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Cooperative membership and farmers' choice of marketing channels – Evidence from apple farmers in Shaanxi and Shandong Provinces, China☆

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ABSTRACT

Cooperatives are established to improve farmers' production conditions, to increase their bargaining power and to enable them to benefit from modern value chains. In China, farmers are members of a cooperative for multiple reasons. Little is known on whether and how cooperative membership affects farmers' choice of marketing channels. This paper examines determinants of farmers' choice of marketing channels, especially how cooperative membership impacts upon this choice. Our analysis is based on survey data collected in 2015 among 625 apple growing farm households in the provinces Shaanxi and Shandong. We employ endogenous switching probit models to deal with potential endogeneity of membership in estimating the determinants of marketing channel choices. We find that cooperative membership has a positive impact on selling to wholesalers and a negative impact on selling to small dealers, but no significant impact on selling to the cooperative itself. As products sold through cooperatives generally comply with relatively stringent food quality and safety standards, these results imply that policies promoting cooperative members to sell their products through cooperatives are likely to have a significant impact on food quality and food safety in China.

1. Introduction

Recent structural changes in agro-food markets are characterised by increasing public concern about food quality and food safety in both developed and developing countries. Demand for better quality food and for stricter safety standards is growing, mainly due to the increasing purchasing power of consumers (Narrod et al., 2009). These changes can be both opportunities and challenges to smallholder farmers. On the one hand, the changes allow farmers to benefit from opportunities arising from export markets, local supermarkets and new processing firms (Bijman, 2016). On the other hand, these new markets in turn require compliance with higher production and food safety standards and the stronger coordination of sequential activities in the value chain (Abebe et al., 2013). The high costs of compliance with these standards can exclude smallholder farmers from these new markets.

Cooperatives can facilitate smallholder farmers to access markets and strengthen their economic position. Firstly, cooperatives enable farmers to bargain collectively with both sellers of inputs and buyers of farm products (Bijman and Iliopoulos, 2014). Secondly, cooperatives can support the information flow between farmers and the market and thus help farmers to meet the specific requirements of high-value added food markets (Wollni and Zeller, 2007). In addition, cooperatives can help realize food traceability (Moustier et al., 2010), thereby contributing to food safety.

The Chinese land tenure reform in the late 1970s turned the farm household into the basic unit of agricultural production. The land reform provided most farmers with an adequate basis for their livelihoods. However, the reform also resulted in land fragmentation and small-scale agriculture, which have become an obstacle to develop modern agriculture (Tan et al., 2008). Like smallholder farmers in other developing countries, Chinese farmers often have difficulties in accessing high-value agricultural markets. Having realised that cooperatives can facilitate smallholders to meet market requirements, the Chinese government began promoting the development of cooperatives at the beginning of the 21st century (Jia

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et al., 2012). The promulgation of the Chinese law on Specialised Farmers Cooperatives in 2006 has been a milestone in the development of Chinese cooperatives. By October 2015, over 40% of farm households had become members of at least one cooperative.[1]

Research on agricultural cooperatives has focussed on two main issues. One issue is the relationship between the cooperative and its members, such as the determinants of cooperative membership (Fischer and Qaim, 2012; La Ferrara, 2002), the relationship between farmers' preferences and the functions of the cooperative (Cechin et al., 2013; Kalogeras et al., 2009), and the effect of cooperatives on farmers' market participation (Barrett, 2008; Hellin et al., 2009). The other issue is the impact of cooperatives on agricultural production, the adoption of agricultural technology, and farmers' welfare (Abebaw and Haile, 2013; Chagwiza et al., 2016).

Limited literature is available on whether or not, and to what extent, the development of cooperatives affects farmers' choice of marketing channels. Milford (2014) and Mujawamariya et al. (2013) analyse the reasons for producers' choice of different marketing outlets by comparing production costs and transaction costs involved in dealing with different buyers with different production requirements, respectively. Both studies do not examine the impact of cooperative membership on the choice of marketing channels. Jia et al. (2012) analyse the main marketing channels of cooperatives in China and find that cooperatives mainly sell products to wholesale markets and facilitate farmers' access to markets by bridging farmers and government-driven agribusiness. Since they use the cooperative as the unit of analysis, they do not examine farmers' motivations for joining cooperatives, nor the impact of membership on farmers' choice of marketing channel. Insights into such choices by farmers are important to evaluate recent policies in China that aim at stimulating farmers' involvement in high-value food chains through promoting their participation in cooperatives. The objective of this paper is therefore to examine the determinants of cooperative membership for farmers and the effect of membership and other factors on farmers' choices of marketing channels.

We focus our analysis on apple farmers in the two main apple producing areas in China. China is the world's leading producer of apples, producing roughly 55% of the total apple output in 2015 (Frederick et al., 2015). Apples are the fruit crop with the largest acreage and the highest production value in China, and have been the dominant income source for farmers in the two main apple production regions – the Bohai Gulf area and the Loess Plateau area (Wang and Huo, 2014). The empirical analysis is based on an extensive field survey of 625 apple farm households in Shaanxi Province located in the Loess Plateau and Shandong Province in the Bohai Gulf. We employ an endogenous switching probit model to estimate the determinants of each marketing channel taking into account the potential endogeneity of the membership decision.

2. Theoretical framework

Arguments for the existence of cooperatives can be found both in neoclassical economics and in transaction cost economics. Sexton (1990) posits the competitive yardstick effect of cooperatives, which means that cooperatives have a competition enhancing effect in oligopolistic markets. It was found that the degree of yardstick effect is determined by membership, market structure and the resulting volume of deliveries (Hoffman and Royer, 1997). However, neoclassical economics provides little insight in how to structure transaction relationships. Transaction cost economics offers a better framework to analyse the transaction attributes and the governance structures (Sykuta and Cook, 2001).

2.1. Transaction cost theory

Transaction costs arise due to attributes of the transaction as well as characteristics of the human actors involved in the transaction. Williamson (2005) assumes that transaction costs are caused by bounded rationality and opportunism of human behaviours and attributes of a transaction, especially uncertainty, frequency[2] and asset specificity (Williamson, 1979). The choice of cooperatives as an institutional arrangement results from increasing asset specificity and transaction uncertainties (Ménard, 2007). In addition, Key et al. (2000) argue that transactions between farmers and buyers are closely related to farmers' assets for production and their geographical location. For example, due to the small size of the farm, economies of scale cannot be realised by smallholders; they thus face higher external transaction costs in obtaining inputs and financial services.

2.1.1. Production-specific assets

We define production-specific assets as both physical and human investments that are specialised and unique to a product. Physical production asset specificity consists of land, machinery, buildings and is closely related to the specialisation of the farm. Human asset specificity arises from "learning by doing" (Williamson, 1998). Skill acquisition requires time, energy and money. Acquired skills, especially job-specific skills, are not easy to transfer across jobs. Human asset specificity in this sense is a sunk cost, which leads to a high probability of being locked in.

2.1.2. Geographical location

Geographical conditions limit the size and distribution of farms. Small farms usually face high transaction costs because economies of scale in transacting cannot be realised. Smallholders have higher unit costs of procuring inputs, obtaining credit and other financial services, getting agronomic and market information, and marketing products (Wiggins et al., 2010). In addition, adverse geography generally co-occur with poor roads, leading to high transportation costs.

2.1.3. Transaction uncertainty

Transactions are subject to both behavioural and environmental uncertainty. Behavioural uncertainty comes from the opportunistic inclinations of the transacting parties (John and Weitz, 1988), while environmental uncertainty results from the inability to specify the exact conditions of the future exchange. Uncertainties lead to transaction costs. Direct ex ante transaction costs arising from behavioural uncertainty and information asymmetry include the costs of screening and selecting partners. Direct ex post transaction costs are related to the processes put in place to measure a partner's performance (Standifird and Marshall, 2000).

2.2. Farmers' choices

We distinguish between two choices farmers can make. The first choice is about membership of a cooperative, while the second choice is about marketing channel. We assume that farmers make these decisions on the basis of the costs and benefits related to each choice. However, it is impossible to measure all the costs and benefits of both decisions (Masten et al., 1991). It is particularly difficult to measure accurately the transaction costs associated with the marketing process. Transaction costs thus are mainly assessed in a comparative manner (Verhaegen and Van Huylenbroeck, 2001). We adopt the empirical approach proposed by Williamson (1991), which means we focus on the transaction characteristics in order to estimate the determinants of farmers' membership and marketing channel choice.

[1] Translated by authors from the news report entitled "1.47 million cooperatives including 40% of farm households nationwide". The original text is written in Chinese and was released on January 1, 2016; it can be found at: http://politics.people.com.cn/n1/2016/0111/c1001-28035566.html.

[2] In our empirical analysis we use cross-section data on marketing channels used by apples producers in the year 2014. We therefore disregard transaction frequencies in the remainder of this paper.

2.2.1. Choice of cooperative membership

Cooperative membership brings both material and immaterial benefits to farmers. Firstly, cooperatives decrease transaction costs and improve transaction efficiency (Royer, 2011). Buyers can offer higher prices for products because of the reduced transaction costs (Swinnen, 2005). Secondly, participating in cooperatives can improve small farmers' access to both input and output markets (Key et al., 2000). In addition, members can benefit from the decision rights over the cooperatives' strategic assets and thus reduce the risk of being locked in or held up (Hendrikse and Bijman, 2002). The immaterial benefits of membership mainly refer to the social interaction with other members, developing both personal social networks and business relationships (Hansen et al., 2002).

The typical costs of membership include membership fees, time and energy involved in cooperative affairs such as decision-making and monitoring manager performance (Pascucci et al., 2012b). We assume that farmers decide to participate in a cooperative when the benefits of participation exceed the costs thereof.

2.2.2. Choice of marketing channel

A marketing channel refers to a set of interdependent organisations involved in the process of making a product or service available for use or consumption (Palmatier et al., 2014). We focus on the upstream segment of the marketing channel: the transaction relationship between apple producers and their buyers. In China, the main marketing channels for apple farmers are small dealers, wholesalers and cooperatives. Farmers choose one or several channels through which to sell their products.

We assume that the farmer decides to sell products after evaluating transaction costs and benefits associated with each marketing channel given his/her own production conditions. To a large extent transaction costs and benefits are determined by the characteristics of the marketing channels.

Small dealers are small and itinerant traders. They visit villages and look for potential sellers. When an agreement is reached between the small dealer and the farmer, the dealer buys the products directly from the farmer. Such transactions are spot deliveries, most of which are carried out either at farm gate or storage location. Grading and packaging work is usually done by the farmers themselves.

Compared with small dealers, wholesalers usually have a larger scale of business. Instead of buying products directly from farmers, they usually employ local villagers as brokers to contact with potential sellers. Most wholesalers will choose a convenient location in the village where all the potential sellers bring their products. Wholesalers employ workers to do grading and primary packaging.

Cooperatives are relatively new actors in marketing channels. We would like to emphasise that cooperative membership does not necessarily mean choosing the cooperative as the marketing channel. Not all members deliver their products to the cooperative, while non-member farmers can also sell the products to the cooperative.

Other channels mainly consist of juice processors and selling within personal social networks. Farmers usually sell degraded apples to juice processors.

The conceptual framework presented above is depicted schematically in Fig. 1.

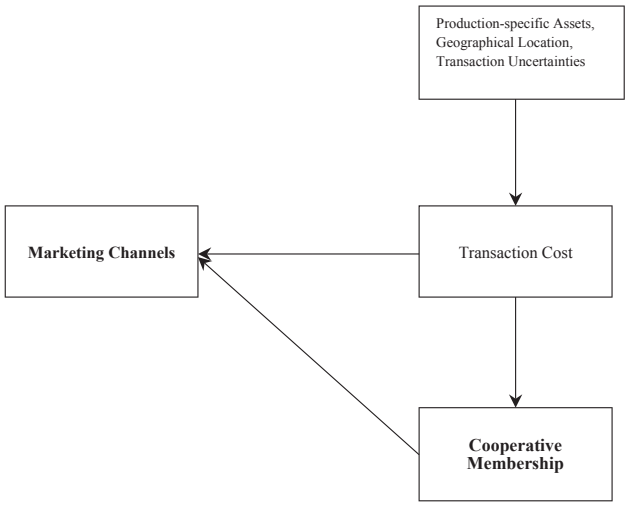

Fig. 1. Conceptual framework.

3. Model specification

When we evaluate the effect of cooperative membership on farmers' choice of marketing channels, we cannot ignore the potential endogeneity of membership. Farmers may self-select into cooperatives because of unobserved factors such as incentives and ability. These same unobservables may also influence the choice of marketing channel. For example, a farmer may choose to become a cooperative member with the intention to benefit from the possibility of selling outputs through a certain marketing channel. If in such case the error terms of the membership model and the marketing channel model correlate, membership will be endogenous in the marketing choice equation. Neglecting or failing to account for endogeneity of cooperative membership will result in inconsistent estimates and lead to spurious conclusions (Heckman, 1978).

Instrumental variable (IV) estimation and control function approaches are two common methods to deal with endogeneity of strictly continuous outcome variables (Heckman, 1978; Wooldridge, 2014). However, addressing the problem of endogeneity in limited dependent variable models is complicated by the fact that a nonlinear model is applied to fit the data, which invalidates a simple IV procedure (Wooldridge, 2010). For binary outcomes a simple alternative strategy is to use a Linear Probability Model (LPM) and two-stage least squares (2SLS) to instrument the endogenous binary regressor (Angrist, 2001). However, the LPM has many known problems such as predictions outside the [0,1] interval and constant marginal effects. Moreover, a 2SLS approach is less efficient than a full information maximum likelihood (FIML) approach that is used in the method applied in this study.

One alternative approach is to estimate a bivariate probit regression with a recursive structure, viz. one of the outcomes is an endogenous regressor in the other equation. E.g. the cooperative membership decision is a covariate in the marketing channel decision equation but not vice versa. Greene (2008) shows that by using FIML one can ignore the endogenous nature of the binary regressor and proceed as if there were no endogeneity problem. For an application of this approach see e.g. Pascucci et al. (2012a).

In this study we use a related though slightly different approach, the endogenous switching probit model (Miranda and Rabe-Hesketh, 2006). Like the recursive bivariate probit, this model jointly estimates two binary equations, one for cooperative membership and one for delivery with the membership dummy included as a covariate in the latter. The endogenous switching probit differs from the recursive bivariate probit in that it explicitly models the dependence between the residuals of the switch equation (cooperative membership) and the outcome equation (choice of marketing channel) via shared random effects, thus mimicking the selection problem described above. The bivariate probit model only considers the correlation between residuals of both equations, without explicitly modelling why these residuals are related. The shared random effect in the endogenous switching probit reflects unobservables related to both cooperative membership and choice of marketing channel.

Building on Pascucci et al. (2012a), we specify the membership equation (C_i^*) and the choice model of marketing channel (M_{ij}^*) are:

$$C_i^* = \alpha X_i + u_i, \quad C_i = 1 \text{ if } C_i^* > 0,\ C_i = 0 \text{ otherwise.}$$
$$M_{ij}^* = \beta Y_i + \gamma C_i^* + v_i, \quad M_{ij} = 1 \text{ if } M_{ij}^* > 0,\ M_{ij}^* = 0 \text{ otherwise.} \tag{1}$$

Where X_i represents a vector of explanatory variables of cooperative membership, Y_i represents a vector ofexplanatory variables of marketing channel choices, α, β and γ are coefficients to be estimated, and u_i and v_i are residual terms. To model the potential endogeneity of cooperative membership, we use a shared random effect ε_i to induce the dependence between u_i and v_i (Miranda and Rabe-Hesketh, 2006),

$$u_i = \lambda\varepsilon_i + \zeta_i \quad (2)$$

$$v_i = \varepsilon_i + \delta_i \quad (3)$$

Here ε_i, ζ_i, and δ_i are hypothesised to be independently and identically distributed, with mean 0 and same variance of 1; λ is a factor loading.

We can derive the correlation ρ between u_i and v_i as $\rho = \frac{\lambda}{\sqrt{2(\lambda^2+1)}}$. If ρ equals 0, C_i^* will be exogenous in the marketing choice equation and consistent estimates of β and γ in Eq. (1) can be obtained by fitting ordinary probit models. If ρ is significantly different from 0, C_i^* is endogenous and thus an endogenous switching model will be employed.

4. Farm survey

We conducted a survey among farm households between January and March, 2015[3] in Shaanxi Province in the Loess Plateau region and Shandong Province in the Bohai Gulf region. A multistage sampling procedure was used for the selection of observation units. In the first stage, we used the probability proportional to size (PPS) method to select 7 counties (out of the 10 most important apple production counties) in Shaanxi and 8 counties (out of the 10 most important apple production counties) in Shandong according to the size of apple production in 2014. In the second stage, we asked the Agricultural Bureau in each county for the list of apple cooperatives in the county[4]; 5 cooperatives were randomly selected from those lists. Therefore, in total we first selected 75 cooperatives. However, the chairmen of 12 out of the 75 selected cooperatives could not be reached. Therefore, we dropped these 12 cooperatives from our sample resulting in a final sample of 63 cooperatives that were interviewed (30 in Shaanxi and 33 in Shandong). We did face-to-face interviews with the chairperson or other officials involved in cooperative management.[5] Data about the cooperative (e.g. number of members, initiation) were also collected.

Next, 10–12 farm households were interviewed in the village where the cooperative is located.[6] At least 6 cooperative members in each village were interviewed. This gave a total number of 700 farm households that were interviewed, composed of 429 member farm households and 271 non-member households. Using a structured questionnaire, information was collected on apple production in 2009 and 2014 and apple marketing in 2014 (including input use, costs, yields, and output price), as well as household and farm characteristics (e.g. age, education, farm size, and asset investments), and farmers' perceptions about transactions. The collected information was based as much as possible on written records; for farmers that did not keep records it is based on recall data. Some of the interviewed farmers had not sold the apples harvested in 2014, but kept these apples in cold storage. We excluded these farmers from our analysis. Finally, data from 625 farmers, including 374 member farmers (184 in Shaanxi and 190 in Shandong) and 251 non-member farmers (110 in Shaanxi and 141 in Shandong) have been used in the analysis.

[3] Because of the Chinese spring festival in February, our survey was conducted in two periods, before and after the spring festival.

[4] We do not know the number of cooperatives that were on each list. For the sake of confidentiality, the local agricultural bureaus did not allow us to take the name lists of cooperatives out of their offices.

[5] In two cases, the cooperative chairmen were out of office for business during our survey time. We had no choice but to interview others involved in the cooperative management. Both of them knew their chairmen well and could pass on basic information about the chairmen, such as age, education level, and work experience.

[6] The (five or ten) enumerators went in different directions from the local village offices and interviewed the first one or two farm households who were found at home.

5. Variable specifications and expected effects

Table 1 shows the variables used to explain farmers' decision on cooperative membership and choice of marketing channels. Their choice is based on the conceptual framework in Section 2.

Indicators of production-specific assets are as follows. We use the apples-bearing land area (labelled 'area') to proxy output size and farm scale. To deal with potential endogeneity, we use a five-year lag for this variable. The share of land dedicated to apple production is used to measure the farmer's degree of specialisation. The more specialised the farm is, the more likely the farmer will have specific assets on the farm (Pascucci et al., 2012a). Due to potential reverse causality between farmer's degree of specialisation in apple production and cooperative membership, we exclude the specialisation variable from the cooperative membership switch equation. The degree of participation in non-farm work for the household head is included as an indicator of access to cash income. Studies have shown that non-farm activities can be an important source of cash income for farm households (Reardon et al., 1994). We expect that with increasing participation in non-farm work, the farmer has more liquidity. Transaction costs hence decrease. As farm size (i.e. apples-bearing land area) is one of the explanatory variables in the model, the estimated coefficient for participation in non-farm work reflects the impact for given farm sizes. The probability for the farmer to become a cooperative member thus will decrease with the increasing participation in the non-farm work. However, being a cooperative member may reduce the farmer's participation in the non-farm work due to involving in the cooperative business. Due to potential reverse causality between farmer's degree of participation in non-farm work and cooperative membership, we exclude the non-farm work variable from the cooperative membership switch equation.

Human capital increases "the ability to perceive, interpret, and respond to new events in a context of risk" (Schultz, 1982). Farmer's education level and age are used as indicators of human capital. In addition, the frequency of participation in technical training and the self-evaluated level of apple producing skills[7] are also included.

We use the number of plots each household cultivates, the distance to the nearest wet market,[8] and a dummy variable indicating whether or not there are apple brokers[9] in the village or nearby to depict geographical location. Farmers in mountainous or hilly areas tend to have small and scattered land holdings (Tan et al., 2008). Moreover, the distance to the nearest agricultural wet market is used as an indicator of market access. The dummy variable of apple brokers in the same village as well as nearby villages is used to proxy the availability of market information. We hypothesise that farm households with more plots, larger distance to a wet market, and few information sources experience higher transaction costs in marketing.

We measure the transaction uncertainty based on farmers' transaction experiences. Questions about farmers' perceptions of transaction uncertainty are grouped into three categories: ex ante uncertainty, uncertainty during the delivery, and ex post uncertainty. Five-level Likert scales are used to measure the degree of uncertainty. To measure physical environmental uncertainty, which affects economic activities and transaction costs, we use an indicator of whether there have been production losses caused by extreme weather in the past 5 years.

We also control for the institutional environment. The Chinese government has been crucial in the genesis of cooperatives in China. Particularly since 2007, government support has been an important

[7] "Self-evaluated level of apple producing skills" might not only capture farming skills but also perceived self-efficacy (Wuepper and Sauer, 2016).

[8] A wet market is a traditional (street) market selling fresh produce and meat (Tracey-White, 1991).

[9] The term of "apple broker" refers to a person who functions as an intermediary between farmers and buyers in searching, contacting and bargaining.

Table 1
Expected effects.

Hypothesis		Variable name	Impact on TC	Impact on membership	Description
Control variables		gender	+/−	+/−	gender of the household head (male = 1)
		quality	+/−	0	% of the apples without blemishes in the total apple output in 2009
Production-specific assets (PA)	Physical PA	area	+	+	size of land bearing apples (unit: *mu*[a])
		non-farm work	−	0	the household head participating in non-farm work = 1, otherwise = 0
		specialisation	+	0	share of land dedicated to apple production
	Human PA	age	+/−	+/−	age of the household head
		education	−	+	years of education of the household head
		household size	+/−	+/−	household size
		training	+	+	frequency of participation in technical trainings in 2009
		skill level	+	+	self-evaluated level of apple producing skills (1 = bad; 2 = mediocre; 3 = good; 4 = excellent)
Geographical location		plots	+	+	number of plots cultivated by the household
		apple brokers	−	−	presence of apple brokers in the same village or nearby villages = 1, otherwise = 0
		distance	+	+	distance to the nearest agricultural spot market (unit: km)
Transaction uncertainty (TU)	Environmental uncertainty	weather loss	+	+	loss caused by extreme weather in the past 5 years = 1, otherwise = 0
	Behavioural uncertainty	ex-ante TU1	+	0	ex-ante TU (To what extent do you agree with the statement that "I have no idea about prices to be offered by buyers beforehand?" Scale 1–5)
		ex-ante TU2	−	0	ex-ante TU (To what extent do you agree with the statement that "I know beforehand about the quality requirements of buyers?" Scale 1–5)
		during TU	+	0	during TU (To what extent do you agree with the statement that "I suffered loss caused by decisions that were changed unilaterally by buyers during the transaction?"[b] Scale 1–5)
		ex post TU	+	0	ex post TU (To what extent do you agree with the statement that "I suffered loss caused by delayed payments by buyers?" Scale 1–5)
Institutional environment		initiation	0	+	cooperative was initiated by village cadres or another government organisation = 1, otherwise = 0
		village cadre	0	+	any family member has experience as village cadre = 1, otherwise = 0
		region	+/−	+/−	regional dummy (Shaanxi = 1; Shandong = 0)

Note: TC denotes transaction cost.
+ stands for positive impact; − stands for negative impact; +/− stands for unclear direction; 0 stands for no impact.
[a] *mu* is traditional Chinese unit of area (1 hectare = 15 *mu*).
[b] The change during the transaction mainly refers to quitting the transaction unilaterally or lowering the promised intentionally by the buyer before the final deal is reached by both parties.

reason for the foundation of cooperatives (Deng et al., 2010). We use three dummy variables to sketch the institutional settings: whether the cooperative was initiated by village cadres or by another government organisation, whether family members have been village cadres, and a dummy reflecting the regional in which the household resides. The first two institutional variables are assumed to only affect the farmer's choice of membership, not the choice of marketing channels.

Using exclusion covariates in the switch equation that do not enter the outcome equation is the preferred approach for model identification (e.g. Deb and Trivedi, 2006). The three variables that are used as such in our model are the frequency of participating in training for apple production in 2009, whether cooperatives were initiated by village cadres or other government organisations, and whether any family member has experience as village cadre. Technical training in apple production increases the likelihood that farmers specialise in apple production, and therefore join apple cooperatives. The training usually does not include marketing-related training, and therefore is unlikely to have a direct effect on the choice of marketing channels. There are also no a priori reasons to expect that the way in which cooperatives are initiated has a direct effect on farmers' choice of marketing channels. Likewise, cooperative membership is likely to be affected by the presence of one or more family members with village cadre experience. But a direct effect of village cadre experience on marketing channel choice is much less plausible.

6. Results

6.1. Descriptive statistics

6.1.1. Marketing channels

We find that most farm households plant more than one apple cultivar. The most common cultivars are Fuji, Gala, Delicious, and Jonathan. In Shandong, Fuji is the dominant cultivar planted, accounting for 70.2% of the total planting area and 76.2% of the total apple output in 2008; in Shaanxi, the plantation area of Fuji apples equals 65% of the total area and the planting area has been increasing (Cong, 2008). We thus focus our analysis on Fuji apples only.

The main marketing channels for apple farmers are wholesalers, small dealers and cooperatives. As shown in Table 2, the share of wholesalers in the marketing channels is 43.7 percent, followed by small dealers (41.9 percent), cooperatives (10.6 percent) and other channels (3.7 percent). Relatively more non-member farmers sell their apples to small dealers and relatively fewer farmers sell their output to

Table 2
Apple marketing channels used by members and non-members of cooperatives.

Marketing channel	Members	Non-members	Total (%)
Wholesalers	176 (44.0%)	120 (44.8%)	296 (43.7%)
Small dealers	156 (38.1%)	128 (47.8%)	284 (41.9%)
Cooperatives	59 (14.4%)	13 (4.9%)	72 (10.6%)
Other channels	18 (4.4%)	7 (2.6%)	25 (3.7%)
Total	409 (100%)	268 (100%)	677 (100%)

Table 3
Descriptive statistics.

Variable name	Members Mean (S.D.)	Non-members Mean (S.D.)	Difference	Full sample Mean (S.D.)
membership	1.00	0.00	1.00	0.60
	(0.00)	(0.00)		(0.49)
gender	0.99	0.97	0.02*	0.98
	(0.12)	(0.16)		
quality	83.38	82.69	0.69	83.1
	(17.71)	(17.69)		(17.69)
area	8.59	7.63	0.96	8.2
	(10.85)	(22.06)		(16.3)
non-farm work	0.10	0.13	−0.03	0.11
	(0.34)	(0.30)		(0.36)
specialisation	0.83	0.85	−0.02**	0.84
	(0.23)	(0.23)		(0.23)
age	51.99	52.05	−0.06	52.01
	(7.99)	(9.66)		(8.69)
education	9.47	8.88	0.59***	9.23
	(2.27)	(2.52)		(2.39)
household size	3.75	3.64	0.11	3.7
	(1.37)	(1.49)		(1.42)
training	2.09	1.22	0.87***	1.74
	(2.15)	(1.66)		(2.01)
skill level	2.39	2.63	−0.24***	2.53
	(0.69)	(0.72)		(0.72)
region	0.49	0.44	0.05	0.47
	(0.50)	(0.5)		
plots	3.86	3.55	0.31**	3.73
	(2.16)	(1.71)		(1.99)
apple brokers	0.42	0.43	−0.01	0.43
distance	7.53	6.83	0.7	7.25
	(8.50)	(8.32)		(8.43)
weather loss	0.79	0.78	0.01	0.79
	(0.40)	(0.42)		
ex ante TU1	3.34	3.37	−0.03	3.35
	(1.38)	(1.37)		(1.37)
ex ante TU2	4.22	4.18	0.04	4.21
	(1.03)	(1.02)		(1.02)
during TU	3.02	2.88	0.14	2.96
	(1.45)	(1.42)		(1.44)
ex post TU	2.75	2.62	0.13	2.69
	(1.57)	(1.52)		(1.55)
initiation	0.45	0.41	0.04	0.43
	(0.5)	(0.49)		(0.5)
village cadre	0.27	0.16	0.11***	0.22
	(0.44)	(0.36)		
Observations	374	251	–	625

Note: S.D. denote standard deviations.
*** Denote that mean values for cooperative members are significantly different from non-member farmers at 1% levels.
** Denote that mean values for cooperative members are significantly different from non-member farmers at 5% levels.
* Denote that mean values for cooperative members are significantly different from non-member farmers at 10% levels.

cooperatives. Most farmers use just one marketing channel; 52 out of 625 farmers (8.3 percent) sell their apples through two marketing channels. To avoid losing relevant information about these households, we use dummy variables for each of the channels used by the farmers in the sample as dependent variables and use endogenous switching probit models for estimating the coefficients of variables that explain the three marketing channel choices.

6.1.2. Explanatory variables: cooperative members and non-members

Table 3 shows descriptive statistics (mean and standard deviation) of the explanatory variables used in the regression analysis and the mean difference of these variables between member farmers and non-member farmers. We find that, in general, apple farm households are highly specialised with 84 percent of the land dedicated to apples on average, but with dispersed (3.73 plots per household on average) and small production scales (mean apples-bearing land area of 0.55 ha). As to the differences between the two groups, cooperative members have higher education levels, more plots of land and participate more in technical training for apple production on average than non-members; and their families have more experience as village cadres on average than non-members. In contrast, non-members are more specialised in apple production and have better producing skills on average than members. The regional dummy statistics show that 49% of member farmers and 44% of non-members in our sample are from Shaanxi Province.[10]

6.2. Estimation results

We use the endogenous switching probit model (ESP) specified in (1) to estimate the factors affecting cooperative membership and choice of marketing channels. As shown in Table 1, we use 19 explanatory variables to estimate factors affecting farmers' choice of membership and 20 explanatory variables for the choice of marketing channels.[11] We focus on the three main marketing channels, i.e. wholesalers, small dealers and cooperatives (see Table 2). Due to the small share of apple farmers using other channels (3.7%; see Table 2), we do not distinguish it as a separate channel in the marketing channel choice equations.

First, we check the potential multicollinearity of explanatory variables on the basis of variance inflation factors (VIFs) in two separate linear probability models estimated using OLS (Menard, 2002). For the membership equation, the highest VIF is 7.74[12] (average of 1.87) and for the three delivery equations of each market channel the highest value is 8.16 (average of 1.89). Both values are lower than the often chosen critical value of 10 (Spanos and McGuirk, 2002), indicating that multicollinearity is not a major problem. Table 4 shows the estimation results.

6.2.1. Switch model: cooperative membership

The second and third column of Table 4 present the estimation results for the switch model of membership. We find that the apple bearing area has a significant positive effect on the probability of being a member of a cooperative. As regards to the human capital indicators, we find that education of the household head, the frequency of participating in production trainings and the self-evaluated skill level have significant positive effects on cooperative membership. The age of the household head (an indicator of working experience) and household size, on the other hand, do not significantly affect membership decisions. With respect to the indicators of geographic location, only the number of plots owned by the household have significant impact on membership. We do not find significant effects for the indicators of transaction uncertainty. Finally, only one of the two institutional environment variables is found to have a significant impact on membership decisions. We find that households with family members having experience as village cadre are significantly more likely to participate in a cooperative. It may also be noted that two of three instrumental variables used for identification, frequency of training and experience as village cadre, have a significant effect on membership.

6.2.2. Outcome model: choice of marketing channel

The six columns at the right-hand side of Table 4 summarise the estimation results for the three main marketing channels. The values of

[10] It is not possible to include 14 county dummies, instead of a province dummy, in the model because for the cooperatives channel equation can no longer be estimated in that case (given the limited number of households selling through that channel).
[11] Besides the variables listed in Table 1, we also include the square term of "area" in the estimations.
[12] The inclusion of the square term of area in both choice models contributes to the high value of VIF. If we delete this square term in both models, the average values of VIF for both membership model and marketing channel model will decrease to 1.18 and 1.17, respectively.

Table 4
Estimation results for endogenous switch probit model of three main marketing channels.[a]

Variables	Switch model		Wholesalers		Small dealers		Cooperatives	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
membership	–	–	0.961***	0.196	−1.116***	0.353	0.201	0.769
gender	0.367	0.389	0.166	0.378	−0.190	0.383	−0.052	0.539
quality	–	–	0.006**	0.003	−0.003	0.003	0.003	0.005
area	0.040***	0.014	−0.038*	0.021	0.029	0.022	0.030	0.029
$(area)^2$	0.000	0.000	0.001*	0.000	−0.001	0.001	0.000	0.001
non-farm work	–	–	0.236*	0.134	−0.311**	0.160	0.092	0.235
specialisation	–	–	0.459**	0.231	−0.622***	0.246	0.589	0.378
age	0.002	0.007	−0.007	0.007	0.006	0.007	−0.002	0.010
education	0.045**	0.023	−0.002	0.023	−0.023	0.026	0.040	0.035
household size	−0.002	0.044	−0.078*	0.043	0.043	0.043	0.119*	0.063
training	0.135***	0.028	–	–	–	–	–	–
skill level	0.252***	0.077	−0.044	0.077	−0.018	0.088	0.126	0.118
region	0.135	0.142	0.358***	0.136	−0.235	0.148	−0.298	0.204
apple brokers	−0.120	0.128	0.455***	0.121	−0.195	0.122	−0.707***	0.186
plots	0.052*	0.030	0.045*	0.027	−0.065**	0.033	0.053	0.034
distance	0.003	0.006	0.012*	0.006	−0.012*	0.007	0.006	0.009
weather loss	0.102	0.129	−0.076	0.124	0.087	0.127	0.365*	0.198
ex-ante risk1	−0.028	0.040	0.018	0.037	0.033	0.039	−0.076	0.054
ex-ante risk2	0.021	0.052	0.012	0.049	0.015	0.050	−0.104	0.068
during-risk	0.009	0.038	−0.077**	0.036	0.071**	0.037	−0.037	0.051
ex-post risk	0.045	0.036	−0.029	0.034	0.045	0.035	0.028	0.049
initiation	−0.017	0.099	–	–	–	–	–	–
village cadre	0.232*	0.129	–	–	–	–	–	–
_cons	−2.219***	0.725	−1.095	0.789	0.969	0.828	−2.775	1.170
ρ	–	–	−0.664***	0.099	0.590**	0.338	0.243	0.398
No. of obs.	625		625		625		625	

* Denote significance level of 10%.
** Denote significance level of 5%.
*** Denote significance level of 1%.
[a] Each marketing channel choice model has one corresponding switch model. Because the estimated coefficients in each switch model have the same signs and similar degrees of significance, we present the results for the switch model of the wholesalers channel for simplicity. Estimation results of the other two switch models are shown in Table A.1 in the Appendix.

ρ are significant (at the 1% and 5% level, respectively) in the wholesalers and small dealers models. These findings support the premise that the cooperative membership decision is an endogenous decision in the choice of these marketing channels. For the cooperative channel, however, we find that ρ does not significantly differ from zero. Thus membership can be considered exogenous in the case of selling to cooperatives. Therefore, in principle an ordinary probit model could be applied for estimating the factors affecting the choice of this channel. However, note that this result may be due to the relatively small number of farmers selling to cooperatives. Therefore, for congruency we stick to the endogenous switching probit results for all three market outlets.

The most striking result is that for cooperative membership, which is the main focus of our study. We find that membership has a significant positive effect on the probability that an apples farmer will sell the output to a wholesaler, and a significant negative effect on the probability of selling to a small dealer. But membership of a cooperative does not have a statistically significant effect on the probability of selling apples to a cooperative.

With regard to production-specific assets, we find that land area has a significant non-linear impact on the probability of selling to wholesalers. With an increase in the apples bearing area, farmers seem to be less inclined to sell apples to wholesalers. But when the area exceeds 19 *mu* (about 1.27 ha), the probability of selling to wholesalers increases with the area. The positive relationships between apples bearing area and selling to small dealers or cooperatives are both not statistically significant. We further find that more specialised apple farmers who are more involved in non-farm work are more likely to sell their output to wholesalers and less likely to sell it to small dealers. The results do not show significant relationships between human capital assets and choice of marketing channels, with one exception. We find that household size exerts a significant negative and positive impact (at the 10 percent level) on the likelihood of selling to wholesalers and cooperatives, respectively.

Geographic location seems to play an important role in marketing channel choices. We find that the presence of apple brokers in the village or nearby has a significant positive impact on the probability of selling to wholesalers and a significant negative impact on selling to cooperatives. Farmers living in villages with a relatively large distance to the nearest agricultural wet market are more likely to sell their output to wholesalers and less likely to sell it to small dealers. Selling to cooperatives is not significantly affected by the distance to the nearest wet market. The number of plots cultivated by a household has a negative impact on the likelihood of selling to small dealers, but no significant effect either on selling to wholesalers to cooperatives. We further find that, controlling for other factors affecting channel choices, farmers in Shandong province are more likely to sell their apples to wholesalers as compared to farmers in Shaanxi province.

The impact of transaction uncertainty on marketing channel

choice is limited. We find evidence that farmers who experienced an output loss during the previous five years are more likely to sell their apples to cooperatives. Selling to wholesalers or small dealers is not significantly affected by weather-induced losses. Ex ante and ex post transaction uncertainties do not have significant effects on farmers' output channel choices. But uncertainty during a transaction, as caused by unilateral decisions of the buyer, makes apples farmers more likely to sell to small dealers and less likely to sell to wholesalers.

7. Discussion

7.1. Determinants of marketing channel choices

Our major finding is that cooperative membership has a significantlypositive effect on the choice of wholesalers, a negative effect on the choice of small dealers and an insignificant effect on the choice of cooperatives as marketing channel for the apple farmers surveyed for this study. We will discuss this result and its policy implications in more detail in the next chapter.

The land area bearing fruits is found to have a significant negative effect on the probability of selling to wholesalers up to a turning point of almost 19 *mu* (about 1.27 ha.). This finding suggests that very small farmers often sell their apples jointly with other farmers to wholesalers; with increasing land size they are more likely to sell all their output to small dealers or cooperatives. But the estimated coefficients for land area in the equations for the latter two marketing channels do not differ significantly from zero (at a 10 percent level).

With respect to other production-specific assets, we find that farmers who are more involved in non-farm work and those that devote a larger share of their land to apples production are more likely to sell their output to wholesalers and less likely to sell it to small dealers. Transaction costs incurred at the farmers' side may explain the first of these two findings. Farmers involved in non-farm work will face relatively high opportunity costs of the time that they spend on negotiating transactions, obtaining information, and so on. The amount of time spent on output selling transactions will generally be lower for the wholesalers channel, especially when cooperatives coordinate such transactions. The finding that more specialised apples farmers are more likely to sell their output to wholesalers may have to do with the apple quality. More specialised farmers will generally have more knowledge about appropriate production technologies and be able to produce more uniform output. The costs involved in quality checking and grading, which is usually done by the wholesalers themselves, are therefore less.

We do not find evidence that sunk costs in human asset-specificity affect the choice of output channels by apples farmers. The only human capital variable that has a statistically significant impact is household size in both the wholesalers and the cooperatives channels equations. It exerts a negative and positive impact (at the 10 percent level) on selling to wholesalers and cooperatives, respectively. The results suggest that larger households may have closer contacts with cooperatives and therefore are more likely to sell their output through cooperatives, rather than the other channels. More research is needed to examine the exact underlying mechanism.

The presence of apple brokers in the village or nearby has a significant positive impact on the probability of selling to wholesalers and a significant negative impact on selling to cooperatives. Similar to cooperatives, apple brokers usually help organise transactions commissioned by wholesalers, especially in the villages without cooperatives. Our findings indicate that in villages where cooperatives are present apple brokers induce a switch in marketing channels from cooperatives towards wholesalers. Other geographical location factors are also found to play important roles. Farmers living in villages with a relatively large distance to the nearest agricultural spot market are more likely to sell their output to wholesalers and less likely to sell it to small dealers. Proximity to a wet market usually means more potential buyers. In particular there will be more itinerant small dealers with relatively limited travel radius near a wet market. These small dealers prefer to buy apples from sellers nearby to economise on their costs. For similar reasons, the number of plots cultivated by a household is found to have a negative impact on the likelihood of selling to small dealers. Farm households with a large number of plots usually live in relatively remote, hilly or mountainous areas which are less accessible for small traders.

Cooperatives usually buy all grades of their members' apples, even the ones with blemishes caused by extreme weather during the growth period. This fact probably explains why we find that farmers who experienced an output loss during the previous five years are more likely to sell their apples to cooperatives. Ex ante and ex post transaction uncertainties do not have significant effects on farmers' output channel choices. The limited effects of transaction uncertainties on farmers' choice of marketing channels can be explained from specific characteristics of apple wholesalers. When wholesalers plan to buy apples from farmers, they usually provide farmers with specific information about quality grades and the corresponding prices for each grade. This information is released beforehand and thus reduces the potential loss caused by ex-ante uncertainties. Wholesalers usually pay farmers in cash after the transaction, which reduces the potential loss caused by ex post uncertainty. Results of our survey show that 259 out of 285 farm households[13] (i.e. 91 percent) selling to wholesalers received payment at the same time as the transaction took place. Due to the relatively large transaction volumes, wholesalers usually buy apples from different farmers within the same village and/or nearby villages. They thus can choose among different farmers supplying apples, and usually select farmers who offer apples of comparatively high quality. The significant positive effect of the quality variable in the wholesalers channel equation is consistent with this observation. Farmers that have not been selected have to take the loss caused by this uncertainty during transactions, and will need to sell to other channels, e.g. small dealers. This explains why we find that uncertainty caused by unilateral decisions of the buyer makes apples farmers more likely to sell to small dealers instead of wholesalers.

7.2. Determinants of cooperative membership

The significantly positive effect of land area on cooperative membership is in line with our hypothesis that large-scale farms have more specific assets for apples production. As these assets cannot easily be transferred to other productive purposes, farmers with a larger area of apple bearing land have a greater probability to join cooperatives. Likewise, we find that human asset specificity as reflected by the level of education of the household head, the frequency of technical training and the perceived skill level have significant positive effects on cooperative membership. The only significant indicator of geographic location is plots. Farm households with a larger number of plots usually live in relatively remote, hilly or mountainous. They usually experience higher transaction costs during marketing and thus are more probably to participate in cooperative. This result is in line with our previous hypothesis. However, we do not find significant effects for the indicators of the transaction uncertainty variables.

Finally, we find that households with one or more family members having experience as a village cadre are significantly more likely to

[13] We only collected transaction details about the most important marketing channel for each household. For 285 households out of the 296 farmers in our sample who sold apples to wholesalers (see Table 2), the wholesale channel was the most important marketing channel.

participate in a cooperative. Village cadres in China are supposed to fulfil state tasks (Kung et al., 2009) and they are generally quick responders not only to new agricultural technologies and techniques, but also to the new government policies. Given the recent focus in Chinese policy making on the development of cooperatives, it is no surprise that households with village cadre experience are more likely to become members of a cooperative.

7.3. Robustness checks

As a robustness check, we compare the endogenous switching probit results (Table 4) with results from a linear probability model estimated with 2SLS (2SLS-LPM; Table A.2) and a bivariate probit model (BPM; Table A.3).

Compared with the endogenous switching probit (ESP) estimates, we find that the 2SLS-LPM coefficient estimates have similar signs and effects but are less efficient.[14,15] This is also reflected in a smaller number of statistically significant parameters in the 2SLS-LPM compared to the ESP. The results of the Durbin-Wu-Hausman test for endogeneity of cooperative membership in the 2SLS-LPM are in line with the statistically significant correlation coefficient estimated by the ESP presented in the bottom row of Table 4. The main conclusion of our study regarding the impact of cooperative membership on farmers' choice of marketing channels remains the same.

Comparing the results estimated by the BPM and the ESP, we find that the coefficients are very similar both in magnitudes and significant levels. However, generally the ESP produces smaller standard errors than BPM, which gives ESP a comparative advantage. The conclusions that we can draw from the BPM are exactly the same as the ones drawn from the ESP in Section 7.1.

8. Conclusions

This paper seeks to examine how cooperative membership affects farmers' choice of marketing channels. Using transaction cost economics as a theoretical framework, we employ three endogenous switching probit models to estimate the determinants of each marketing channel based on field survey data collected among 625 farming households in Shaanxi and Shandong provinces in China. The empirical results show that cooperative membership has a significantly positive effect on the choice of wholesalers as marketing channels, along with a negative effect on choosing small dealers and an insignificant effect on choosing cooperatives.

We explain the varying effects of cooperative membership on farmers' choice of the different marketing channels mainly from the perspective of services by cooperatives. Both the current small market share represented by cooperatives and the services provided by cooperatives, especially the marketing information service and marketing coordination activities for members, explain the insignificant effect of cooperative membership on farmers' choice of cooperatives as the marketing channel. Even if cooperatives do not buy their members' apples, most of them collect marketing information, introduce wholesalers to members and help coordinate transactions for members. Membership thus exerts a positive effect on the choice of wholesalers, but a negative effect on the choice of small dealers, as a marketing channel.

We thus can conclude that the majority of the surveyed cooperatives are supply cooperatives, rather than marketing ones. Most of these cooperatives were established after 2007 and they are still young compared to other entities in the market. According to Cook's cooperative life cycle framework (2009), they are still in the phase of economic justification or organizational design. Hence, it is not surprising that only a small share of the members sell their apples to the cooperatives. Cooperatives still need time to develop, and to realize their potential in facilitating smallholder access to markets and strengthening their economic position.

One important field in which cooperatives can play a crucial role is in improving food traceability. Due to the increasing purchasing power of consumers, technical developments of examining food safety, and especially the recent food scandals, there is growing attention for food traceability, food safety and food quality in China. Cooperatives are regarded as a form of collective action that can help realize food traceability and thus promote food safety (Narrod et al., 2009). For China, Jia et al. (2012) find that those agricultural products that are sold to supermarkets and export firms via cooperatives meet stringent food safety standards and quality requirements. Products sold directly to small traders or wholesalers are generally not tested for their safety (Huang et al., 2008). Our survey data also show that among the 30 households in our sample who had their apples tested for pesticide residues, 24 households (80%) sold apples to cooperatives. However, we find that membership of apples cooperatives does not promote marketing apples through cooperatives. Promoting food quality and food safety therefore requires more than just promoting cooperative membership. In particular, current policies aimed at stimulating agricultural cooperatives may use the public health aspects of food quality improvement to justify a preferential treatment of marketing-oriented cooperatives.

The number of Chinese agricultural cooperatives has increased rapidly since 2006. Over 40% of farm households had joined at least one cooperative by the end of 2015. However, the market share held by cooperatives is still low. What role cooperatives play in the changing agricultural markets and how they can benefit both smallholder farmers and consumers in China are questions that still need to be further explored. Answers to these two questions not only concern the food safety of consumers, but also concern Chinese smallholder farmers' options in adapting to new high-value added markets and increasing their incomes. Our research only provides some first insights into the limited role played by apples cooperatives in the selling of products. More research is needed, particularly on the aforementioned two issues, to augment the science-based evidence needed for designing appropriate food policies that stimulate the role of farmers' cooperatives in promoting food quality and safety as well as smallholder incomes.

One potential limitation of our research is that due to data constraints, we have only explored the determinants of farmers' choice of marketing channels from the perspective of farmers. If we would have data about buyers and other parties in the value chain, especially information about the flexibility of each marketing channel, the services provided and the prices offered by different buyers, we could use this to gain additional insights into farmers' choices of marketing channels. A fruitful future research direction would be to focus on collecting and analysing such detailed information on channel characteristics.

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[14] Coefficients and standard errors of ESP and 2SLS-LPM are not directly comparable due to different transformations used. Amemiya (1981) suggested to multiply the probit coefficients and standard errors by 0.4 (and add 0.5 for the constant) to make them comparable to LPM parameters.

[15] We could also estimate the three different marketing choice equations together as a system using 3SLS (3SLS-LPM). However, since all three equations contain the same variables theoretically there is no gain in efficiency (Greene, 2008: 257–258). This was confirmed when estimating such a system (results available upon request).

Appendix A. Detailed switch model results and results of robustness checks

See Tables A1–A3.

Table A1
Switch model estimation results corresponding to other two marketing channels.

Variables	Small dealers		Cooperatives	
	Coef.	S.E.	Coef.	S.E.
gender	0.396	0.397	0.412	0.377
area	0.039***	0.013	0.041*	0.022
(area)^2	0.000	0.000	0.000	0.001
age	0.001	0.007	0.001	0.007
education	0.045**	0.023	0.045*	0.023
household size	−0.001	0.044	0.000	0.044
training	0.130***	0.029	0.127***	0.030
skill level	0.249***	0.077	0.258***	0.078
region	0.141	0.142	0.151	0.145
apple brokers	−0.121	0.128	−0.139	0.129
plots	0.047	0.030	0.052*	0.030
distance	0.003	0.007	0.004	0.007
weather loss	0.105	0.129	0.095	0.131
ex-ante risk1	−0.030	0.040	−0.027	0.040
ex-ante risk2	0.026	0.053	0.021	0.053
during-risk	0.009	0.038	0.010	0.038
ex-post risk	0.047	0.036	0.050	0.037
initiation	0.000	0.102	−0.010	0.109
village cadre	0.235*	0.133	0.221	0.143
_cons	−2.234	0.740	−2.279***	0.730

* Denotes significance at 10%.
** Denotes significance at 5%.
*** Denotes significance at 1%.

Table A2
2SLS-LPM regression results.

Variables	Wholesalers		Small dealers		Cooperatives	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
membership	0.557**	0.261	−0.567**	0.248	0.008	0.146
gender	0.047	0.166	−0.057	0.158	0.017	0.093
quality	0.002	0.001	−0.001	0.001	0.000	0.001
area	−0.004	0.005	0.002	0.005	0.003	0.003
(area)^2	0.000	0.000	0.000	0.000	0.000	0.000
non-farm work	0.116	0.073	−0.136**	0.069	0.019	0.041
specialisation	0.173	0.108	−0.232**	0.103	0.105*	0.060
age	−0.003	0.003	0.002	0.003	−0.001	0.002
education	−0.005	0.011	−0.006	0.011	0.007	0.006
household size	−0.035*	0.018	0.017	0.017	0.020**	0.010
skill level	−0.031	0.041	0.006	0.039	0.023	0.023
region	0.118*	0.064	−0.061	0.061	−0.046	0.036
apple brokers	0.204***	0.055	−0.084	0.052	−0.108***	0.031
plots	0.013	0.013	−0.018	0.012	0.015**	0.007
distance	0.005*	0.003	−0.004	0.003	0.001	0.002
weather loss	−0.038	0.055	0.037	0.053	0.051*	0.031
ex-ante risk1	0.008	0.017	0.013	0.016	−0.010	0.009
ex-ante risk2	0.009	0.022	0.003	0.021	−0.018	0.012
during-risk	−0.033**	0.016	0.029**	0.015	−0.008	0.009
ex-post risk	−0.014	0.016	0.020	0.015	0.005	0.009
constant	0.061	0.363	0.820**	0.346	−0.111	0.204
No. of observ.	625		625		625	
χ^2 (Durbin score)		7.128***		5.008**		0.344
F (Wu-Hausman)		6.956***		4.870**		0.332

Table A3
Bivariate Probit model (BPM) regression results.

Variables	Wholesalers		Small dealers		Cooperatives	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
membership	0.994***	0.272	−1.116***	0.352	0.201	0.769
gender	0.153	0.382	−0.190	0.383	−0.052	0.539
quality	0.006**	0.003	−0.003	0.003	0.003	0.005
area	−0.038*	0.020	0.029	0.022	0.030	0.029
$(area)^2$	0.001*	0.000	−0.001	0.001	0.000	0.001
non-farm work	0.231	0.145	−0.311**	0.160	0.092	0.235
specialisation	0.450**	0.229	−0.622***	0.246	0.589	0.378
age	−0.007	0.007	0.006	0.007	−0.002	0.010
education	−0.003	0.023	−0.023	0.026	0.040	0.035
household size	−0.078*	0.043	0.043	0.043	0.119*	0.063
skill level	−0.049	0.081	−0.018	0.088	0.126	0.118
region	0.349**	0.147	−0.235	0.148	−0.298	0.204
apple brokers	0.453***	0.120	−0.195	0.122	−0.707***	0.186
plots	0.043	0.029	−0.065**	0.033	0.053	0.034
distance	0.012*	0.007	−0.012*	0.007	0.006	0.009
weather loss	−0.075	0.123	0.087	0.127	0.365	0.198
ex ante TU1	0.018	0.037	0.033	0.039	−0.076	0.054
ex ante TU2	0.012	0.049	0.015	0.050	−0.104	0.068
during TU	−0.075**	0.036	0.071**	0.037	−0.037	0.051
ex post TU	−0.030	0.034	0.045	0.035	0.028	0.049
constant	−1.057	0.818	0.969	0.828	−2.775*	1.170
ρ	−0.686***	0.170	0.590**	0.231	0.201	0.769
No. of observ.	625		625		625	

* Denotes significance at 10%.
** Denotes significance at 5%.
*** Denotes significance at 1%.

References

Abebaw, D., Haile, M.G., 2013. The impact of cooperatives on agricultural technology adoption: empirical evidence from Ethiopia. Food Pol. 38, 82–91.
Abebe, G.K., Bijman, J., Pascucci, S., Omta, O., 2013. Adoption of improved potato varieties in Ethiopia: the role of agricultural knowledge and innovation system and smallholder farmers' quality assessment. Agric. Syst. 122, 22–32.
Amemiya, T., 1981. Qualitative response models: a survey. J. Econ. Lit. 19, 1483–1536.
Angrist, J.D., 2001. Estimation of limited dependent variable models with dummy endogenous regressors: simple strategies for empirical practice. J. Bus. Econ. Statist. 19, 2–28.
Barrett, C.B., 2008. Smallholder market participation: concepts and evidence from eastern and southern Africa. Food Pol. 33, 299–317.
Bijman, J., 2016. The changing nature of farmer collective action: introduction to the book. In: Bijman, J., Muradian, R., Schuurman, J. (Eds.), Cooperatives, Economic Democratization and Rural Development. Edward Elgar Publishing Ltd., Cheltenham, UK, pp. 1–22.
Bijman, J., Iliopoulos, C., 2014. Farmers' cooperatives in the EU: policies, strategies, and organization. Ann. Public Coop. Econ. 85, 497–508.
Cechin, A., Bijman, J., Pascucci, S., Omta, O., 2013. Decomposing the member relationship in agricultural cooperatives: implications for commitment. Agribus. 29, 39–61.
Chagwiza, C., Muradian, R., Ruben, R., 2016. Cooperative membership and dairy performance among smallholders in Ethiopia. Food Pol. 59, 165–173.
Cong, P., 2008. Report about the Nationwide Survey of Apple Cultivars. Chinese Academy of Agricultural Sciences, Beijing.
Deb, P., Trivedi, P.K., 2006. Maximum simulated likelihood estimation of a negative binomial regression model with multinomial endogenous treatment. Stata J. 6, 246–255.
Deng, H., Huang, J., Xu, Z., Rozelle, S., 2010. Policy support and emerging farmer professional cooperatives in rural China. Chin. Econ. Rev. 21, 495–507.
Fischer, E., Qaim, M., 2012. Linking smallholders to markets: determinants and impacts of farmer collective action in Kenya. World Devel. 40, 1255–1268.
Frederick, C., Liu, M., Wu, B., 2015. 2015 Fresh deciduous fruit annual for China. In: Frederick, C. (Ed.), GAIN Report. USDA, Washington, DC.
Greene, W.H., 2008. Econometric Analysis, sixth ed. Pearson Education, Upper Saddle River, NJ.
Hansen, M.H., Morrow, J., Batista, J.C., 2002. The impact of trust on cooperative membership retention, performance, and satisfaction: an exploratory study. Int. Food Agribus. Man. 5, 41–59.
Heckman, J.J., 1978. Dummy endogenous variables in a simultaneously equation system. Econometrica 46, 931–960.
Hellin, J., Lundy, M., Meijer, M., 2009. Farmer organization, collective action and market access in Meso-America. Food Pol. 34, 16–22.
Hendrikse, G., Bijman, J., 2002. Ownership structure in agrifood chains: the marketing cooperative. Am. J. Agr. Econ. 84, 104–119.
Hoffman, S., Royer, J.S., 1997. Evaluating the Competitive Yardstick Effect of Cooperatives on Imperfect Markets: A Simulation Analysis. Western Agricultural Economics Association Annual Meeting, Reno-Sparks, NV.
Huang, J., Wu, Y., Zhi, H., Rozelle, S., 2008. Small holder incomes, food safety and producing, and marketing China's fruit. Rev. Agric. Econ. 30, 469–479.
Jia, X., Huang, J., Xu, Z., 2012. Marketing of farmer professional cooperatives in the wave of transformed agrofood market in China. Chin. Econ. Rev. 23, 665–674.
John, G., Weitz, B.A., 1988. Forward integration into distribution: an empirical test of transaction cost analysis. J. Law Econ. Organ. 4, 337–355.
Kalogeras, N., Pennings, J.M., van der Lans, I., Garcia, P., van Dijk, G., 2009. Understanding heterogeneous preferences of cooperative members. Agribus. 25, 90–111.
Key, N., Sadoulet, E., De Janvry, A., 2000. Transactions costs and agricultural household supply response. Am. J. Agr. Econ. 82, 245–259.
Kung, J., Cai, Y., Sun, X., 2009. Rural cadres and governance in China: incentive, institution and accountability. Chin. J. 61–77.
La Ferrara, E., 2002. Inequality and group participation: theory and evidence from rural Tanzania. J. Public Econ. 85, 235–273.
Masten, S.E., Meehan, J.W., Snyder, E.A., 1991. The costs of organization. J. Law Econ. Organ. 7, 1–25.
Ménard, C., 2007. Cooperatives: hierarchies or hybrids? In: Karantininis, K., Nilsson, J. (Eds.), Vertical Markets and Cooperative Hierarchies. Springer, Netherlands, pp. 1–18.
Menard, S., 2002. Applied Logistic Regression Analysis, second ed. Sage, Thousand Oaks, CA.
Milford, A.B., 2014. Co-operative or coyote? Producers' choice between intermediary purchasers and Fairtrade and organic co-operatives in Chiapas. Agric. Hum. Values 31, 577–591.
Miranda, A., Rabe-Hesketh, S., 2006. Maximum likelihood estimation of endogenous switching and sample selection models for binary, count, and ordinal variables. Stata J. 6, 285–308.
Moustier, P., Tam, P.T.G., Anh, D.T., Binh, V.T., Loc, N.T.T., 2010. The role of farmer organizations in supplying supermarkets with quality food in Vietnam. Food Pol. 35, 69–78.
Mujawamariya, G., D'Haese, M., Speelman, S., 2013. Exploring double side-selling in cooperatives, case study of four coffee cooperatives in Rwanda. Food Pol. 39, 72–83.
Narrod, C., Roy, D., Okello, J., Avendaño, B., Rich, K., Thorat, A., 2009. Public–private partnerships and collective action in high value fruit and vegetable supply chains. Food Pol. 34, 8–15.
Palmatier, R., Stern, L., El-Ansary, A., Anderson, E., 2014. Marketing Channel Strategy. Pearson Prentice Hall, Upper Saddle River, NJ.
Pascucci, S., Gardebroek, C., Dries, L., 2012a. Some like to join, others to deliver: an econometric analysis of farmers' relationships with agricultural co-operatives. Eur. Rev. Agr. Econ. 39, 51–74.
Pascucci, S., Royer, A., Bijman, J., 2012b. To Make or to Buy: Is this the Question? Testing making or buying decisions to explain innovation sourcing strategies in the food sector. Int. Food. Agribus. Man. 15, 99–118.

Reardon, T., Crawford, E., Kelly, V., 1994. Links between nonfarm income and farm investment in African households: adding the capital market perspective. Am. J. Agr. Econ. 76, 1172–1176.
Royer, A., 2011. Transaction costs in milk marketing: a comparison between Canada and Great Britain. Agr. Econ. 42, 171–182.
Schultz, T.W., 1982. Investing in People: The Economics of Population Quality. University of California Press, Berkeley, CA.
Sexton, R.J., 1990. Imperfect competition in agricultural markets and the role of cooperatives: a spatial analysis. Am. J. Agr. Econ. 72, 709–720.
Spanos, A., McGuirk, A., 2002. The problem of near-multicollinearity revisited: erratic vs systematic volatility. J. Economet. 108, 365–393.
Standifird, S.S., Marshall, R.S., 2000. The transaction cost advantage of Guanxi-based business practices. J. World Bus. 35, 21–42.
Swinnen, J.F.M., 2005. When the Market Comes to You-or Not. The World Bank, Washington, DC, pp. 98.
Sykuta, M.E., Cook, M.L., 2001. A new institutional economics approach to contracts and cooperatives. Am. J. Agr. Econ. 83, 1273–1279.
Tan, S., Heerink, N., Kruseman, G., Qu, F., 2008. Do fragmented landholdings have higher production costs? Evidence from rice farmers in Northeastern Jiangxi province, PR China. Chin. Econ. Rev. 19, 347–358.
Tracey-White, J.D. (Ed.), 1991. FAO Agricultural Services Bulletin: Wholesale Markets No. 90. FAO, Rome, Italy.
Verhaegen, I., Van Huylenbroeck, G., 2001. Costs and benefits for farmers participating in innovative marketing channels for quality food products. J. Rural Stud. 17, 443–456.
Wang, L., Huo, X., 2014. Transaction costs comparison between cooperatives and conventional apple producers: a case study of North-western China. Ann. Public Coop. Econ. 85, 233–255.
Wiggins, S., Kirsten, J., Llambí, L., 2010. The future of small farms. World Devel. 38, 1341–1348.
Williamson, O.E., 1979. Transaction-cost economics: the governance of contractual relations. J. Law Econ. 22, 233–261.
Williamson, O.E., 1991. Comparative economic organization: the analysis of discrete structural alternatives. Adm. Sci. Q. 36, 269–296.
Williamson, O.E., 1998. Transaction cost economics: how it works; where it is headed. Economist 146, 23–58.
Williamson, O.E., 2005. The economics of governance. Am. Econ. Rev. 95, 1–18.
Wollni, M., Zeller, M., 2007. Do farmers benefit from participating in specialty markets and cooperatives? The case of coffee marketing in Costa Rica. Agr. Econ. 37, 243–248.
Wooldridge, J.M., 2010. Econometric Analysis of Cross Section and Panel Data. MIT Press, Cambridge, MA.
Wooldridge, J.M., 2014. Quasi-maximum likelihood estimation and testing for nonlinear models with endogenous explanatory variables. J. Economet. 182, 226–234.
Wuepper, D., Sauer, J., 2016. Explaining the performance of contract farming in Ghana: the role of self-efficacy and social capital. Food Pol. 62, 11–27.