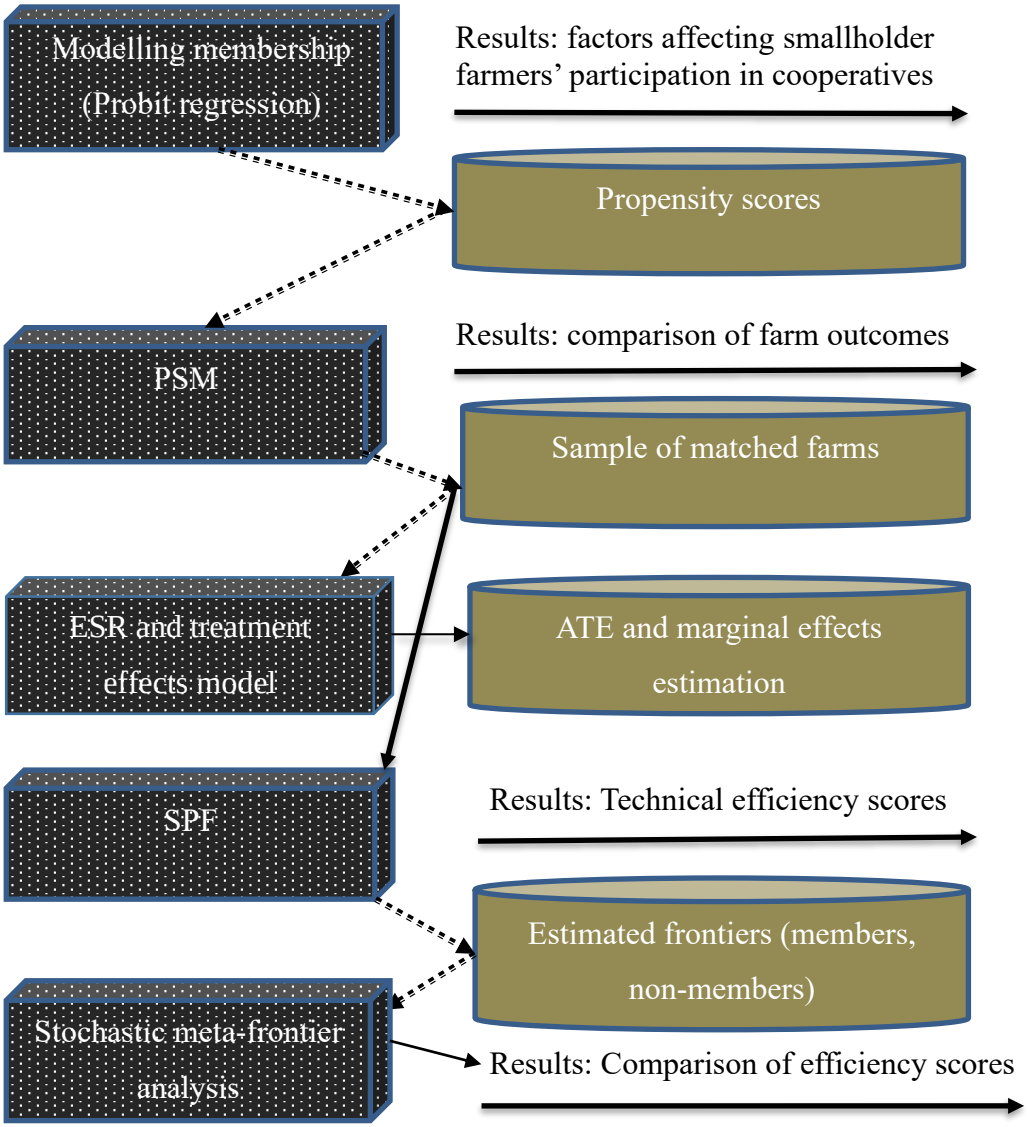
al. 2017). It is important to note that the probit regression modelled the cooperative membership equation using the maximum likelihood estimation.

The study also operationalised social capital as an important precondition for collective action participation among the identified variables. This variable is critical in this study because many farmers in post-Soviet transition countries seem to show psychological resistance to collective action participation; hence the study briefly elaborates on it. Social capital refers to the level of mutual trust among people (Coleman 1988), the capacity for cooperation, or the norms and networks that enable group members' cooperation and collective action (Woolcock & Naraya 2000). Social capital is a vital immaterial stock that can minimise monitoring costs, improve cooperation and consequently productivity and economic, or even environmental outcomes (Chloupkova et al. 2003; Mojo et al. 2015; Pretty et al. 2020). The concept of social capital is important in the context of group formation in Georgia and other Eastern European countries, given the negative experiences of socialist regimes in the past. Many authors (Sommerville et al. 2011; Lerman & Sedik 2014) identified the negative experience of farmers with Soviet collective farms as a strong obstacle to the current development of cooperatives in Georgia. However, trust was emphasised as an important element of farmers' intentions and attitude to participate in collective action in Central and Eastern European countries (Möllers et al. 2017). The authors further underscored that the success and sustainability of cooperation depend on interpersonal trust among people. Pretty (2003) highlighted that people are poised to invest in collective activities if others do not free ride. The global assessment of social groups in agriculture also suggests that social capital plays a pivotal role in sustainable natural resources management and biodiversity (Pretty et al. 2020).

The study followed Liang et al. (2015) social capital approach in their Chinese study (i.e., external dimension, relational dimension, and cognitive dimension). The external dimension was of the form "Social network" (neighbour effect on farming advice – i.e., farmers

indicated the number of times in a year they receive farm advice from their neighbours and the number of siblings living close by). Regarding the relational dimension of social capital, "Trust" (operationalised as interpersonal trust among farmers in the area – farmers commented on whether they have a certain level of trust in other farmers in the area). The cognitive dimension of social capital was of the form "Perception" (i.e., farmer believes that cooperative membership can generate economic benefits - farmers were asked to provide feedback on whether membership in cooperatives could generate economic benefits).

The empirical framework of the study builds on five methods: (1) propensity score matching (Caliendo & Kopeinig 2008), (2) treatment effects model (Cong & Drukker 2000), (3) endogenous switching regression (Lokshin & Sajaia 2004), (4) sample selection stochastic frontier (Greene 2010), and (5) stochastic meta-frontier (Amsler et al. 2017) structured in five steps (Figure 14). The first step estimates the factors that affect farmers' decisions to participate in cooperatives and collective activities (see equation 1). In addition to bringing more knowledge on determinants of cooperative membership, this step generates propensity scores to become members on which the matching techniques build. The second step provides subsamples of similar member and non-member farms as a base for showing the differences in productivity (i.e., yields, farm revenues and net returns) and for further analysis of technical efficiency in the case of Mongolia analysis. Steps 2 and 3 estimates a treatment effects model and endogenous switching regression, respectively, for farms in Georgia and Moldova. Step 4 estimates a stochastic production frontier with the treatment of selection biases for farms in Mongolia. The outcome of step 4 generates frontiers for both groups and technical efficiency scores. The final step estimates a stochastic meta-frontier to compare technical efficiency estimates between the two groups of farmers for farms in Mongolia.



Source: Author's own construct

Figure 14. Empirical framework – the econometric strategy

4.4.2. Self-selection and endogeneity issues

As farmers may self-select into cooperative membership, unobserved characteristics such as inherent abilities, motivation and risk preference can potentially affect the decision to join cooperatives and outcome variables under study. To fully address self-selection bias and endogeneity issues in estimating the impact of cooperative membership on outcomes of interest, the perception[2] of economic benefits associated with participation in cooperatives was used as an instrument. The instrument should affect participation in agricultural cooperatives (i.e., equation 18, page 57) rather than potato yield and technical efficiency (equation 19, page 53). The instrument was validated using a probit model for the selection equation and OLS regression for estimated yield and technical efficiency levels. The validity test result shows that the instrument affects cooperative membership ($LR(1)\chi^2 = 23.82, p = 0.01$) in equation (1) but is not significant on yield ($\mathrm{F} = 0.36, p = 0.550$ and $\mathrm{F} = 2.04, p = 0.155$) for cooperative members and non-members, respectively and technical efficiency ($\mathrm{F} = 0.00, p = 0.994$ and $\mathrm{F} = 1.06, p = 0.306$) for cooperative members and non-members, respectively, using the matched sample.

It is important to note that farmers participation in off-farm work poses an issue of endogeneity as farmers may face challenges allocating resources to cooperative activities and off-farm work. Therefore off-farm work may be jointly determined with farmers' decision to participate in cooperatives and thus making it potentially endogenous. Similarly, crop diversity is likely endogenous with cooperative membership due to possible resource allocation (e.g., labour and time) between potato and other crops cultivated. Also, farmers could receive more extension visits due to cooperative membership. Therefore, extension visits may be jointly

[2] The instrument addresses the endogeneity of cooperative membership in the Mongolian analysis and the endogenous switching regression in Moldova analysis; page 53.

determined with farmers' decision to participate in cooperatives and thus making it potentially endogenous. These potential endogeneities in the analysis are corrected using the two-stage control function approach proposed by Wooldridge (2015). The first stage entails estimating separately the off-farm work, crop diversity and extension visits with identification variables and other explanatory variables employed in the probit model. In this case, the variables off-farm, crop diversity and extension visits were the dependent variables in each scenario of the control function approach. The farmer's opinion on whether it was challenging to find off-farm work in the vicinity denoted the instrument for off-farm work and training from public/private institutions about cultivating food crops for crop diversity. In the case of extension visits, the number of farm plots owned by the farmer was the instrument. The instruments should significantly influence off-farm work, crop diversity and extension visits and not directly affect membership in the cooperative. In the second stage analysis, the off-farm and crop diversity and extension visit variables, together with their predicted residuals from the first stage, are incorporated into the cooperative membership probit model (equation 1, page 45). The results of the endogeneity test are presented in the appendix, page 128-129.

4.4.3. Propensity score matching technique

The application of propensity score matching in observational studies makes it possible to capture selection bias resulting from observable factors. The tendency that a farmer will become a cooperative member is estimable from a discrete choice model (a probit model in this study) given in equation (1), on page. 45. Propensity scores are assigned to the treatment (cooperative members) and control group (non-members) and are the basis for matching the most similar farms from the treatment group. The effect of cooperative membership is the average treatment effect on the treated (ATT) and is computed below as:

$$ATT = E(Y_1|\mathrm{D} = 1) - E(Y_0|\mathrm{D} = 0) \qquad (2)$$

where Y_1 and Y_0 are the mean values of the outcome variable (yield) and D is a dummy variable equal to 1 if the farmer is a member of the cooperative and 0 if otherwise.

Various matching algorithms exist in the literature in implementing PSM (see Cameron & Trivedi 2005; Caliendo & Kopeinig 2008). The study applied the nearest neighbour matching algorithm as used in other recent studies (Villano et al. 2015; Abdul-Rahaman & Abdulai 2018) with a replacement of up to 5 matches per cooperative member to the counterfactual non-member within a calliper distance of 0.05 and 0.015. Propensity scores within the region of common support form the basis for further analysis. (Leuven & Sianesi 2003).

4.4.4. Treatment effects model

The study estimates the economic impact (farm revenue and net returns) of collective action on small Georgian farmers using the treatment effect model. The outcome variables (farm revenue and net returns) are a function of household and plot-level characteristics conditional on cooperative membership in equation (1) in page 45. The outcomes of interest are expressed succinctly as:

$$Y_i = \alpha X_i + \gamma D_i + u_i \quad (3)$$

where Y_i is a vector of outcome variables, α and γ are parameters to be estimated and u_i is the random disturbance term. The performance indicators were acquired by asking farmers to provide information on the inputs and output of their production. Thus, net returns were, in this case, computed as the value of crops/products per hectare valued at market prices minus variable cost, and farm revenue as the value of crops/products per hectare valued at market prices. Similar economic indicators exist in the literature (e.g., Abate et al. 2014; Ma & Abdulai 2017; Ma et al. 2018).

It is important to note that as farmers may self-select into cooperative membership, unobservable characteristics such as inherent abilities, motivation and risk preference are likely

to affect the decision to join cooperatives and outcome variables under study. Thus, the error terms in equations (1) and (3) may be correlated, resulting in the potential endogeneity of the cooperative membership variable. To this end, using ordinary least squares (OLS) can generate bias and inconsistent estimates. Propensity score matching (PSM) is an impact evaluation technique often used to control observable bias, thus making it vulnerable to unobservable bias. Recent studies (Fischer & Qaim 2012; Verhofstadt & Maertens 2014; Mojo et al. 2017) have employed PSM to control observable attributes in observational studies.

Unlike the PSM technique, the treatment effects model eliminates observable and unobservable bias in sample selection. It estimates the cooperative membership model and outcome functions concurrently (Cong & Drukker 2000). The method also provides a direct marginal effect of participation in cooperatives on the outcome variables under study. The error terms in equations (1) and (3) (i.e., u_i and ε_i) of the treatment effect model are assumed to have a bivariate Gaussian distribution with a zero mean and correlation, such that $\rho_{\varepsilon u} = corr\ (\varepsilon_i, u_i\ )$. Selection bias due to unobservable factors arises if $\rho_{\varepsilon u}$ is significantly different from zero (Cong & Drukker 2000; Ma & Abdulai 2017). In a situation where $\rho_{\varepsilon u}$ is negative, it indicates a negative selection bias, suggesting that farmers with lower than mean net returns and farm revenue have a higher tendency of joining cooperatives (Ma & Abdulai 2017), the opposite is true for positive selection bias.

Following the framework of Ma and Abdulai (2017) and Cong and Drukker (2000), the expected outcomes for the i[th] farmer conditional on participation and non-participation can be expressed respectively as:

$$Z(Y_i|D=1) = \alpha X_i + \gamma + Z(u_i|D=1) = \alpha X_i + \gamma + \rho_{\varepsilon u}\delta_{\varepsilon u}\frac{\emptyset(K\alpha_i)}{\Phi(\mathrm{K}\alpha_i)} \qquad (4)$$

$$Z(Y_i|D=0) = \alpha X_i + Z(u_i|D=0) = \alpha X_i - \rho_{\varepsilon u}\delta_{\varepsilon u}\frac{\emptyset(K\alpha_i)}{1-\Phi(\mathrm{K}\alpha_i)} \qquad (5)$$

where $\emptyset(.)$ is the standard normal probability density function, $\Phi(.)$ the standard normal cumulative density function. The ratio of $\emptyset(.)$ and $\Phi(.)$ refers to the inverse Mills. α and γ are parameters to be estimated; and X_i is a vector of explanatory variables defined previously. The difference in expected farm revenue and net returns between the sample (N) of members and non-members (i.e., the difference between equations (4) and (5) known as the average treatment effect (ATE) can be estimated as:

$$ATE = N^{-1}\sum_{i=1}^{N}[Z(Y_i|D=1) - Z(Y_i|D=0)] \quad (6)$$

The treatment effects model requires at least an instrument to improve identification in the membership equation that does not appear in the outcome function. In particular, the instrument controls for unobservable attributes that may bias the impact of cooperative membership. In this study, distance to the nearest large market is used as an instrument. The instrument is expected to influence cooperative membership but should not directly affect outcome variables. Shiferaw et al. (2014) used a similar instrument in their study in Ethiopia. The study tested the instrument's validity through a probit model for the cooperative membership model and an OLS regression for the outcome variables. The validity test results show that the instrument affects cooperative membership ($LR(1)\chi^2 = 4.42, p = 0.035$) in equation (1) but is insignificant in the farm revenue function ($\mathrm{F} = 0.020, p = 0.878$ and $\mathrm{F} = 0.85, p = 0.358$) for members and non-members, respectively. Also, considering net returns as an outcome variable ($\mathrm{F} = 0.040, p = 0.849$ and $\mathrm{F} = 1.220, p = 0.273$) for members and non-members, respectively.

4.4.5. Endogenous switching regression model

One caveat of PSM is its inability to account for unobservable bias, which may lead to biased and varying estimates of the impact of cooperative membership. Following other recent empirical studies (e.g., Shiferaw et al. 2014; Mojo et al. 2017), the endogenous switching

regression (ESR) is employed to control unobservable bias in this study. The study estimates the ESR model following the "movestay" command of Lokshin and Sajaia (2004). The approach uses the full information maximum likelihood method to estimate two outcome functions conditional on a selection equation. Computation of endogenous switching regression (ESR) involves a two-stage approach. The first stage involves estimating the choice of cooperative membership through discrete-choice modelling. The second stage estimates two regime equations for cooperative members and non-members for the outcome variable under study. The model is as follows:

$$\text{Regime 1: } Y_{1i} = X_{1i}\beta_1 + \varepsilon_{1i}, if\ D_i = 1 \tag{7}$$

$$\text{Regime 2: } Y_{2i} = X_{2i}\beta_2 + \varepsilon_{2i}, if\ D_i = 0 \tag{8}$$

where Y_{1i} and Y_{2i} is outcome variable (i.e., farm revenue) in regimes 1 and 2, and X_i denotes a vector of covariates defined as previously, β is a vector of parameters to be estimated. The error elements in the selection and outcome equations are assumed to have a trivariate normal distribution, with a zero mean and covariance matrix expressed as:

$$\text{Cov}\,(\eta, \varepsilon_1\varepsilon_2) = \begin{bmatrix} \vartheta_\eta^2 & \vartheta_{\eta 1} & \vartheta_{\eta 2} \\ \vartheta_{1\eta} & \vartheta_1^2 & . \\ \vartheta_{2\eta} & . & \vartheta_2^2 \end{bmatrix} \tag{9}$$

where ϑ_η^2 is the variance of the disturbance term in the selection equation, ϑ_1^2 and ϑ_2^2 are the variances of the error terms in the outcome (farm revenue) functions, $\vartheta_{1\eta}$ and $\vartheta_{2\eta}$ denote the covariance of η_i and ε_{1i} and ε_{2i}. Because Y_{1i} and Y_{2i} are not observed concurrently, the covariance between ε_{1i} and ε_{2i} is not defined. Given that the error elements of the selection equation η_i correlate with the error terms of the outcome functions (i.e., ε_{1i} and ε_{2i}), the expected values of ε_{1i} and ε_{2i} conditional on the sample selection are nonzero (Di Falco et al. 2011). That is:

$$E[\varepsilon_{1i}|D_i = 1] = \vartheta_{1\eta}\frac{\emptyset(\beta_{i\alpha})}{\Phi(\beta_{i\alpha})} = \vartheta_{1\eta}\lambda_{1i}, \quad (10)$$

$$E[\varepsilon_{2i}|D_i = 0] = -\vartheta_{2\eta}\frac{\emptyset(\beta_{i\alpha})}{1-\Phi(\beta_{i\alpha})} = \vartheta_{2\eta}\lambda_{2i} \quad (11)$$

where $\emptyset(.)$ is the standard normal probability density function, $\Phi(.)$ the standard normal cumulative density function, and $\lambda_{1i} = \frac{\emptyset(\beta_{i\alpha})}{\Phi(\beta_{i\alpha})}$, and $\lambda_{2i} = \frac{\emptyset(\beta_{i\alpha})}{1-\Phi(\beta_{i\alpha})}$, where λ_{1i} and λ_{2i} are the Inverse Mills Ratio (IMR) was estimated from the selection equation (1) and incorporated in the outcome functions (7) and (8) to correct for selection bias in the endogenous switching regression. If the covariances $\vartheta_{1\eta}$ and $\vartheta_{2\eta}$ are statistically significant, then membership in cooperative and farm revenue are correlated, suggesting the existence of endogenous switching regression, hence rejecting the null hypothesis of the absence of sample selection bias. To identify the endogenous switching regression (ESR) model, the selection equation (1) should contain a selection instrument coupled with those generated by the non-linearity of the selection model of cooperative membership (Shiferaw et al. 2014; Mojo et al. 2017). In this regard, asset ownership and perception of economic benefit from cooperation represent the selection instruments (i.e., to improve identification). Asset ownership is believed to influence farmers' decisions to participate in the cooperative and is unlikely to affect farmers' farm revenue. Wossen et al. (2017) employed a similar instrument to analyse the impact of extension access and cooperative membership on technology adoption and household welfare in rural Nigeria. Similarly, cooperatives' perception of economic benefit is likely to influence farmers' decisions to join cooperatives but not farm revenue. The study tested the instrument's validity through a probit model for the cooperative membership model and an OLS regression for the outcome equations. The validity test results indicate that the instruments jointly influence the probability of cooperative membership ($LR(2)\chi^2 = 27.52, p = 0.000$) in the selection

equation but is insignificant in the farm revenue models ($F = 0.91, p = 0.404$ and $F = 0.11, p = 0.896$) for cooperative members and non-members, respectively.

The endogenous switching regression can estimate the average treatment effect on the treated (ATT) and untreated (ATU) in real and counterfactual scenarios. That is the expected outcomes of farm heads that are cooperative members (12) and non-members (13), as well as outcomes of members if they had not been cooperative members (14) and non-members if they had been members (15). The conditional expectation of farm revenue is as follows:

$$E(Y_{1i}|D_i = 1) = X_{1i}\beta_1 + \vartheta_{1\eta}\lambda_{1i} \quad (12)$$

$$E(Y_{2i}|D_i = 0) = X_{2i}\beta_2 + \vartheta_{2\eta}\lambda_{2i} \quad (13)$$

$$E(Y_{2i}|D_i = 1) = X_{2i}\beta_2 + \vartheta_{2\eta}\lambda_{2i} \quad (14)$$

$$E(Y_{1i}|D_i = 0) = X_{1i}\beta_1 + \vartheta_{1\eta}\lambda_{1i} \quad (15)$$

The predicted change in members, the effect of participation on the treated (ATT) and the predicted change in non-members and the effect of participation on the untreated (ATU) is estimated as the difference between (12) and (14) and (13) and (15) correspondingly.

$$ATT \;\; E(Y_{1i}|D_i = 1) - \; E(Y_{2i}|D_i = 1) \quad (16)$$

$$ATU \;\; E(Y_{1i}|D_i = 0) - \; E(Y_{2i}|D_i = 0) \quad (17)$$

4.4.6. Stochastic production frontier and sample selection

The stochastic production frontier (SPF) can be applied to model input-output relationships (production function) of businesses in various production sectors, including agriculture. The study estimates SPF conditional on a probit model of cooperative membership to examine the impact of agricultural cooperative membership on the yield and technical efficiency of smallholder potato farmers in rural Mongolia. Given that farmers self-select into

cooperative members and non-members, sample selectivity bias may arise from observable and unobservable attributes. The study adopts the sample selection stochastic frontier (SPF) approach proposed by Greene (2010) to control selection bias due to unobservable factors. The self-selection bias and SPF models, together with their error structures, can be expressed succinctly by two equations as follows:

$$\text{Sample selection: } D_i = 1[\alpha' Z_i + w_i > 0], w_i \sim N[0,1] \tag{18}$$

$$\text{Stochastic frontier model: } y_i = \beta' x_i + v_i - u_i, \tag{19}$$

where (y_i, x_i) $a$re observed only when $D_i = 1$

The error component is specified as follows: $\varepsilon_i = v_i - u_i$

$$u_i = |\sigma_u U_i| \text{ where } U_i \sim N(O,1)$$

$$v_i = \sigma_v V_i \; w_i \sim N[0,1] \text{ where } V_i \sim N(0,1)$$

$$(w_i, v_i) \sim N_2[(0,0), (1, \rho\sigma_v, \sigma_v^2)$$

where D is a dichotomous variable equal to one for cooperative members and zero for non-members, Z is a vector of variables incorporated in the selection equation and w_i is the unobservable error term. Additionally, y is the yield per hectare, x is a vector of inputs in the production frontier, and ε is the composed error term, v_i is noise component, u_i denotes technical inefficiency, and the coefficients α and β are the technology parameters to be estimated. In the above models, sample selection bias arises if there is a correlation between the noise in the stochastic frontier v_i and the error term w_i in the membership selection equation (Greene 2010). A statistically significant ρ indicates the presence of selection bias due to unobservable factors, while an insignificant ρ indicates the absence of selection bias due to unobservable factors. Readers can refer to Greene (2010) and Bravo-Ureta et al. (2012) for more details on the sample selection stochastic frontier and estimation. The Cobb–Douglas and the Translog production functions are the two common functional forms that are used in

efficiency studies (Bravo-Ureta et al. 2007). The Cobb–Douglas functional form is used in this study (see Table 20). The same framework is used to estimate the selectivity-corrected SPF model for non-members, in which case D in equation (1) equals 1 for non-members and 0 for members. Following the framework of Anang et al. (2017) and Ma et al. (2018), the production frontier for members is estimated using the Cobb-Douglas function as follows:

$$Log(Y_i) = \beta_0 + \sum_{j=1}^{5} \beta_j \, LogX + \mu_i D_i + (v_i - u_i) \tag{20}$$

where Y_i denotes yield of the i^{th} farmer; X represents a vector of production variables transformed into planting materials seed (tubers), labour, land, expenses and fertiliser. Zero input values of fertiliser were handled following a procedure developed by Battese (1997), such that the logarithm of fertiliser value is taken only if it is positive and zero otherwise and accordingly, a dummy variable to account for the non-use of fertiliser is included in the SPF model (Villano et al. 2015). The technical inefficiency element u_i is a linear function of socio-economic and plot-level factors illustrated in equation (21) as:

$$u_i = \alpha_o + \sum_{j=1}^{7} \alpha_j G_{ji} \tag{21}$$

where α_j is the coefficient of the explanatory variables and G_i denotes farm and socio-economic and plot-level factors that affect production efficiency: sex, age, education, credit constrained, crop diversity, irrigation, total farmland.

Aside from the functional forms considered and tested in the SFA analysis, the study also tested the effects of socio-economic and plot-level factors on farmers technical inefficiency in potato production in the Mongolian analysis. The study also tested if cooperative members and non-members have the same technology in agricultural production. This justifies using the sample selection stochastic production frontier developed by Greene

(2010) and makes it possible to control observed and unobserved selection biases in observational studies.

4.4.7. Stochastic meta-frontier

Meta-frontier analysis has become important in efficiency studies because it allows a direct comparison of technical efficiency estimates between groups, which is a limitation of the two methods described above because the technical efficiency estimates of the previous approach pertain to the groups' frontier (González-Flores et al. 2014; Villano et al. 2015). Following Amsler et al. (2017), meta-frontiers (the envelope of the group-specific frontiers) of cooperative members and their non-member peers are estimated by the stochastic frontier technique instead of the linear programming approach by Battese et al. (2004) and O'Donnell et al. (2008). The former approach is advantageous because it allows statistical interpretations (Huang et al. 2014). The meta-frontier (f_i) is conceptually denoted by a stochastic frontier model that envelops individual groups' frontier characterised by the i^{th} observations and the j^{th} group expressed (Amsler et al. 2017) as:

$$y_i = f\left(x_i', \beta_{j_i}\right) \exp(v_{i,j_i} - u_{i,j_i}), \tag{22}$$

where j_i is the group to which a farmer belongs, v_{i,j_i} is the statistical noise, and u_{i,j_i} denotes the non-negative one-sided technical inefficiency term. Given that farmers in j groups (j=1, 2) operate under a different technology denoted by a set of stochastic frontier models:

$$y_{ik} = x_i'\beta_k + v_{ik} - u_{ik} \tag{23}$$

where y_{ik} is observed for $k = j_i$ as generated by y_i , the meta-frontier with respect to the stochastic frontier can be written as:

$$f_{ik} = x_i'\beta_k + v_{ik}\,, k = 1, 2. \tag{24}$$

with $y_{ik} \leq f_{ik}$, indexes the meta-frontier expressed as:

$$f_i = \max\left[f_{i1}, \ldots, f_{iK}\right] \tag{25}$$

The ratio of the *j*'s group production frontier to the meta-frontier denotes the meta-technology gap ratio (MTR), which can be attributed to a farmer's choice of a technique based on either belonging to a cooperative or not is expressed as:

$$MTR_i^j = \frac{f^j}{f_i} \tag{26}$$

At any given input level X_i, a farmer's observed output y_i and the meta-frontier f_i can be separated into three components as:

$$\frac{f^j}{f_i} = MTR_i^j \times TE_i^j \times \exp(V_{ji}) \tag{27}$$

The three components correspondingly index the i^{th} farmer's MTR, technical efficiency and random noise. The MTR and technical efficiency are bounded between 1 and 0. The meta-technical efficiency (MTE) of the farmer in relation to the meta-frontier production technology of the *j*'s group is expressed as:

$$MTE = TE_i^j \times \text{MTR} \tag{28}$$

4.5. Description of variables in the study

Table 4 shows the non-economic indicators used to evaluate the social benefits of cooperative membership. Due to the limited written financial evidence and documentation of farmers, the cooperative members had to express their level of subjective agreement/disagreement (on a five-point Likert scale ranging from 0 = strongly disagree to 4 = strongly agree). This evaluation of non-economic benefits was done with farmers from Georgia and Moldova because the sectors could be compared, unlike Mongolia, where it was only one sector.

The second (continuation) part of Table 5 shows the operationalisation of the stochastic production frontier analysis variables. The output variable (yield) was normalised to give a share of the factor variables accurately. As a standard practice in econometrics, the input variables such as fertiliser, seeds, labour and expenses were all deflated against their geometric mean before performing the production function estimation relative to the assumptions of the production technology. In the case of multiple output technology, decision-making units are likely to adopt distance functions. However, the restrictive reporting of smallholder farmers has grave consequences on standard models' applications. Tables 6 and 7 present the descriptive statistics of variables used in the economic analysis and stochastic production frontier.

Table 4. Variables used in the evaluation of non-economic benefits

Variables	Definition (all statements are expressed as the subjective opinion of members about the change in the last three years)
Dependent variable "non-economic benefits"	
Improved service from input suppliers	Farmer's opinion on improved service from input suppliers on a scale of 0-4; strongly disagree – strongly agree
Access to market information	Farmer's opinion on access to market information on a scale of 0-4; strongly disagree – strongly agree
Improved extension services	Farmer's opinion on improved access to extension services on a scale of 0-4; strongly disagree – strongly agree
Better access to processing	Farmer's opinion on better access to processing on a scale of 0-4; strongly disagree – strongly agree
Access to information about good agricultural practices	Farmer's opinion on access to information about good farm practices on a scale of 0-4; strongly disagree – strongly agree
Increased opportunity for training	Farmer's opinion on increased opportunity for training on a scale of 0-4; strongly disagree – strongly agree
Better chance of sharing experiences with other farmers	Farmer's opinion on better chance of sharing experiences with other farmers on a scale of 0-4; strongly disagree – strongly agree
Increased opportunity to take part in community development	Farmer's opinion on increased opportunity to take part in community development on a scale of 0-4; strongly disagree – strongly agree

Table 5. Variables used in the economic analysis

Variables	Definition
Dependent variables	
Membership	1 if farmer is a cooperative member, 0 otherwise
Yield	Total yield of potato harvested (Kg/ha)
Farm revenue	The value of farm products (USD/ha)[a, b, c]
Net returns	Gross revenue minus variable costs (USD/ha)[a]
Farmer characteristics	
Gender	1 if the famer is male, 0 otherwise
Age	Age of farmer (years)
Household size	Number of household members
Education	Number of years of formal schooling by the farmer
Institutional factors	
Credit constrained	Farmer has access to farm credit
Extension visits	Total extension visits to the farmer per year
Plot-level factors	
Total farmland	Total farmland managed by farmer (ha)
Irrigation	1if the farmer uses irrigation, 0 otherwise
Crop diversity	Number of crop types a farmer cultivates
Farm size	Area of land under cultivation (ha)
Off-farm work	1if the farmer participates in off-farm work, 0 otherwise
Land ownership	1 if own land, 0 otherwise
Asset ownership	1 if the farmer owns a farm equipment, 0 otherwise
Social capital factors	
Perception	1 if the farmer perceives cooperative generates economic benefits, 0 otherwise
Trust	1 if the farmer trust other farmers in the area, 0 otherwise
Social network1	Annual neighbour effect on farming advice
Social network2	Number of siblings living nearby
Location factors	
Distance to market	Distance from farm to closest large market (km)
Location Western	1 if the farmer is located and farms in the Western region, 0 otherwise
Location Eastern	1 if the farmer is located and farms in the Eastern region, 0 otherwise
Location Central	1if the farmer is in located and farms in the Central region, 0 otherwise
Location Northwest	1 if the farmer is located and farms in the Northwest region, 0 otherwise
Location Southern	1 if the farmer is located and farms in the Southern region, 0 otherwise
Selenge Province	1 if the farmer is located and farms in Selenge province, 0 otherwise

Table 5. continued.

Variable	Definition
Tuv Province	1 if the farmer is located and farms in Tuv province, 0 otherwise
Darkhan-Uul Province	1 if the farmer is located and farms in Darkhan-Uul province, 0 otherwise
SPF model variables	Quantity of tubers planted (kg/ha)
Seed	
Fertiliser	Total quantity of fertiliser applied (kg/ha)
Labour	Total labour used in potato production (worker-days/ha)
Expense	Expenditures on insecticides and fungicides (USD)][c]

Notes: [a]1 USD = 2.615 Georgia Gel; [b]1 USD = 17.234 Moldovan Leu; [c]1 USD = 2,701.17 Tughrik (MNT).

Table 6. Descriptive statistics of variables used in the econometric analysis

Variables	Georgia			Moldova			Mongolia		
	Pooled	Members	Non-members	Pooled	Members	Non-members	Pooled	Members	Non-members
Farm revenue	5,993.32	7,213.39	5,023.52	7,307.19	9,343.51	5,218.53	1,594.68	2,079.02	1,185.12
	(3,079.43)	(3,460.61)	(2,333.54)	(2,995.30)	(2,480.11)	(1,718.31)	(1,054.20)	(1,159.10)	(744.77)
Net returns	5,552.25	6,539.02	4,767.89						
	(3,104.69)	(3,613.81)	(2,368.16)						
Gender	0.69	0.72	0.67	0.69	0.75	0.63	0.43	0.39	0.47
	(0.46)	(0.45)	(0.47)	(0.46)	(0.43)	(0.49)	(0.50)	(0.49)	(0.50)
Age	47.85	46.66	48.79	47.34	47.92	44.97	46.88	48.28	45.71
	(11.60)	(10.93)	(12.08)	(10.78)	(10.25)	(10.19)	(10.50)	(11.06)	(9.89)
Household size	3.52	3.80	3.30	3.72	3.53	3.97	3.54	3.24	3.79
	(1.08)	(1.06)	(1.05)	(1.70)	(1.27)	(1.26)	(1.31)	(1.20)	(1.35)
Education	13.07	13.77	12.51	11.12	12.09	11.49	11.13	11.50	10.81
	(2.39)	(1.55)	(2.77)	(2.84)	(2.77)	(3.25)	(3.52)	(3.46)	(3.55)
Credit constrained							0.57	0.55	0.60
							(0.50)	(0.50)	(0.49)
Extension visits	2.48	3.22	1.90						
	(1.68)	(1.71)	(1.40)						
Total farmland							3.31	3.62	3.06
							(1.55)	(1.63)	(1.14)
Irrigation							0.81	0.85	0.77
							(0.39)	(0.36)	(0.42)
Crop diversity							3.86	3.55	4.13
							(2.10)	(1.93)	(2.21)
Farm size	1.38	1.51	1.29	2.91	3.14	2.67	2.18	2.24	2.12
	(0.85)	(1.08)	(0.61)	(1.10)	(1.20)	(0.93)	(1.70)	(1.75)	(1.65)
Land ownership				0.81	0.61	0.68	0.43	0.43	0.28
				(0.39)	(0.49)	(0.47)	(0.50)	(0.50)	(0.45)
Asset ownership	0.68	0.73	0.63	0.90	0.97	0.82			
	(0.47)	(0.45)	(0.48)	(0.30)	(0.17)	(0.39)			

Table 6. continued.

Variables	Georgia			Moldova			Mongolia		
	Pooled	Members	Non-members	Pooled	Members	Non-members	Pooled	Members	Non-members
Perception	0.78	0.97	0.62	0.93	0.92	0.94	0.79	0.93	0.68
	(0.42)	(0.18)	(0.48)	(0.25)	(0.27)	(0.24)	(0.41)	(0.26)	(0.47)
Trust	0.65	0.77	0.56	0.88	0.96	0.79			
	(0.48)	(0.42)	(0.50)	(0.33)	(0.19)	(0.41)			
Social network1	9.46	11.57	7.79						
	(6.64)	(8.24)	(4.40)						
Social network2				4.22	2.24	1.14			
				(1.59)	(1.48)	(1.21)			
Distance to market	21.85	23.56	20.49	28.85	33.51	30.22	23.47	25.37	21.87
	(10.58)	(11.72)	(9.41)	(13.11)	(14.36)	(12.48)	(8.89)	(9.8)	(7.71)
Western	0.71	0.71	0.72						
	(0.45)	(0.46)	(0.45)						
Eastern	0.15	0.29	0.28						
	(0.36)	(0.46)	(0.45)						
Central				0.56	0.55	0.56			
				(0.50)	(0.50)	(0.50)			
Northwest				0.21	0.25	0.18			
				(0.41)	(0.43)	(0.39)			
Southern				0.23	0.20	0.26			
				(0.42)	(0.40)				
Selenge							0.44	0.54	0.35
							(0.50)	(0.50)	(0.48)
Tuv							0.32	0.22	0.40
							(0.47)	(0.41)	(0.49)
Darkhan-Uul							0.24	0.24	0.24
							(0.43)	(0.43)	(0.43)
Observations	210	93	117	205	105	100	251	115	136

Notes: Standard deviations in parentheses.

Table 7. Descriptive statistics of input and output variables of the stochastic frontier model.

Variables	Pooled		Members		Non-members	
	Mean	SD	Mean	SD	Mean	SD
Yield	7,630.80	4,566.62	9,121.74	5,129.51	6,370.07	3,592.34
Seed	325.48	181.85	373.77	171.06	284.65	181.28
Land	2.18	1.70	2.242	1.75	2.12	1.66
Fertiliser	134.15	136.06	141.81	118.99	127.67	149.10
Labour	56.56	21.73	50.21	19.19	61.93	22.36
Expense	687.23	619.96	666.38	659.48	703.40	586.50
Observations	251		115		136	

4.6. Tools for data analysis and hypotheses testing

All the models in the analysis are estimated using STATA version 14 and LIMDEP version 11. Analysis of variance (ANOVA), specifically one-way ANOVA, was used to compare the sectors regarding members' subjective opinions of the non-economic benefits generated by cooperatives (see Table 4). The study used one-way ANOVA to compare the various sectors (except in the case of Mongolia) and to test the difference between the mean values of the various sectors. The Shapiro-Wilk normality test indicated that the various sectors passed the normality assumption. In addition, the Breusch-Pagan test for heteroscedasticity between the sector variables was rejected, thus allowing the application of a parametric test (one-way ANOVA in this study). There has not been a consensus in the literature on whether parametric tests like ANOVA is unsuitable for Likert scale variables. Once the Likert scale variable meets the assumptions of parametric tests, it will behave more like an interval-scale measurement, and thus, a parametric test could be applied. The t-test statistic was employed to compare differences in farm yield, farm revenue and net returns between cooperative members and their non-member counterparts.

The study fitted the hypotheses using the binary probit regression and the generalised likelihood ratio (LR) test. The LR test is relevant only for the SFA or methods using the maximum likelihood estimator. Generally, the LR test is of the form:

$$LR = -2 * (InL_p - (InL_m + InL_{nm})) \quad (29)$$

where InL_p, InL_m and InL_{nm} denote the log-likelihood function values obtained from the pooled SPF model and the two separate SPF models for cooperative members and non-members respectively.

5. Chapter 5 Results

5.1. Introduction

Chapter five presents the results of the econometric models outlined in the methodology and the characteristics and administration of the cooperatives in the three countries. The results are presented separately for each country.

5.2. Group characteristics and governance in the three countries

Table 8 presents the results of the group characteristics and governance of cooperatives in the three countries. As shown, all the cooperatives are producer groups that produce and market their products. Apart from Georgian and Moldovan cooperatives, females dominate cooperatives in Mongolia. In addition, most of the cooperatives have a limited number of young farmers, which is even more evident in Moldovan cooperatives. The oldest cooperative in the three countries was established in 2002, while the youngest was in 2018, suggesting that all the farmer groups are 21st-century cooperatives. In terms of the channel of sales, there exist two common channels of marketing among the cooperatives in the three countries, that is own selling option and selling through the cooperatives. As illustrated in Table 8, all the cooperatives in the three countries have similar governance structures. Decision-making processes in the cooperatives are taken together by the group executives and members. The results show that all the cooperatives in the three countries meet at least once per week to deliberate on group matters.

Table 8. Cooperatives group characteristics and governance

Indicator/Country	Georgia	Moldova	Mongolia
Type of cooperative	Producer & marketing cooperatives	Producer & marketing cooperatives	Producer & marketing cooperatives
Main product	Honey, hazelnut & grape	Walnut, plum & apple	Potato
Total membership	370	206	481
Gender composition	Males (72%), females (38%)	Males (75%), females (25%)	Males (39%), females (61%)
Youth	22%	19%	21%
Channel of sales	Own selling and via cooperatives	Own selling and via cooperatives	Own selling and via cooperatives
Buyers	Farmgate sales, supermarkets, mini-shops, restaurants, wholesalers, local traders and consumers	Farmgate sales, traders from small and big cities	Farm gate sales, local traders and consumers
Year of establishment	Min (2014) Max (2013)	Min (2012) Max (2005)	Min (2018) Max (2002)
Frequency of meeting	Min (once per year) Max (once per week)	Min (twice per year) Max twice per week	Min (once per year) Max (once per week)
Decision making	Board members and members	Leaders and board members	Leaders and members
External support	ENPARD - Tractor, processing and storage equipment, funds and training	-	-

Source: Key informant interviews with group executives, 2018 and 2019.

5.3. Results – Georgia

5.3.1. Sectoral assessment of non-economic benefits of cooperation

Table 9 presents the results of the non-economic benefits of cooperative membership in Georgia. Members of all the three sectors agreed on positive non-economic benefits from cooperation (with an overall mean larger than 2, on the Likert scale of 0-4). Farmers especially appreciate the chance to share experiences with other farmers, increased opportunities for training, and access to information about good agricultural practices. However, the subjective opinions of grape cooperatives indicate that they have significantly increased their chance to participate in community development projects compared to the honey and hazelnut sectors. The respective statistical significance confirms the results in the fifth column in descending magnitude.

Table 9. The evaluation of non-economic benefits of cooperation by members in Georgia.

Non-economic indicators *(0 – full disagreement, 4 – full agreement)*	Grapes (G) Mean	Hazelnuts (Ha) Mean	Honey (Ho) Mean	ANOVA
Improved service from input suppliers	2.93 (0.83)	2.70 (1.09)	2.56 (1.03)	0.347
Access to market information	2.96 (0.85)	2.63 (0.96)	2.92 (1.11)	0.385
Improved extension services	2.56 (0.97)	2.40 (1.25)	2.81 (1.12)	0.337
Better access to processing	2.93 (0.83)	2.37 (1.19)	2.86 (1.02)	0.076* (G, Ho>Ha)
Access to information about good agricultural practices	3.19 (0.68)	2.73 (1.28)	3.28 (0.91)	0.074* (G, Ho>Ha)
Increased opportunity for training	3.19 (0.92)	3.03 (1.25)	3.06 (1.04)	0.849
Better chance of sharing experiences with other farmers	3.44 (0.70)	3.47 (0.90)	3.39 (0.90)	0.928
Increased opportunity to participate in community development	3.11 (0.70)	2.13 (1.43)	2.31 (1.09)	0.003** (G, Ho>Ha)
Overall	3.11 (0.80)	2.88 (0.98)	3.06 (0.93)	

Notes: * and ** denote significance levels at 10% and 5%, respectively. Standard deviations in parentheses. Notations G, Ho and Ha, denote grapes, honey and hazelnut sectors in descending order of statistical significance.

5.3.2. Choice of cooperative membership and farm economic performance

The results of the ATE of cooperative membership in the context of participation and nonparticipation, computed from equation (6), are presented in Table 10. As shown, cooperative membership increases farm revenue by 32.9% and net returns by 27.8%. The result indicates that participation in cooperatives leads to higher farm outcomes.

Table 10. Average treatment effect of cooperative membership on farm outcomes in Georgia.

Outcome variables	Observations	Members	Non-members	ATE	t-value	change (%)
Farm revenue	210	6,980.36	5,253.51	1,726.852***	15.78	32.9
Net returns	210	6,323.85	4,949.31	1,374.55***	12.30	27.8

Notes: *** denote significance level at 1%. The outcome variables is measured in USD/ha. ATE indicates the average treatment effects.

Tables 11 and 12 show the estimates of the cooperative membership choice model and the economic impact of cooperation on performance indicators. The estimation results show that the residual coefficient of the potential endogenous variable (extension visits) predicted from the first stage probit regression is statistically insignificant, suggesting that extension visits are not endogenously determined in farmers' decisions to participate in cooperatives. The results show that farmers' educational status, household size, distance to market and visits by extension agents significantly affect farmers' decisions to join cooperatives. Accordingly, social networks and trust also positively affect participation in cooperatives.

Concerning the impact of participation on members' economic performance, the results show that the coefficients of $\rho_{\varepsilon u}$ are significantly different from zero, suggesting the presence of sample selectivity bias arising from unobservable characteristics. The negative sign of $\rho_{\varepsilon u}$ suggests that farmers who obtain lower farm revenues and net returns relative to the sample average have a higher probability of participating in the cooperatives. Moreover, the null hypothesis for $\rho_{\varepsilon u} = 0$ is rejected at the 5% and 1% levels, suggesting a correlation between the cooperative membership model and the outcome variables.

Tables 11 and 12 show the treatment effects model results in the third column, next to the OLS model for comparison. It shows that participation in cooperatives has a positive and statistically significant impact on farm revenue and net returns with a marginal effect of 5,591.629 USD and 4,781.131 USD, respectively. Relative to the average values of the pooled sample in the second column in Table 6, these marginal effects reflect an increase in farm revenue of 92.3% and net returns of 86.1%. Compared with the OLS model's marginal effects, the OLS model's marginal effects are significantly smaller than that reported in the treatment effects model. Clearly, it shows that the OLS model underestimates the impact of cooperative membership on farm outcomes. Similarly, a comparison of the ATE estimates from the propensity score matching (PSM) estimation approach at the lower part of Tables 11 and 12 shows that the ATE values are lower than the values estimated by the treatment effects model in Table 10. This finding suggests that unobservable attributes affect the choice of participation and performance indicators, resulting in negative selection bias leading to an underestimated ATE in the PSM estimates.

The results further show that education tends to have a negative and significant impact on farm revenue and net returns. Similarly, social networks and the perception of the benefits from cooperation negatively affect farm revenue and net return.

Table 11. Impact of cooperative membership on farm revenue in Georgia.

Variables	Treatment effects model		OLS
	Participation in cooperatives	Farm revenue	Farm revenue
Membership		5,591.629 (1,449.976)***	2,374.066 (472.093)***
Gender	-0.374 (0.314)	-111.302 (478.622)	-225.394 (447.299)
Age	-0.010 (0.010)	41.263 (18.439)**	36.833 (16.423)**
Education	0.127 (0.062)**	-347.647 (93.588)***	-243.755 (75.028)***
Household size	0.427 (0.114)***	-316.099 (246.818)	1.598 (183.979)
Asset ownership	0.156 (0.276)	654.010 (518.259)	766.755 (467.484)
Extension visits	0.301 (0.067)***	-18.946 (190.123)	249.066 (146.176)*
Farm size	0.075 (0.118)	-232.623 (227.626)	-138.931 (215.737)
Social network	0.072 (0.020)***	-93.947 (33.900)***	-51.142 (29.339)*
Perception	0.296 (0.269)	-803.739 (466.071)*	-628.236 (425.277)
Trust	0.725 (0.210)***	-51.888 (479.116)	589.241 (404.503)
Region	0.233 (0.230)	-30.041 (504.927)	88.841 (438.854)
Residual (extension visits)	0.474 (1.306)		
Market distance	0.025 (0.009)***		
Constant	-5.996 (1.080)***	8,697.854 (2,146.984)***	6,041.283 (1,611.251)***
ath ($\rho_{\varepsilon u}$)	-0.821 (0.338)**		
$\rho_{\varepsilon u}$	-0.676 (0.184)**		
Ln(δ)	8.008 (0.095)***		
R-squared			0.229
Wald test ($\rho_{\varepsilon u} = 0$)	7.340***		
ATE (PSM)[a]	1,545 (410.485)***		
Observations	210		

Notes: *, ** and *** denote significance levels at 10%, 5% and 1%, respectively. The outcome variable (farm revenue) is in USD/ha. [a] ATE (PSM) is the average treatment effects estimated by propensity score matching model, using the teffects psmatch command in Stata. Robust standard errors in parentheses.

Table 12. Impact of cooperative membership on net returns in Georgia.

Variables	Treatment effects model		OLS
	Participation in cooperatives	Net returns	Net returns
Membership		4,781.131 (1,974.399)***	1,962.177 (494.322)***
Gender	-0.295 (0.300)	-274.517 (469.693)	-374.475 (456.667)
Age	-0.010 (0.010)	52.577 (18.084)***	48.626 (16.685)***
Education	0.142 (0.063)**	-341.622 (85.959)***	-250.601 (73.027)***
Household size	0.427 (0.115)***	-281.206 (235.096)	-2.867 (190.334)
Asset ownership	0.203 (0.277)	624.558 (508.022)	723.336 (474.773)
Extension visits	0.302 (0.068)***	-0.127 (176.447)	234.682 (152.595)
Farm size	0.092 (0.121)	-153.408 (240.719)	-71.323 (227.603)
Social network	0.073 (0.020)***	-82.084 (31.236)***	-44.582 (28.695)
Perception	0.360 (0.276)	-803.617 (471.329)*	-649.856 (442.837)
Trust	0.728 (0.216)***	138.378 (451.104)	700.081 (411.077)*
Region	0.241 (0.232)	14.317 (491.105)	118.472 (442.538)
Residual (extension visits)	0.015 (1.357)		
Market distance	0.026 (0.009)***		
Constant	-6.048 (1.074)***	7,584.900 (1,974.399)***	5,257.438 (1,601.076)***
ath ($\rho_{\varepsilon u}$)	-0.686 (0.237)***		
$\rho_{\varepsilon u}$	-0.595 (0.153)***		
Ln(δ)	8.008 (0.075)***		
R-squared			0.199
Wald test ($\rho_{\varepsilon u} = 0$)	6.420**		
ATE (PSM)[a]	1,042.409 (431.388)**		
Observations	210		

Notes: *, ** and *** denote significance levels at 10%, 5% and 1%, respectively. The outcome variable (net returns) is in USD/ha. [a] ATE (PSM) is the average treatment effects estimated by propensity score matching model, using the teffects psmatch command in Stata. Robust standard errors in parentheses.

5.4. Results – Moldova

5.4.1. Sectoral assessment of non-economic benefits of cooperation

Table 13 shows the results comparing the social benefits derived from cooperatives among the three selected sectors in Moldova. The members agreed that there are positive non-economic benefits from cooperation (with an overall mean greater than 3, on the Likert scale of 0-4). Farmers especially appreciate the chance to share experiences with other farmers, increased opportunities for training, access to information about good agricultural practices, and market information. The respective statistical significance confirms the results in the fifth column in descending magnitude.

Table 13. The evaluation of non-economic benefits of cooperation by members in Moldova.

Non-economic indicators *(0 – full disagreement, 4 – full agreement)*	Walnuts (W) Mean	Plums (P) Mean	Grapes (G) Mean	ANOVA
Improved service from input suppliers	2.65 (1.18)	2.55 (1.23)	2.44 (1.13)	0.783
Access to market information	3.90 (0.31)	3.79 (0.60)	3.56 (0.98)	0.183
Improved extension services	3.35 (1.23)	3.00 (1.30)	3.19 (1.14)	0.575
Better access to processing	3.20 (1.15)	2.58 (1.64)	2.35 (1.64)	0.121
Access to information about good agricultural practices	3.45 (1.36)	3.88 (0.42)	3.87 (0.49)	0.066* (P, G>W)
Increased opportunity for training	3.60 (0.99)	3.85 (0.71)	3.81 (0.56)	0.434
Better chance of sharing experiences with other farmers	3.70 (0.85)	3.64 (0.75)	3.75 (0.67)	0.657
Increased opportunity to participate in community development	3.15 (1.04)	2.97 (1.21)	2.83 (1.25)	0.581
Overall	3.38 (0.39)	3.28 (0.57)	3.23 (0.62)	

Notes: * denote significance level at 10%. Standard deviations are reported in parentheses. Notations G, W and P denote grapes, walnut and plums sectors in descending order of statistical significance.

5.4.2. Cooperative participation decision

Table 14 shows the results of the probit regression model with membership status as the dependent variable. The chi-square test statistics ($LR\chi^2(15) = 93.882$) indicate that the parameter estimates jointly influence cooperative membership decisions at the 1% significance level. The results show that being male and having larger farmland influence farmers' participation decisions in cooperatives. The results further show that trust, the number of siblings living close by, and the perception that cooperative membership generates economic benefits also exhibit a positive and significant effect on participation decisions. Conversely, larger households are less likely to participate in cooperatives, as confirmed by the negative coefficient of the household size variable.

The marginal effect of the variable asset ownership also increases the probability of membership by 37%. Similarly, distance to output markets increases participation by 0.4%. The size of the farm also increases the tendency of cooperative membership by 5.2%. Relative to the south (reference region), farmers in the northwest region are more likely to participate in cooperatives. The result suggests that geographic effect plays a role in farmers decisions to participate in cooperatives.

Table 14. Probit model estimates of cooperative membership in Moldova.

Variables	Coefficients	Standard error	Marginal effects	Standard error
Constant	-5.012***	1.194		
Gender	0.699***	0.241	0.183***	0.061
Age	0.002	0.011	0.0004	0.003
Education	0.008	0.033	0.002	0.009
Household size	-0.199**	0.081	-0.052**	0.020
Household farm workers	0.037	0.111	0.010	0.029
Farm size	0.197**	0.101	0.052**	0.002
Market distance	0.014*	0.008	0.004*	0.002
Trust	1.254***	0.425	0.328***	0.097
Social network	0.398***	0.079	0.104***	0.017
Off-farm work	0.040	0.240	0.011	0.063
Land ownership	-0.139	0.231	-0.036	0.060
Northwest	0.653*	0.345	0.171**	0.087
Central	0.351	0.296	0.092	0.075
Asset ownership	1.417***	0.466	0.370***	0.111
Perception	0.863***	0.286	0.225***	0.067
Pseudo-R^2	0.339			
LR χ^2 (15)	93.882***			
Observations	205			

Notes: *, ** and *** denote significance levels at 10%, 5% and 1%, respectively. Robust standard errors reported. The reference region is south

Table 15 reports the estimates of the effect of participation by the five-nearest neighbour matching. The results show the presence of a positive and statistically significant effect of membership on farm revenue. Notably, cooperative membership tends to increase farm revenue by 63.2 %.

Table 15. The average impact of cooperative membership on farm revenue in Moldova.

Outcome variable	Members	Non-members	ATT	Std. error
Farm revenue	9,494.928	5,818.234	3,676.693***	551.905

Notes: *** denote significance levels at 1%. The outcome variable (farm revenue) is in USD/ha. Nearest neighbour (tolerance level = 0.015). The matched sample includes 77

members and 100 non-members from a matching estimator and a common support condition. Standard errors are estimated using bootstrap with 200 replications.

5.4.3. Estimation results of the endogenous switching regression

Table 16 shows the effect of participation and its heterogeneous effects under actual and counterfactual scenarios. As shown, cooperative members would have accumulated 3,272.280 USD (i.e., 53.9%) less had they not been cooperative members, thus the effect of participation on members (ATT). Similarly, individuals who are non-members would have earned about 4,999.023 USD (i.e., 95.8%) more if they had been cooperative members.

Table 16. Average expected farm revenue; heterogeneity and participation effect in Moldova.

	Decision-making phase		
Sub-sample	To be a member	Not to be a member	Effects of participation
Members	9,339.478	6,067.198	ATT = 3,272.280***
	(111.884)	(93.721)	(14.243)
Non-members	10,216.130	5,217.107	ATU = 4,999.023***
	(209.530)	(79.659)	(22.416)
Diff[a]	HE_1 = -876.113***	HE_2 = 850.091***	HE_3 = -1,726.743***
	(234.412)	(123.560)	(2.610)

Notes: *** denote significance level at 1%, respectively. The outcome variable (farm revenue) is in USD/ha. Standard errors in parentheses; [a] denote t-test of difference between actual and counterfactual scenarios of members and non-members. HE - transitional heterogeneity. Subsample size: cooperative members 105, non-members 100

Table 17 presents the estimates of the endogenous switching regression estimated by the full information maximum likelihood. As Table 17 shows, the correlation coefficients (ρ_j) between the farm revenue function and the selection equation is negative and significantly different from zero only for cooperative members. The result indicates the presence of sample selectivity bias and, if not accounted for, will lead to bias and inconsistent estimates of the impact of cooperative membership. In addition, the likelihood ratio test for the joint significance of the

three equations for the farm revenue (LR χ^2 = 4.73, p = 0.05) shows that the error term of the selection equation and the error terms of the outcome equations are correlated.

The coefficient of gender exhibits a negative and significant effect on farm revenue for both members and non-members. The results also show that household agricultural workers decrease the farm revenue of cooperative members. However, the variable representing education increases farm revenue. Regarding location variables, the result indicates that non-members in the northwest region tend to obtain lower farm revenue than their peers in the south (reference region).

Table 17. Endogenous switching regression estimates of farm revenue in Moldova.

Variables	Members		Non-members	
	Coefficient	Standard error	Coefficient	Standard error
Constant	14,507.910***	2,506.955	5,114.963***	1,608.809
Gender	-1,943.927***	626.703	-1,580.687***	500.055
Age	-9.552	26.097	5.608	18.167
Education	248.942***	76.986	16.153	49.097
Household size	-36.620	193.985	47.982	134.420
HH farm workers	-406.177*	227.116	229.085	186.103
Farm size	-245.908	208.212	-324.553	211.645
Market distance	-14.955	17.303	11.732	13.494
Trust	-3,503.368***	1,221.393	940.783*	504.365
Social network	-257.436	160.103	-183.958	203.377
Off-farm work	303.575	552.547	419.488	413.703
Land ownership	925.496	450.207	-64.714	387.087
Northwest	-95.762	664.433	-1,601.025**	694.362
Central	-337.183	654.164	-648.934	424.963
ρ_j	-0.558**	0.285	-0.461	0.549
Observations	105		100	

Notes: *, ** and *** denote significance levels at 10%, 5% and 1%, respectively. The outcome variable (farm revenue) is measured in USD/ha.

Robust Standard errors reported. The reference region is south.

5.5. Results – Mongolia

5.5.1. Determinants of participation in farmers' cooperatives

Table 18 shows the estimates of the probit selection model using the matched sample. The chi-square test statistic is significant at the 1% level, implying the joint significance of the parameters for participation in cooperatives. The household size variable has a negative and significant effect on the probability of being a member of a cooperative. The finding suggests that households with a larger family size tend to participate less in cooperatives. As reported in Table 18, farmers with more farmlands tend to participate more in cooperatives than smaller farmland owners.

Accordingly, the educational status of the farmer increases the probability of cooperative membership by 2.4%, suggesting that farmers who are aware of and understand cooperatives and their potential benefits are more likely to join agricultural cooperatives. Distance to market also shows a positive and statistically significant effect on participation in cooperatives. The results also show that farmers who cultivate different types of crops are less likely to join cooperatives. Regarding participation in off-farm work, farmers who participate in off-farm work have about a 14.8% higher probability of participating in cooperatives. Relative to Darkhan-Uul, farmers located in Selenge are more likely to participate in cooperatives, suggesting that geographic location play a role in farmers' decision to participate in agricultural cooperatives. The estimated results also show that the residuals of the off-farm work and crop diversity variables are not statistically significant, suggesting that there is no causality bias between off-farm work, crop diversity and cooperative membership decision.

Table 18. Probit model estimates of determinants of cooperative membership in Mongolia.

Variables	Coefficients	SE	Marginal effects	SE
Constant	-3.709*	1.931		
Gender	0.206	0.340	-0.063	0.104
Age	0.006	0.012	0.002	0.004
Household size	-0.150**	0.070	-0.046**	0.021
Education	0.078**	0.033	0.024**	0.010
Credit constrained	-0.062	0.198	-0.019	0.060
Total farmland	0.207***	0.076	0.063***	0.022
Distance to market	0.034*	0.019	0.010*	0.006
Irrigation	-0.380	0.435	-0.116	0.133
Crop diversity	-0.123**	0.050	-0.038**	0.015
Off-farm work	0.485**	0.211	0.148**	0.062
Land ownership	0.182	0.264	0.055***	0.080
Selenge province	0.565**	0.278	0.172**	0.083
Tuv province	0.088	0.549	0.027	0.168
Perception	1.104***	0.267		
Off-farm work (residual)	-1.617	1.640		
Crop diversity (residual)	0.473	0.320		
Log Likelihood	-121.852			
LR Chi^2 (16)	49.690***			
Observations	227			

Notes: *, ** and *** represent significance level at the 10%, 5% and 1% respectively. Robust standard errors reported. The reference province is Darkhan-Uul.

Before presenting the results of the stochastic production frontier, it is appropriate to present the results of the hypotheses relating to the SFA analysis – test of the presence of technical inefficiency in potato production, the choice of functional form and test of homogeneity of technology between cooperative members and non-members (i.e., estimation of a single production frontier). The generalised likelihood ratio test was employed to test if socio-

economic and plot-level factors affect the presence of technical inefficiency in potato production. The null hypothesis that the socio-economic and plot-level factors do not elucidate the presence of technical inefficiency in potato production was rejected, suggesting that technical inefficiency played a significant role in observed output variability in potato production (Table 19).

Table 19. Test of presence of technical inefficiency in potato production in Mongolia

Sample	Null Hypothesis	Log Likelihood Function (H_0)	Test Statistic	Critical Value	Decision
Unmatched sample					
Pooled	$H_0: all\ \alpha_j = 0$	-194.915	14.48**	11.383 (7)	Reject H_0: technical inefficiency present
Members		-71.076	15.490**		Reject H_0: technical inefficiency present
Non-members		-114.558	16.760**	11.383 (7)	Reject H_0: technical inefficiency present
Matched sample					
Pooled	$H_0: all\ \alpha_j = 0$	-177.164	12.960*	11.383 (7)	Reject H_0: technical inefficiency present
Members		-62.877	13.250*		Reject H_0: technical inefficiency present
Non-members		-104.471	14.290**	11.383 (7)	Reject H_0: technical inefficiency present

Notes: Critical values are at 10% and 5% significance level and obtained from χ^2 distribution table. Figures in brackets are number of restrictions.

The third hypothesis tests the choice of function form for the stochastic production frontier, specifically, the Translog functional form (H_A) against the Cobb-Douglas (H_0). The results show that the Cobb–Douglas was preferred over the Translog by the maximum likelihood ratio test (Table 20).

Table 20. Test of choice of functional form of the conventional stochastic production frontier.

Sample	Null Hypothesis	Log Likelihood Function (H_0)	Test Statistic	Critical Value	Decision
Unmatched sample					
Pooled	$H_0: \beta_j = 0$	-198.696	18.590	30.578 (15)	Do not reject H_0: Cobb-Douglas appropriate
Matched sample					
Pooled	$H_0: \beta_j = 0$	-181.356	17.970	30.578 (15)	Do not reject H_0: Cobb-Douglas appropriate

Notes: Critical values are obtained from χ^2 distribution table. Figures in brackets are number of restrictions.

The fourth hypothesis tests the estimation of separate stochastic production frontiers for cooperative members and non-members relative to the pooled. The null hypothesis is that the pooled sample is not statistically different from the subsamples of cooperative members and non-members. The result in Table 21 rejects the null hypothesis favouring the estimation of separate SPFs for cooperative members and non-members in both the unmatched and matched samples.

Table 21. Test of estimation of separate SPF for cooperative members and non-members.

Null Hypothesis	Log Likelihood Function (H_0)	Test Statistic	Critical Value	Decision
Unmatched sample				
$H_0: lnL_P = lnL_M = lnL_{NM}$	-187.675[a]	36.330***	30.578 (15)	Reject H_0: separate SPF appropriate
Matched sample				
$H_0: lnL_P = lnL_M = lnL_{NM}$	-170.685[b]	34.210***	30.578 (15)	Reject H_0: separate SPF appropriate

Notes: Critical values are at 1% significance level and obtained from χ^2 distribution table. Figures in brackets are number of restrictions. [a] and [b] are the log likelihood values for the pooled.

5.5.2. Stochastic production frontier estimates

The maximum likelihood estimates of the unmatched and matched samples relative to the conventional stochastic production frontier vis-à-vis selectivity-corrected SPF models are presented in Tables 22 and 23, respectively. Since the results of the unmatched sample are prone to observable and unobservable selection bias, the results of the matched sample are, in this case, discussed. All estimated models show positive partial production elasticities with different levels of statistical significance and magnitudes except for fertiliser and seeds in the separate frontiers. These results are consistent with the Cobb-Douglas production frontier estimates reported by Olagunju et al. (2021). The null hypothesis of similar technology between cooperative members and non-members (i.e., estimation of the common pool) was rejected in a likelihood ratio test ($LR\chi^2(15) = 34.210, P < 0.01$) validating the estimation of separate SPFs over the pooled sample. The results show that the coefficient of cooperative membership is positive and statistically significant at the 1% level, suggesting that cooperative membership tends to increase potato yields.

In the separate SPF estimation results, the variables land, seed, fertiliser and expenditure on insecticides and fungicides contribute the most to potato yield for cooperative members after controlling for observable and unobservable bias. For example, a 100% increase in fertiliser, ceteris paribus, would increase yield by approximately 25.9% at the conventional level. For non-members, the variable with the highest output elasticity is the use of seeds. In the estimation of the sample selection SPF models, the coefficient for the selectivity variable $\rho_{(w,v)}$ is significantly different from zero at 5% levels for cooperative members, which indicates the presence of sample selectivity bias due to unobserved attributes.

The inefficiency component in Table 23 shows the estimates of the determinants of technical inefficiency in potato production. Variables with negative coefficients have a negative relationship with technical inefficiency and thus a positive effect on technical efficiency and vice versa.

Regarding cooperative members, gender (i.e., being male) increases their technical efficiency in potato production. Female farmers among the cooperative members were less technically efficient compared to their male counterparts.

Conversely, irrigation and total farmland under farmers' control negatively influence the cooperative members' technical efficiency.

The determinants of technical inefficiency for the non-members include the age of the farmer and total farmland. As expected, the accumulated experience of older farmers is likely to influence their production efficiency compared to younger farmers. The negative correlation coefficient between total farmland and technical inefficiency indicates that non-members with more farmlands are more technically efficient than those with smaller farmlands.

Table 22. Maximum likelihood estimates of the conventional and sample selection SPF models for the unmatched sample in Mongolia.

Variables	Conventional SPF						Sample selection SPF			
	Pooled		Members		Non-members		Members		Non-member	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Constant	9.113***	0.111	9.522***	0.123	9.083***	0.092	9.449***	0.152	9.140***	0.155
In (land)	0.004	0.070	0.153	0.113	0.024	0.086	0.198***	0.069	0.033	0.090
In (seed)	0.163*	0.094	-0.022	0.151	0.270***	0.010	0.227*	0.136	0.007	0.123
In (fertiliser)	0.125**	0.062	0.273***	0.064	-0.069	0.083	-0.175	0.185	0.254*	0.121
In (labour)	0.073	0.085	0.068	0.103	0.176	0.114	0.093	0.123	0.129	0.170
In (expense)	0.157***	0.039	0.177***	0.042	0.054	0.058	0.204***	0.054	0.091	0.069
Fertiliser dummy	0.164**	0.076	0.129	0.092	0.237**	0.098	0.137	0.117	0.183	0.120
Membership	0.350***	0.074	-	-	-	-	-	-	-	-
$\rho_{(w,v)}$	-	-	-	-	-	-	0.711*	0.406	0.054	0.572
Inefficiency model										
Constant	0.693	0.903	-2.369	1.453	2.155*	1.160				
Gender	-0.488**	0.250	-1.024**	0.401	-0.428	0.308				
Age	-0.026**	0.012	-0.004	0.017	-0.033**	0.014				
Education	-0.044	0.035	-0.003	0.056	-0.061	0.042				
Credit constrained	-0.482*	0.250	-0.673*	0.393	-0.397	0.319				
Crop diversity	0.103*	0.058	-0.046	0.109	0.167**	0.075				

Table 22. continued.

Variable	Conventional SPF						Sample selection SPF			
	Pooled		Members		Non-members		Members		Non-members	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Irrigation	0.261	0.325	1.101*	0.590	0.031	0.366				
Total farmland	0.021	0.091	0.355**	0.145	-0.209*	0.120				
Log Likelihood	-187.675		-63.329		-106.181		-137.501		-182.943	
Observations	251		117		136		117		136	

Notes: *, ** and *** denote significance levels at 10%, 5% and 1%, respectively.

Table 23. Maximum likelihood estimates of the conventional and sample selection SPF models for the matched sample in Mongolia.

Variables	Conventional SPF						Sample selection SPF			
	Pooled		Members		Non-members		Members		Non-member	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Constant	9.131***	0.150	9.503***	0.124	9.120***	0.095	9.420***	0.170	9.239***	0.175
In (land)	-0.001	0.074	0.169	0.125	0.034	0.088	0.206***	0.073	0.038	0.101
In (seed)	0.161	0.099	-0.071	0.164	0.259**	0.106	0.259*	0.136	0.002	0.139
In (fertiliser)	0.114*	0.066	0.259***	0.067	-0.085	0.089	-0.248	0.201	0.240*	0.124
In (labour)	0.094	0.092	0.086	0.107	0.224*	0.125	0.125	0.132	0.177	0.183
In (expense)	0.154***	0.043	0.180***	0.045	0.046	0.060	0.195***	0.057	0.070	0.077
Fertiliser dummy	0.155*	0.082	0.163	0.099	0.237**	0.104	0.164	0.130	0.168	0.129
Membership	0.357***	0.077	-	-	-	-	-	-	-	-
$\rho_{(w,v)}$	-	-	-	-	-	-	0.800**	0.399	-0.132	0.778
Inefficiency model										
Constant	0.983	0.918	-2.314	1.542	2.389**	1.186				
Gender	-0.559**	0.275	-1.104**	0.446	-0.457	0.329				
Age	-0.028**	0.013	-0.009	0.018	-0.033**	0.014				
Education	-0.050	0.037	0.011	0.061	-0.070	0.043				
Credit constrained	-0.332	0.256	-0.486	0.417	-0.368	0.332				
Crop diversity	0.078	0.065	-0.057	0.113	0.166*	0.088				

Table 23. continued.

Variable	Conventional SPF						Sample selection SPF			
	Pooled		Members		Non-members		Members		Non-members	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Irrigation	0.240	0.340	1.151*	0.661	0.025	0.381				
Total farmland	-0.001	0.097	0.320**	0.148	-0.210*	0.123				
Log Likelihood	-170.686		-56.251		-97.328		-128.480		-170.014	
Observations	227		104		123		104		123	

Notes: *, ** and *** denote significance levels at 10%, 5% and 1%, respectively.

Table 24 shows the average difference in the yield of cooperative members and non-members using the matched sample. The estimates indicate a positive and statistically significant difference between the yield of members and non-members at the 1% significant level. The finding suggests that, on average, cooperative members attain about 24.5% more yield than their non-member counterparts. The analysis, therefore, demonstrates that participation in cooperatives has a positive effect on the productivity of cooperatives members.

Table 24 further shows the average impact of cooperative membership on farm revenue. Similarly, cooperative members obtain 44.2% more farm revenue than non-members. The finding suggests that cooperative membership has a positive and significant impact on members welfare.

Table 24. The average impact of membership on potato and farm revenue in Mongolia

Outcome variable	Members	Non-members	ATT	SE
Yield (kg/ha)	9,285.577	7,010.333	2,275.244***	731.028
Farm revenue (USD/ha)	2,088.004	1,165.467	922.537***	162.050

Notes: *** denotes significance level at 1%. ATT estimates of five nearest neighbour (calliper = 0.05 and a common support condition imposed). Standard errors are estimated using bootstrap with 200 replications.

Table 25 shows the heterogeneous impact of agricultural cooperative membership on yield, farm revenue and technical efficiency based on the surveyed provinces. The results show that cooperative membership has a more significant effect on potato yields for farmers in Tuv province and a lesser impact on the potato yield for farmers in Selenge province. On the other hand, Darkhan-Uul farmers obtained higher farm revenue than their counterparts in Tuv and Selenge. These findings suggest that farmers in Darkhan-Uul are somewhat cost-efficient than farmers in Selenge and Tuv provinces. Regarding the technical efficiency levels, farmers in Darkhan-Uul have the highest efficiency scores, while farmers in Tuv province have the lowest efficiency scores despite the higher yields. The results suggest that increasing yield does not

necessarily imply high efficiency as, for example, “high input” farmers can obtain high yields but use their inputs inefficiently (Mochebelele & Winter-Nelson 2000). In addition, differences in production technologies can influence the efficiency levels of farmers.

Table 25. The heterogeneous impact of cooperative membership on productivity in Mongolia.

Outcome	Location	Observations	Mean outcome		Difference[a]	t-value
			Members	Non-members		
Yield (kg)	Darkhan-Uul	58	9,719.23	6,716.56	3,002.67**	2.527
	Selenge	99	7,972.22	5,862.22	2,110**	2.419
	Tuv	70	11,770.83	6,981.52	4,789.31***	4.606
Farm revenue (USD)	Darkhan-Uul	58	2,434.77	1,258.85	1,175.92***	4.470
	Selenge	99	1,875.94	1,084.20	791.74***	4.031
	Tuv	70	2,376.44	1,292.45	1,083.98***	4.559
TE (%)	Darkhan-Uul	58	0.663	0.523	0.141***	2.679
	Selenge	99	0.637	0.491	0.146***	3.750
	Tuv	70	0.610	0.587	0.023	0.476

Notes: [a] Difference refers to the effect of cooperative membership after correcting for observable and unobservable biases. *** and ** represent 1% and 5% levels of significance, respectively. TE refers to technical efficiency.

5.5.3. Technical efficiency and stochastic meta-frontier estimates

As Table 26 shows, the mean technical efficiency of cooperative members is consistently higher (64% and 69%) compared to 54% and 56% of non-members, depending on the control of biases of the various models. The technical efficiency estimates of members and non-members indicate the presence of managerial gaps and the effect of selectivity bias (Villano et al. 2015). A further review of Table 26, shows the results of the meta-frontier analysis. The reported MTR ratios indicate the relationship between technology and productivity gaps between both categories vis-à-vis MTE, with a higher value suggesting better yields. In particular, the estimated MTRs indicate a statistically significant difference in production technology between the two groups, with members operating closer to the meta-frontier than non-members. The MTE estimates relating to the sample selection indicate that,

on average, while cooperative members are about 55% technically efficient, their non-member peers are 42% technically efficient. These findings suggest that, with the same level of inputs, cooperative membership tends to increase potato output by 13% more than non-members.

Table 26. Levels of technical efficiency and stochastic meta-frontier estimates in Mongolia.

Index	Members	SD	Non-members	SD	Mean diff[a]
Conventional SPF	0.689	0.166	0.562	0.230	0.144***
Sample selection SPF	0.637	0.166	0.535	0.216	0.102***
MTR	0.867	0.158	0.780	0.147	0.087***
MTE	0.552	0.182	0.417	0.240	0.135***

Notes: *** represent 1% level of significance; [a] denote test of means between cooperative members and non-members

6. Chapter 6 Discussion

A qualitative assessment with the executives of the cooperatives and other stakeholders in the three countries pointed out similar conditions and potential for product realisation by new cooperatives. However, the production dominates among atomised small farmers, who are at the mercy of intermediaries who come and collect the farm products. Traditional farm gate sales and local traders dominate as available marketing channels. Even though the products are different in the study countries, the products are demanded on international markets and have export potential. Most interviewed farmers indicated the lack of new marketing channels and low prices given by intermediaries as the main obstacle.

The findings demonstrate that men in Georgia and Moldova still dominate collective farming businesses. In contrast, the opposite is the case for Mongolian cooperatives, even though the cooperative movements aim for more balanced gender roles. Arguably, female farmers are disadvantaged in participating in collective action, likely due to the numerous unmeasured economic activities such as household duties and the likes.

The empirical results show that the distance from farm to output markets positively influence farmers decisions to new collective activities in the three countries. Instinctively, greater distance from output markets increases production and transaction costs and encourages cooperatives and collective logistics participation. Abdul-Rahaman and Abdulai (2018) reported a similar finding. Within the Georgian cooperative context, farmers' educational status positively influence participation in collective action, complying with recent studies, for instance, Verhofstadt and Maertens (2015) and Chagwiza et al. (2016). While the size of the household increases the decision of Georgian farmers to join cooperatives, as Abate et al. (2014), Mojo et al. (2017) and Ma and Abdulai (2016) already confirmed, the tendency to become a member of the cooperative increases with larger household size, the opposite was observed in Mongolia. A possible reason is that smaller households are attracted because they

can benefit from the services provided by the cooperatives and save some labour (e.g., shared labour support and reduced input costs through bulk purchase). Social capital and openness of the farmer to the advice from others and the number of contact with extension officers positively influenced participation in Georgia farmers, as already reported in other recent empirical studies (Mojo et al. 2017; Abdul-Rahaman & Abdulai 2018). However, the causality of predictions among Georgia new farmers' groups seems weaker since many new cooperatives received more training and extension support from the donors only after they established their groups.

Besides personal, household, and social network characteristics, Georgian and Moldovan farmers that hold optimistic believes about benefits derived from the membership (their cognitive dimension of the social capital) tend to sacrifice their independence and autonomous decision about their farms and join the collective activities. Additionally, the relational dimension (trust) of social capital also increases farmers decision to participate in cooperatives. These findings are consistent with, for instance, the results of Bakucs et al. (2012), Liang et al. (2015), Möllers et al. (2017) and Ma and Abdulai (2018) in modelling cooperation in Croatia, Romania and China.

On the other hand, total farmland under farmers' control and ownership of farming-related assets represent substantial "sunken" investments and resources of the farmer and his/her orientation on commercial farm production. Their influence on the probability to join cooperative businesses in Moldova and Mongolia comply with the assets-specificity theory of transaction costs and the findings of Abate et al. (2014), Mojo et al. (2017), Ma et al. (2018) and Ito et al. (2012).

In addition, the results of the membership model among Mongolian farmers also show that farmers who cultivate different types of crops are less likely to join cooperatives. Abate et al. (2014) observe otherwise in their Ethiopia study on the impact of agricultural cooperatives

on the technical efficiency of smallholder farmers. Regarding participation in off-farm work, the results show that farmers who participate in off-farm work have about a 14.8% higher probability of participating in cooperatives. The results based on the dummy variables related to different production regions also suggest that geographic location plays a role in farmers' decisions to join cooperatives in Moldova and Mongolia and not in Georgia.

The empirical results of the various econometric models show a positive and statistically significant impact of cooperative membership on farmers' yield, farm revenue, and net returns in the three countries. When considering a similar performance indicator like farm revenue, significant differences exist between cooperative members and their non-member cohorts in the three countries despite the different sectors of farmers. The positive impact of cooperatives on farm outcomes is consistent with previous empirical studies (Verhofstadt & Maertens 2014; Chagwiza et al. 2016; Ma & Abdulai 2016; Abdul-Rahaman & Abdulai 2018; Michalek et al. 2018; Bachke 2019) in Rwanda, Ethiopia, China, Ghana, Slovakia and Mozambique. The analysis even suggests that Moldovan farmers that do not participate in cooperatives would perform better than members if they join cooperatives, suggesting potential rippling effects of cooperatives as a tool for the economic development of poorer rural households. However, the finding contradicts the results of Bošková et al. (2020) in their study in the Czech Republic. These different outcomes may be due to the varying analytical methods and data used to evaluate member farms. Generally, the positive nexus between cooperative membership and farm economic performance aligns with the economic theory of higher economies of scale and lower transaction costs.

However, in the economic analysis of Georgian farmers, results indicate that education, social network, and perception of benefits from cooperatives negatively affect farm revenue and net returns. Gedara et al. (2012) argued that education is not an ideal index as the general teaching provided in schools may not be directly applicable to cultivating specific types of

crops or agricultural training. The adverse effects of the external and cognitive dimensions of social capital on farm performance suggest that too many social contacts and perceived benefits associated with cooperatives are counterproductive, which in the latter case could lead to opportunistic behaviour in collective activities. Despite the emerging economic advantages of horizontal integration within the value chains, the groups are still relatively small, and their economies of scale remain limited.

Concerning the results reported for Moldovan farmers, education positively increases the farm revenue of members. As expected, educated farmers can understand and apply new and improved farming techniques and thus increase their productivity. On the other hand, household agricultural workers appear to decrease the farm revenues of cooperative members, although it implies more labour endowment for agricultural production. However, an abundance of the labour force may lower marginal productivity and reduce per capita farm revenue generated.

The results regarding the impact of cooperative membership on technical efficiency using the sample selection stochastic production frontier in the case of Mongolia farmers show that the size of the household and gender (i.e., being male) increases their technical efficiency in potato production. Gender plays a role in determining the technical efficiency of potato production in Mongolia. Female farmers are somehow disadvantaged in benefiting from cooperation. In literature, results on gender are somewhat ambiguous; for example, Anang et al. (2017) found that male farmers were more efficient than females among irrigated and rain-fed rice farmers in Ghana; on the other hand, Abate et al. (2014) reported opposite in Ethiopia.

On the other hand, irrigation and total farmland under farmers' control decrease the technical efficiency of cooperative members in Mongolia. Jia et al. (2018) pointed out that over-irrigation in potato production is not uncommon in China's Inner Mongolia. This process

will likely cause water loss and leaching of micronutrients from the soil, which will reduce soil fertility and thus affect yield and technical efficiency.

In comparison with non-members, age and total farmland managed by the farmer influence their technical efficiency. Older farmers within the non-members were more technically efficient compared to the younger farmers. The negative correlation coefficient between total farmland and technical inefficiency shows larger farms provide opportunities for better inputs utilisation within the non-members.

6.1. Overview of empirical analysis methods

The econometric methods used in this study include the treatment effects model, endogenous switching regression (ESR) model, propensity score matching (PSM) technique, Ordinary Least Squares (OLS), sample selection stochastic production frontier (SPF) and stochastic meta-frontier. Among the methods employed, the ESR model, treatment effects model and sample selection SPF model address the issue of selection bias due to observed and unobserved attributes (e.g., innate abilities, motivation of farmers and risk preference) with the inclusion of appropriate instrumental variables, while the PSM technique addresses the issue of selection bias emanating from observable characteristics. Failing to account for unobservable factors would lead to biased and inconsistent estimates of the impact of cooperative membership. In analysing the impact of cooperative membership on farm outcomes of interests by employing OLS regression, cooperative membership was treated as an exogenous variable. The stochastic meta-frontier approach was used to disentangle the productivity gaps between cooperative members and non-members.

The ESR model was used to examine the impact of cooperative membership on farm revenue in the case of Moldova. This approach is appropriate to estimate the effect of a binary endogenous treatment variable on a continuous outcome variable. The ESR model also enables

us to derive factors that affect farm revenue for cooperative members and non-members separately and estimate the average treatment effects and the heterogeneous effect of cooperative membership.

A treatment effects model was used to analyse the impact of cooperative membership on farm revenue and net returns. This method estimates the cooperative membership model and outcome functions simultaneously. The method also provides a direct marginal effect of participation in cooperatives on the outcome variables.

The sample selection SPF was employed to analyse the impact of cooperative membership on yield and technical efficiency. This method is appropriate to model input-output relationships between decision-making units. The first stage of sample selection SPF method involves estimating the farm outcomes of interest conditional on a probit model of cooperative membership. In addition to bringing more knowledge on determinants of cooperative membership, this step generates propensity scores to become members on which the matching techniques build. The subsample from the PSM technique provides the base for the productivity analysis and hence technical efficiency estimation. Finally, the study overcomes the limitation of the sample selection SPF and PSM approach through a stochastic meta-frontier approach that addresses the differences in productivity gaps.

6.2. Review of hypotheses and fulfilment of the study goals

For clarity, the study's main hypotheses, along with its goal fulfilment, are in Table 27. The test-statistic results (Table 10, Table 16 and Table 25) show that cooperative members are significantly different from non-members in yield, farm revenue, and net returns, thus rejecting the null hypothesis of no significant differences between the two groups. Also, personal and social capital factors influence farmers' decisions to join cooperatives, thereby rejecting the

null hypothesis that personal and social factors do not affect smallholder participation decisions in collective activities.

Regarding the stochastic frontier production hypotheses, the test statistics of the generalised likelihood ratio test and t-test rejected the null hypothesis in all cases except the hypothesis of the choice of functional form for the production function.

Similarly, the null hypothesis that socio-economic and plot-level factors did not elucidate the technical inefficiency of cooperative members and non-members was also rejected (Table 19).

The Cobb-Douglas functional form was more appropriate for the conventional stochastic production frontier than the Translog functional form in the productivity analysis of cooperative members and non-members (i.e., rejecting the null hypothesis). Despite the restrictive nature of the Cobb-Douglas model compared to the Translog model, multicollinearity issues are often associated with the inputs and interaction terms when estimating the Translog model (Mayen et al. 2010).

The null hypothesis regarding estimating a single production function (i.e., cooperative members and non-members have the same technology in agricultural production) was rejected (Table 21).

Table 27. Summary of study's goals fulfilment

Study hypotheses	Specific objectives	Method of verification	Results
	1. Describe the characteristics and governance of the various emerging producers' groups (marketing cooperatives) in the selected countries.	Exploratory research	All the cooperatives produce and market their products. All cooperative members from the three countries sell their product on their own and via the cooperatives. Males dominate in all the cooperatives except for cooperatives in Mongolia. Decision-making processes are similar across the cooperatives in the three countries.
1. Personal and social capital factors affect farmers decisions to join collective action	2. Analyse the factors that influence farmers' decisions to join cooperatives/farmer groups.	Probit regression	Being male influences membership decisions but only in Moldova. Age had no effect on participation decisions. Education influences participation in cooperatives in Georgia and Mongolia but not in Moldova. Perception and trust positively and significantly influenced farmers' decisions to join collective action

Table 27. continued

Study hypotheses	Specific objectives	Method of verification	Results
2. Participation in cooperatives is associated with improved economic and social benefits.	3. Evaluate the benefits of newly established farmers' groups for their members in terms of farm profitability and non-economic indicators.	Generalised likelihood ratio (LR) test and t-test statistic	There were differences in farm productivity (i.e., farm revenue) between members and non-members in the three countries.
3. Participation in cooperatives positively contributes to increased technical efficiency	4. Examine the impact of cooperative membership on the technical efficiency of smallholder farmers.	Generalised likelihood ratio (LR) test and t-test statistic	Cooperative members obtained higher technical efficiency (64% and 69%) compared to 54% and 56% of non-members

6.3. Limitations of the study

The study has some shortcomings, and therefore the findings should be interpreted with caution. For instance, the questionnaire did not include environmental and agro-ecological conditions such as soil quality, pests and disease incidence, and drought. However, the geographic location of farmers was included in the analysis to capture location fixed effects.

Furthermore, the relatively low sample size of both cooperative members and non-members in the case of Georgia was because many members were unwilling and relatively inactive. In contrast, others were friends and relatives who were formally included as members only to increase membership and obtain support from the ENPARD programme. In addition, the positive impact on Georgian farmers was influenced by the access to new assets (provided by the ENPARD programme), enabling better processing and storing, thus resulting in higher quality and improved marketing.

The data collection method also influences the positive impact, especially the targeted selection of active groups during the data collection. Most of the farmer groups were inactive (passive) and only joined the group to benefit from the ENPARD support. The positive findings do not reflect that many newly created cooperatives had already failed to survive the end of external support. The ENPARD final evaluation (Kochlamazashvili et al. 2017) reported that up to 50% of new cooperatives would fail to develop into efficient producers' groups.

In Moldova, farmers (both cooperative members and non-members) also showed a similar attitude as in Georgia (i.e., the low willingness to participate in the interviews and many others have migrated to other countries for greener pastures). In Mongolia, the issue of migration among cooperative members and non-members also led to relatively low sample size at the time of data collection. In general, poor records keeping of farmers led to incomplete production information. Also, farmers' inability to evaluate certain farm assets such as tractors and farm animals, among others, led to the few economic indicators used as proxies to measure

the performance of farmers. The situation led to the non-uniform objectives for the studied countries. Generally, cross-sectional data as used in this study have its econometric drawbacks.

7. Chapter 7 Conclusions

This study assessed the impact of smallholder participation in collective action on members' economic and social performance in Georgia, Moldova and Mongolia. The economic indicators assessed include yield, farm revenue and net returns. The social indicators evaluated include farmers' subjective opinions on attributes such as farming experience sharing, participation in community development projects, opportunities for training and extension, and access to information about good agricultural practices.

The results of the membership model generally indicate that demographic and socio-economic and plot-level factors, such as education, age, gender, household size, number of contacts with extension officers and other farmers, distance to market, location characteristics, trust and perception of economic benefits generated from cooperatives significantly influence farmers' decisions to join cooperatives in the three countries.

The empirical results showed that participation in cooperatives is positively and significantly associated with a higher yield, farm revenue and net returns. A negative selection bias from the treatment effect model suggests that farmers who obtained lower farm revenues and net returns than the sample average have a higher probability of joining the cooperatives. This finding confirms that participation in cooperative organisation and other forms of collective action enhances the productivity of small farmers. The ATE estimates further revealed that the underlying effects of cooperative membership increase farm revenue by 33.1% and net returns by 27.8% on average (in the case of Georgian farmers). The results of the Moldovan analysis showed that cooperative members would earn less farm revenue if not members, and farmers who do not participate in cooperatives would benefit more if they joined cooperatives. Also, the result of the Mongolian analysis showed that cooperative members are more technically efficient with an average technical efficiency between 64% and 69%, compared to 54% to 56% for non-members when considering cooperation in the central Asian

region. The findings also showed statistically significant differences in the determinants of technical efficiency between cooperative members and non-members in the Mongolian analysis. Specifically, gender (being male), irrigation and total farmland influence the technical efficiency of members, while age, crop diversification and total farmland affect the technical efficiency of non-members.

The new groups demonstrated initial tangible success, which may start changing minds favouring more entrepreneurship within the studied countries. The young groups need to overcome the first impediments to their membership and operational expansion to provide economically viable rural institutions. The new groups can potentially become essential models for new cooperative movements across Eastern Europe and post-Soviet transition countries.

Even though the results of this study are sector-specific, the findings generally indicate that contemporary cooperatives can be an instrument for enhancing agricultural and rural development even in countries with negative cooperative experience from socialist regimes. Further, the results show that cooperatives in the post-Soviet transition countries are new, and farmers are gradually grabbing the concept with some benefits that are different for different countries.

7.1. Policy implications of the study

The findings of the study have significant policy implications. The similar characteristics and governance structure among cooperatives in the three countries suggest that common cooperative policies may apply to the cooperative organisations in these countries to address the inherited difficulties to ensure the effective collaboration of small farmers. The higher benefits for cooperative members and its multiplier-effects generally suggest the need to intensify government or external donors' support in linking smallholder farmers to existing cooperatives and high-value market chains demanding higher and stable production volumes

and quality. The significant role of cooperatives in increasing farm yield and technical efficiency, using Mongolia as a case study, suggest that participation in agricultural cooperatives can improve the productivity and efficiency of smallholder farmers.

In practice, training programmes designed to enlighten farmers on the tangible benefits of cooperatives will promote intensive participation in cooperative organisations. In addition, the training and the educational programme should encompass monitoring the business performance and planning and evaluating the farm business.

The positive impact of market distance on participation suggests that smallholder farmers, particularly those in remote areas, should be encouraged to join cooperative organisations to relax constraints (e.g., time, information and transaction costs) associated with inputs acquisition from output markets.

In addition, large farmers are encouraged to join cooperatives to improve the management of resources and benefit from collective farm activities of cooperatives. In addition, government and development practitioners should implement capacity-building programmes to enhance members' technical capacity to maximise productivity and farm efficiency.

The findings from the Mongolian analysis indicate that appropriate irrigation investments and management techniques need to be put in place to improve the management of resources at the farm level. The joint effort of various government and non-governmental stakeholders is also necessary to focus on gender-sensitive training, which would extend beyond formal requirements of participation of female farmers to enhance their active involvement and potential to reap tangible benefits.

Mechanisms for transferring knowledge from older farmers to younger farmers within and outside the cooperatives should be of paramount concern.

Within the cooperatives, capacity building programmes related to gender-sensitive awareness and the development of the internal institutional mechanisms in cooperatives for the transfer of knowledge and mutual learning would ensure equal member benefits from collective activities.

Developing internal rules, increasing members commitment and expanding membership base is necessary to increase the economic benefits resulting from higher volumes, ensure economies of scale and higher negotiation power, and guarantee organisational capital required for loans from private institutions. Family bonds might be necessary for reducing initial distrust and communication costs within the cooperatives.

It is important to address the relational and cognitive dimensions of social capital (Liang et al. 2015), to ensure the sustainability of rural cooperatives as the respondents reported trust and experience of the mental block resulting from the Soviet regimes as an obstacle to cooperation during the key informant interviews. Moreover, the study's findings indicate that trust and perceived economic benefits of cooperation are among the most crucial factors influencing smallholder participation in cooperatives.

In addition, mechanisms to tackle attitudes, such as freeriding and low member commitment, will encourage intensive participation in collective activities to avoid unhealthy social behaviours in cooperation. Such behaviours undermine the sustainability and expected effects of spontaneous collective action and external support on social capital formation.

The development of these rural institutions could be promoted by disseminating the existing benefits of collective action to other farmers and enhanced by improved infrastructure for extension services, as education and extension visits facilitated farmers decision to join cooperatives. Increased participation of small farmers in rural cooperatives will inevitably go hand in hand with improved economic and social benefits for small farmers worldwide.

7.2. Suggestions for further studies

The research merits further studies to address the study's limitations and verify and extend the empirical findings in different farming contexts in other post-Soviet and developing countries.

Future studies should consider environmental and agro-ecological conditions when estimating farm productivity to assess the effect of these factors on farm performance for policy formulation.

A study on allocative efficiency between cooperative members and non-members will shed more light on smallholder farmers' input use and input cost decisions.

Follow-up studies using replicated cross-sectional data (with larger sample size) or panel data may evaluate the cost-benefit analysis of the implemented policies in the three countries. Currently, the farmers are small, and cooperatives will make economic sense for cost-benefit analysis only if they are big enough.

Comparative studies involving co-operators in similar sectors in transition and other developing countries will provide further insights into the benefits and perspectives of contemporary cooperatives for policy design aimed at improving smallholder welfare in deprived areas.

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9. List of author's contributions to the scientific journal (published papers with IF)

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12. Appendix

Appendix A – Matching quality test and endogeneity test 126

Appendix B: Questionnaire 130

Appendix C Key informant interviews questionnaire – Managers of cooperatives 136

Appendix A – Matching quality test and endogeneity test

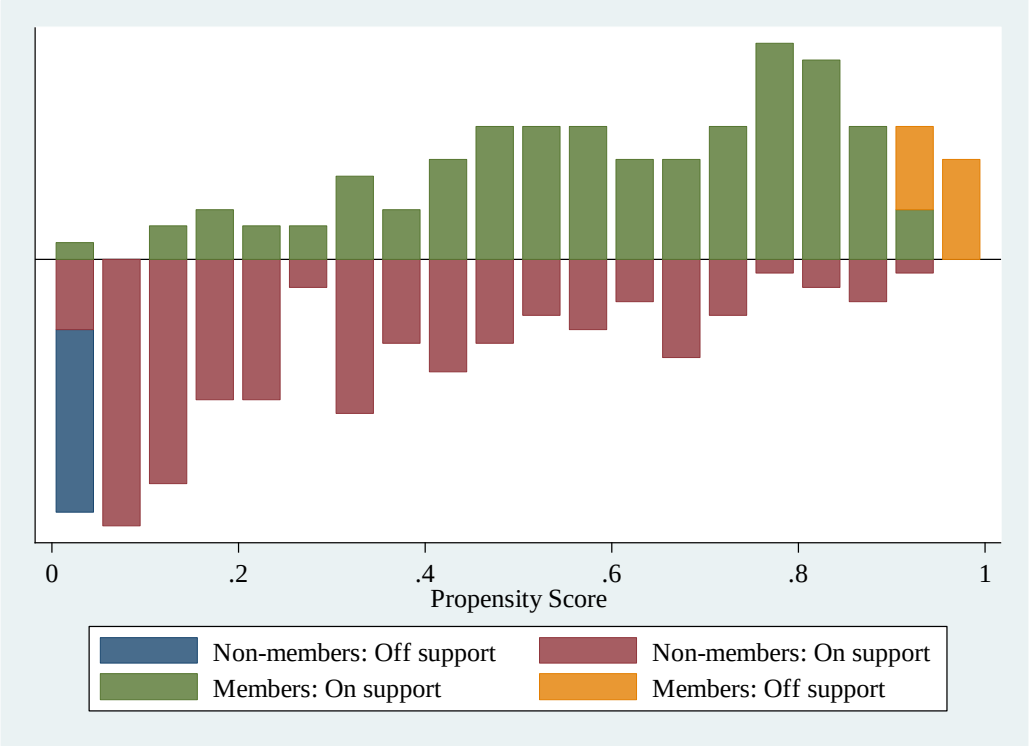

Fig. A1. Density distribution of propensity scores for members and non-members – Mongolia

Table A1. Descriptive statistics of variables used in the econometric analysis (Mongolia study).

Variable	Unmatched sample				Matched sample			
	Members		Non-members		Members		Non-members	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Gender	0.391	0.490	0.471	0.501	0.394	0.491	0.371	0.501
Age	48.278	11.064	45.713*	9.891	47.875	11.099	47.042	9.851
Household size	3.235	1.202	3.794***	1.345	3.346	1.197	3.385	1.339
Education	11.504	3.463	10.809	3.546	11.510	3.450	11.488	3.550
Credit constrained	0.548	0.50	0.596	0.493	0.558	0.499	0.631	0.496
Total farmland	3.617	1.633	3.059***	1.144	3.553	1.666	3.634	1.400
Distance to market	25.374	9.801	21.868***	7.709	24.721	9.786	26.546	7.593
Irrigation	0.852	0.356	0.772	0.421	0.856	0.353	0.867	0.421
Crop diversity	3.548	1.925	4.125**	2.213	3.615	1.967	3.624	2.069
Off-farm	0.774	0.420	0.618***	0.488	0.760	0.429	0.768	0.479
Land ownership	0.426	0.497	0.279**	0.450	0.413	0.495	0.349	0.453
Selenge province	0.539	0.501	0.353***	0.480	0.519	0.502	0.516	0.484
Tuv province	0.217	0.414	0.404***	0.493	0.231	0.423	0.202	0.486
Yield	9,121.739	5,129.509	6,370.074***	3,592.335	9,285.577	5,148.857	6,503.089***	3,678.637
Seed	373.770	171.064	284.650***	181.283	368.880	166.142	371.490	186.291
Land	2.242	1.746	2.124	1.657	2.309	1.802	2.652	1.636
Fertiliser	141.810	118.994	127.67	149.099	142.480	119.208	163.03	153.510
Labour	50.209	19.190	61.934***	22.361	51.385	19.405	50.097	19.812
Expense	666.378	659.483	703.399	586.503	666.378	663.441	703.399	601.960
Observations	115		136		104			123

Notes: Means followed by *, ** and *** are statistically different from cooperative members at the 10%, 5% and 1% levels, respectively.

Table A2. Test for addressing potential endogeneity in extension visit variable (Georgia study)

	Cooperative membership		Extension visits	
Variables	Coefficient	Std error	Coefficient	Std. error
Constant	-6.039***	1.133	-2.801***	1.061
Gender	-0.083	0.214	0.569**	0.251
Age	-0.005	0.009	-0.001	0.009
Education	0.179***	0.047	0.099**	0.046
Household size	0.362***	0.101	0.137	0.107
Ownership	0.240	0.228	0.458*	0.248
Farm size	0.201	0.126	0.229	0.146
Social network	0.073***	0.020	0.009	0.023
Perception	0.406**	0.204	0.533**	0.241
Trust	0.725***	0.214	0.079	0.233
Region	0.206	0.235	0.079	0.271
Market	0.027***	0.010	0.0004	0.011
Number of farm plot	-0.051	0.109	0.286**	0.143
Log likelihood	-108.320		-71.588	
Observations	210			

Notes: *, ** and *** denote significance levels at 10%, 5% and 1%, respectively. Robust standard errors reported.

Table A3. Test for addressing potential endogeneity in off-farm work and crop diversity variables (Mongolia study)

	Cooperative membership		Off-farm work		Cooperative membership		Crop diversity	
Variables	Coefficient	Std error	Coefficient	Std error	Coefficient	Std error	Coefficient	Std. error
Constant	-3.014***	0.994	0.870	0.850	-2.804***	0.955	4.544***	1.129
Gender	-0.132	0.199	0.496**	0.195	-0.128	0.203	-0.209	0.257
Age	0.011	0.009	0.009	0.010	0.011	0.010	0.020	0.013
Household size	-0.146**	0.069	-0.024	0.072	-0.141*	0.076	-0.018	0.093
Education	0.049*	0.029	-0.007	0.027	0.048*	0.028	0.065*	0.035
Credit constrained	0.044	0.185	-0.076	0.190	0.040	0.196	0.142	0.260
Total farmland	0.207***	0.070	0.044	0.062	0.211***	0.064	0.059	0.081
Distance to market	0.018*	0.011	-0.010	0.011	0.018	0.011	-0.045***	0.014
Irrigation	0.257	0.246	-0.331	0.251	0.310	0.262	1.106***	0.342
Crop diversity	-0.112**	0.048	0.004	0.048	-0.122**	0.054		
Off-farm work	0.476**	0.208			0.486**	0.210	0.055	0.267
Land ownership	0.476**	0.208	-0.252	0.196	0.474**	0.202	0.384	0.267
Selenge province	0.337	0.238	-0.019	0.234	0.382	0.257	-0.382	0.326
Tuv province	-0.385	0.264	-0.336	0.269	-0.371	0.294	-1.356***	0.336
Perception	1.089***	0.266	0.008	0.222	1.106***	0.265	-0.102	0.322
Training food crops					-0.294	0.218	-0.658**	0.272
Job perception	0.125	0.197	-0.347*	0.196				
Observations	251				251			

Notes: *, ** and *** denote significance levels at 10%, 5% and 1%, respectively. Robust standard errors reported.

Appendix B: Questionnaire

Survey Questionnaire for "Analysis of Economic and Social Performance of Newly Created Farmers Group in Transition Countries: Evidence from Georgia, Moldova and Mongolia"

These questionnaires have been designed to execute research purposely for academic work. The principal objective is to analyse the economic and social performance of newly created farmers' groups and their determining factors in participation of collective action. All information provided will be used solely and exclusively for academic purpose and all respondents will remain anonymous to the public domain. Information provided would be used to make sound empirical analysis and suggest policy recommendations that would help to improve market access and farmer's socio-economic welfare in the region. The interview process will take nearly one hour of your time.

Interview date …….

Questionnaire number …….

Filled by enumerator:

1. GPS coordinates …….
2. Name of region/province …….
3. Name of village/community …….
4. Gender [1] Male [0] Female

   Main product (plum, grapes, hazelnuts, walnuts, honey, potato)

Fill the below questions with the respondents:

A. HOUSEHOLD AND FARM-LEVEL INFORMATION

5. Age of respondent in years …….
6. Educational status [0] No Formal Education, [6] Primary Education, [12] Secondary/Technical Education, [15] Tertiary Education
7. Marital Status [1] Married [2] Single [3] Divorced [4] Widowed
8. What is your household (HH) size? [number of members] ……
9. Number of HH members that work on the farm? ……..
10. What proportion of household members are under the age of 15 and over the age of 64?
11. What is the number of years you spent in the farming sector? ……
12. What is your total land holding [in hectares]? ……..
13. How many of the agricultural land do you cultivate [in hectares]? ……
14. How many farm plots do you have? ……..
15. How many beehives do you have? ……
16. How did you acquire your farmland? [1] Family/own [2] Rent [3] Purchase [4] Privatisation after kolkhozes
17. Do you have your own processing equipment for your produce? [1] Yes [0] No
18. What is the distance from your farm to the nearest large market? [km] ……
19. Did you have access to farm credit in the last farming season? [1]Yes [0] No
20. Do you use irrigation for your farm? [1]Yes [0] No
21. What is the number of crop types you cultivate? ……..
22. Do you participate in off-farm work? [1]Yes [0] No
23. Is it difficult to find an off-farm work in your catchment area? [1]Yes [0] No
24. Have you received trainings from public/private institutions about the cultivation of other food crops. [1]Yes [0] No

25. What is the distance between your home and available capital sources (e.g., banks, friends or relatives) (km)…….

B. DETERMINANTS OF COOPERATIVE MEMBERSHIP INFORMATION

26. What is the number of external consultants (private, NGO, government extension) visits received in the year prior to this survey at your farm? ……
27. With how many other farmers are you in active contact (number of contacts per year)?
28. How many farmers' organisations do you belong?.....
29. Do you trust other farmers in the neighbourhood? [1]Yes [0] No
30. Do you agree that the cooperative can bring you economic benefits? [1]Yes [0] No
31. How many members of your family joined the cooperative?.....
32. Have you heard about any financial and extension support for establishment of cooperatives (from government or NGOs)? [1] Yes [0] No

For Cooperative members only

Please indicate your assertion whether the following statement influenced you the most to your participation in cooperative.

Statements	Strongly disagree	Partly disagree	Neutral	Partly agree	Strongly agree
33. Financial support from government or NGOs.					
34. Neighbour farmers 35. Other farmers in the cooperatives					
36. Family					
37. Friends 38. Current leader of the cooperative					
39. Government extension agent.					
40. ENPARD employees.					
41. ENPARD campaign in media/website.					

C. PRODUCTION INFORMATION

Please indicate the kilogram of products you harvested and the sales price

Year	**Total yield/ha**	**Price/kg**
2018		
2019		

Please indicate your total cost of production during the 2018 & 2019 cropping year.

Input	**Quantity used**	**Unit cost/total cost**
Seeds		
Fertilisers organic inorganic		
Insecticides/weedicides		
Hired labour/family		
Other farm expenses		

Please indicate your total assets in 2018 & 2019

Asset	**Value** (in local currency)
Animals (goats, sheep, beef & dairy cows)	
Farm machinery (e.g., tractors)	
Storage facilities (e.g., barn)	
Cash crops (e.g., cashew plantation)	

D. SUBJECTIVE OPINION OF FARMERS' ECONOMIC BENEFITS OF COOPERATION (COOPERATIVE MEMBERS ONLY)

Please rate the following questions according to your level of agreement as economic benefit you receive from being a cooperative member

Do you agree with the following statements.	Strongly disagree	Partly disagree	Neutral	Partly agree	Strongly agree
57. Your income has increased in the last 3 years.					
58. You accessed higher quality inputs at a lower price over last 3 years.					
59. You receive higher price for your main product over last 3 years.					
60. You have now more business contacts than 3 years ago					
61. Purchase of your products is now more secure and stable over last 3 years.					
62. You do not have to dedicate so much time to marketing and selling over last 3 years.					
63. You have reduction in the costs of production in the last 3 years.					
64. You have better access to credit and saving services over last 3 years.					
65. You have better access to process your production over last 3 years.					
66. Your bargaining power on the market has improved over last 3 years.					

E. SUBJECTIVE OPINION OF FARMERS' NON-ECONOMIC BENEFITS OF COOPERATION (COOPERATIVE MEMBERS ONLY)

Do you agree with the following statements.	Strongly disagree	Partly disagree	Neutral	Partly agree	Strongly agree
67. Service from input suppliers has improved over the last 3 years					
68. Access to relevant market information have improved over the last 3 years					
69. Service from extension agents have improve over the last 3 years					
70. My social contacts have increased over the last 3 years.					
71. Access to information about good agricultural practices has improved over the last 3 years					
72. Opportunity for further training has increased over the last 3 years					
73. You have better chance to mutually share experience with other farmers than 3 years ago.					
74. Opportunity to participate in decision about the community development has increased in the last 3 years (e.g., social amenities)					

F. MARKETING INFORMATION

75. Did you sell your product through agricultural cooperatives? [1]Yes [0] No

76. How do you evaluate the average sales price of your farm products? [1]Lower [2] Acceptable [3] Higher

77. Who are your main buyers of your farm products? [1]Local traders[2] Traders from other provinces [3] Exporters

78. From which channel do you acquire market transaction information (such as sales price, inputs availability outlets)? [1] government [2] neighbour or friends [3] dealers [4] Cooperatives [5] Media [6] Others….

Appendix C Key informant interviews questionnaire – Managers of cooperatives

Group characteristics

Name of cooperative	Total members	Gender	
		Male	
		Female	
		Total	
		Youth out of the total number	

1. Can you describe the main business of cooperative and its services/benefits for members? Is there any processing or storage services rendered to members?
2. When was the cooperative established/registered? (year)
3. What is the main product of cooperative?
4. Can you describe the governance system of the cooperative? How frequent meetings are held?
5. What is the composition of members - all farmers? Are more members from one family? helpers? non-farmers? friends? Schoolmates?
6. What was the initial investment from members? Was the investment even among members?

7. Did the cooperative have any other grant or loan? Which one and from whom?
8. What are the main assets and facilities of the cooperative?
9. What are the main buyers and how the marketing is organised?
10. What is the total turnover of the cooperative?
11. How much land cooperative has the cooperative/members together?
12. What are the main challenges for cooperative (as a group and for business) now?
13. Who makes decisions in the cooperative?
14. Is the number of members increasing?
15. Do you plan an increase?
16. Are you as a leader employed and paid by the cooperative? Full time or part time?
17. How many hours per week do you spend with cooperative matters?
18. How many and what type of paid employees' does the cooperative have?
19. What is the main income of the cooperative to cover the running cost of the group?
20. How the members organise sales? Together or they compete?
21. What is the system of payments between cooperative and members? Does the cooperative have money for purchase of members produce?
22. How do members pay for services and renting of assets from the cooperative - e.g., trailers, tractor, car, processing, storage?
23. Is there any profit created by the cooperative?
24. How is profit used in the cooperative?

End of the Interview

THANK YOU FOR YOUR COOPERATION