Linking apple farmers to markets: Determinants and impacts of marketing contracts in China

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Abstract

This study investigates the determinants of marketing contract choices and the related impact on farm net returns of apple farmers in China. We employ a two-stage selection correction approach (BFG) for the multinomial logit model. On the basis of the BFG estimation, we also use an endogenous switching regression model and a propensity score matching technique to estimate the causal effects of marketing contract choices on net returns. The empirical results reveal that written contracts increase apple farmers' net returns， while oral contracts exert an opposite impact.

Keywords: Marketing Contracts; Multinomial Logit; Selectivity Correction; China

JEL code: C52; Q13

1. Introduction

Marketing contracts are pre-harvest agreement between producers and contractors, in which only price and quantity are agreed (Wang, Wang, and Delgado 2014). Agro-food marketing on a contractual basis is a common arrangement in agricultural sector all around the world. The coordination mechanisms through marketing contract arrangements play a vital role in linking smallholder farmers to advanced supply chains (e.g., supermarkets, restaurants, processors, and international markets), and leading to rural income growth and poverty reduction (Mangala & Chengappa, 2008; Blandon, Henson, & Islam, 2009; Miyata, Minot, & Hu, 2009). For small farmers living in remote rural areas in particular, agro-food marketing with marketing contracts is an enticing option, which may help overcome imperfect markets, improve access to credit, and reduce transaction costs and income risks (Goodwin & Schroeder, 1994; Musser, Patrick, & Eckman, 1996; Katchova & Miranda, 2004). However, despite the benefits associated with marketing contracts, surveys have found that farmers use fewer marketing contracts in developing countries. For instance, in a survey of the fruit sector in 2005, Huang et al. (2008) found that only 22.86% and 4.76% of grapes are respectively sold with written and oral contracts in Shandong province in China.

The significance of marketing contracts in promoting smallholders' market participation and improving their welfare in developing countries has attracted considerable attention of policy analysts. In particular, several studies have examined farmer's binary choice between participating in advanced agro-food supply chains such as supermarkets through the contractual arrangements and selling at spot markets (e.g., Miyata, Minot, and Hu 2009; Escobal and Cavero 2012; Paulson, Katchova, and Lence 2010; Goodwin and Schroeder 1994; Blandon, Henson, and Cranfield 2009; Franken, Pennings, and Garcia 2014). Most researchers find positive role of marketing contracts in serving as a price risk management and/or providing a premium to average spot market prices. As the uncertainties affecting specific types of transactions increase, spot market becomes increasingly costly. Furthermore, an emerging body

of research reveals that participation in high-value markets such as supermarkets through marketing contracts leads to higher net incomes (Neven et al. 2009; Escobal and Cavero 2012).

A number of authors have also examined the nature and determinants of the choices of different types of marketing contracts (Sartwelle, James D. et al. 2000; Katchova and Miranda 2004; Guo and Jolly 2008; Abdulai and Birachi 2009; Jia, Huang, and Xu 2012). For instance, Katchova & Miranda (2004) investigated farmer's choices of marketing contracts such as cash sales, forward contracts, and futures/options. Abdulai & Birachi (2009) noted that the choice of written contracts, verbal contracts and spot market contracts used in Kenyan fresh milk supply chain are determined by location, information source, distance, travel time and gender. In addition to examining the factors that influence farmer's choices of different types of marketing contracts, understanding the linkages between different marketing contract choices and farm outcomes can also provide significant information to agro-food producers and policy makers on whether a particular choice of marketing contract is an effective option for smallholder farmers who are gradually shifting from traditional spot markets to advanced supply chains. The issue is critical, given the increasing significance of contractual arrangements in linking smallholder farmers to modern supply chains in developing countries (Schipmann and Qaim 2011). However, few studies appear to have analyzed the impact of the choice of different types of marketing contracts on farm net returns.

The present study contributes to the debate on contractual arrangements and farm net returns, by examining how different types of marketing contract choices affect farm net returns. In particular, net returns are employed to provide an indication of income effect as it rules out possible differences in the aspect of output level, prices and variable input costs. The study utilizes a cross-sectional survey data of 422 apple farmers collected in Gansu, Shaanxi and Shandong provinces of China between September and December 2013. In the survey regions, farmers are primarily engaged in apple production for their livelihoods, and they are involved in contractual arrangements including written contracts, oral contracts and no contracts for

apple marketing.

We model farmers' choices of marketing contracts as a selection process, where the expected higher net returns drive their choices of particular types of marketing contracts from available alternatives. Specifically, we employ a selectivity based approach for the multinomial logit (MNL) model to examine the impact of the choice of written contracts, oral contracts, or no contracts on farm net returns. This approach was proposed by Bourguignon, Fournier, & Gurgand (2007), which can identify not only the direction of the bias related to the choice of a given marketing contract, but also which type of marketing contract is the source of the bias. In view of non-experimental nature of the data employed in the analysis, we use an endogenous switching regression (ESR) model and a propensity score matching (PSM) technique to estimate the causal effects of marketing contract choices on net returns.

The rest of the paper is structured as follows: Section 2 gives an overview of apple production and marketing in China. This is followed by conceptual framework and estimation technique. Section 4 presents a description of the data used in the analysis. The estimated results are given in Section 5. Conclusions are discussed in the final section.

2. Overview of apple production and marketing in China

China is the largest apple producer in the world. Apple output reached 37 million metric tons in 2012, accounting for nearly 48.44% of the world's total apple output (FAOSTAT). Although apple is widely grown in China, the major producing areas are concentrated in Bohai Gulf region (Shandong, Hebei and Liaoning provinces) and Northwest Loess Plateau region (Gansu, Shaanxi, Shanxi and Henan provinces). The agro-food market in China is dominated by a large number of smallholder farmers, traders and wholesalers (Huang et al., 2007), and apple marketing is no exception. Apple farmers' participation in domestic and international markets is severely constrained as a result of market imperfection, information asymmetry and high transaction costs, especially those producing apples in hilly and mountainous areas. For instance, farmers have better information about apple quality, while buyers have more

information about the markets. However, the information asymmetry prevents the agro-food transactions from operating efficiently. Given these constraints of apple marketing in China, farmers and buyers have learned to choose contractual arrangements that help in addressing these adverse conditions.

As indicated previously, three main types of contractual arrangements are used in the fresh apple supply chain in China. These include written contracts, oral contracts and no contracts or spot market contracts. Written contracts are formal agreements between farmers and buyers with regards to price, quantity, timing, and product attributes. Written contracts are signed by farmers and buyers who are from different marketing channels after negotiation of the contract terms, which are backed by the law. Oral contracts are informal agreements, in which the transaction terms similar to written contracts are verbally agreed. Oral contract users may receive deposit from the buyers to seal the deal. Compared to written contracts, there exists more uncertainties and external contract failure that may result from changing market conditions in informal oral contracts. For instance, buyers may breach the contract, if the profit losses due to downward market price fluctuation would exceed the deposit costs. Finally, no contract refers to spot market transactions, in which the transaction agreements are made on the market at prices fixed according to demand and price changes, without any advanced commitments.

3. Conceptual framework and estimation technique

3.1 The conceptual framework

The conceptual framework employed here is based on the assumption that farmers choose marketing contracts among mutually exclusive alternatives to maximize the expected net returns (π^*) in the presence of transaction costs (*TC*). These marketing contract alternatives could for example be: (1) written contracts; (2) oral contracts; and (3) no contracts (i.e. spot market selling). In essence, the proportional transaction costs increase the real price of inputs

(O_i) and decrease the real price received for output (P_q) (Key, Sadoulet, and Janvry 2000; Ouma et al. 2010). Let TC_i^p and TC_q^p denote proportional transaction costs per unit of input (*I*) and output (*Q*), so that we can derive the adjusted input price $O_i' = O_i + TC_i^p$ and output price $P_q' = P_q - TC_q^p$. Meanwhile, let TC_i^f and TC_q^f denote fixed transaction costs respectively for input and output market participation. Given these assumptions, farmers are assumed to maximize their farm net returns as:

$$\pi^* = max\left[Q(P_q - TC_q^P) - (O_i + TC_i^P)I - TC_q^f - TC_i^f\right] \quad (1)$$

Thus, from equation (1), we can rewrite a reduced form of net returns function, in which the net returns are determined by the output and variable inputs prices, proportional transaction costs for input and output market participation, and household and farm level characteristics (*Z*) as follows:

$$\pi = \pi(P_q, \mathrm{O}, TC_i^p, TC_q^p, Z) \quad (2)$$

For analytical purposes, we further assume that a household *i* compares the expected net returns from choosing marketing contracts (C_{ij}^M) to that obtained from using no contracts (C_{ij}^N), and the rational individual finally chooses to use the marketing contracts, if $C_{ij}^M - C_{ij}^N > 0$. However, the difference in net returns cannot be directly measured, but can be specified as an index function, with an unobserved variable, C_{ij}^* such that:

$$C_{ij}^* = Z\gamma_{ij} + \eta_i$$

$$C_{ij} = 1, \ \ if\ C_{ij}^* > 0$$

$$C_{ij} = 0, \ \ if\ C_{ij}^* \leq 0 \quad (3)$$

where C_{ij} is a binary indicator that equals 1, if the individual uses the marketing contracts, and 0 if the individual uses no contracts or sell at spot markets; in particular, *j*=1 if the farmer chooses written contracts, while *j*=2 if the individual chooses oral contracts. Thus, the farmer only uses marketing contract if the perceived net returns are positive.

3.2 The issue of impact analysis

In order to examine the impact of marketing contract choice on farm net returns, we assume that farm net return is a linear function of a vector of explanatory variables (X_{ij}) and a marketing contract choice dummy (C_{ij}). Thus, the farm net returns function can be specified as:

$$Y_{ij} = \beta X_{ij} + \delta C_{ij} + \mu_i \qquad (4)$$

where Y_{ij} is farm net returns for choosing written contracts (j=1) and oral contracts (j=2); β and δ are parameters to be estimated; μ_i is an error term that satisfies $\mu_i \sim N(0, \sigma)$. The issue of selection bias arises if unobservable characteristics affect both the error terms in equations (3) and (4), resulting in a correlation between the two error terms, i.e. $\text{corr}(\eta_i, \mu_i) \neq 0$.

When selection is over a large number of exclusive choices (e.g., selling apples by choosing written contracts, oral contracts or no contracts), a two-step method is normally employed to address the issue of selection bias based on a multinomial logit model. Two traditional approaches are suggested by L. Lee, (1983) and Dubin & McFadden (Hereinafter DMF, 1984). However, Lee's method estimates a single selectivity effects for all choices together and DMF method establishes *M*-1 selection terms for the *M* choices, which cannot fully address the selection bias issues arising from multiple choices of marketing contracts. Therefore, this study employs a selectivity correction approach proposed by Bourguignon, Fournier, & Gurgand (Hereinafter BFG, 2007), which is more accurate in capturing selectivity effects generated by alternative choices (Khanal & Mishra, 2014).

3.3 BFG method

The BFG method is a two-step estimation model, accounting for selection bias and systematic differences across groups. The first-step applies an unordered multinomial logit (MNL) model aimed at studying farmers' choices of different types of marketing contracts, as well as creating selectivity terms for unbiased estimation of net returns equations. Since three types of marketing contracts are identified in this study, there are three selectivity correction terms that can be

derived. Given that the first type of marketing contract is chosen (*j*=1), the MNL model is given as:

$$P_1(\varepsilon_1 < 0|Z) = \frac{exp(Z\gamma_1)}{\sum_{j=1}^{3} Z\gamma_j}, j = 1,2,3 \quad (5)$$

where $\varepsilon_1 = max_{j\neq 1}(C_j^* - C_1^*) = max_{j\neq 1}(Z\gamma_j + \eta_j - Z\gamma_1 - \eta_1)$; P_1 is the probability of choosing the first type of marketing contract; j is a categorical variable describing farmers' choices of written contracts (*j*=1), oral contracts (*j*=2) and no contracts (*j*=3); γ_j are the consistent maximum likelihood estimates; Z is a set of explanatory variables for all marketing contract alternatives. In a non-linear model such as the MNL, the estimated coefficients are not interpreted directly, we thus calculate the marginal effects to provide a better understanding about the magnitudes of the coefficients (Greene 2012).

The second step of the BFG method involves the estimation of the net returns equations for the different types of marketing contracts, using ordinary least square (OLS) regression, where the selectivity terms estimated in the first step are simultaneously included to obtain unbiased and consistent estimation. Given that the marketing contract option one is chosen (*j*=1), the outcome equation for net returns, y_1 is specified as:

$$y_1 = X\beta_1 + \sigma_1\left[\rho_1^* m(P_1) + \rho_2^* m(P_2)\frac{P_2}{P_2 - 1} + \rho_3^* m(P_3)\frac{P_3}{P_3 - 1}\right] + w_1 \quad (6)$$

where $m(P_1), m(P_2)$ and $m(P_3)$ are the conditional expectations of η_1^*, η_2^*, η_3^*, which are used to correct for selectivity effects; ρ represents correlation coefficients between μ and η; σ is the standard deviation of the disturbance term from the net returns equation; and w_1 is the error term. The net returns equations for choosing other types of marketing contracts can be written in a similar way.

The selectivity correction terms in equation (6) have econometric interpretations. Specifically, if at least one of them is significant, this would suggest the presence of sample selectivity effects. The estimated coefficients would be biased and inconsistent if these terms are not included in the related net returns equations. Moreover, for each net return specification,

a positive (negative) coefficient of the selectivity term indicates higher (lower) net returns for the farmers, relative to a randomly chosen producer. This is because farmers with better (worse) unobserved endowments are more likely to choose this given marketing contract rather than other alternatives (Bourguignon, Fournier, & Gurgand, 2007). Insignificant selectivity terms indicate the absence of sample selectivity effects.

The BFG estimation investigates the factors associated with the choice of marketing contracts and the related net returns. However, we are also interested in the causal effects of marketing contract choices on net returns. Additional estimations are therefore required. To estimate the causal effects of marketing contract choice accounting for bias due to both observable and unobservable factors, we employ an endogenous switching regression (ESR) model (Lokshin and Sajaia 2004). On the other hand, if none of the selectivity bias correction terms is significantly different from zero in the net return specification for the given marketing contract, this would indicate the absence of selection bias due to unobservable factors. In such a case, we use propensity score matching (PSM) technique to assess the related casual effects of the given marketing contract choice on net returns (Lee 2013). PSM addresses selection bias, but accounts for only observables.

3.4 The ESR model

The ESR is a parametric approach that uses two different estimation equations for a given marketing contract option and other alternatives, while accounting for selection process by including an inverse Mills ratio that is calculated from the selection equation presented in equation (3) (Lee, 1978; Maddala, 1983). The outcome equations are then based on equation (4), separately for each regime, conditional on the marketing contract selection decision, which is estimated by a probit model.

Given the marketing contract choice and outcome equations specified in (3) and (4), respectively, the relationship between the choice of marketing contract and the two regimes can be specified as:

$$C_1^* = Z\gamma_1 + \eta_1 \qquad (7)$$

$$Y_1 = X\beta_1 + \varphi_1 \quad if \;\; C_1 = 1 \qquad (7a)$$

$$Y_0 = X\beta_0 + \varphi_0 \quad if \;\; C_0 = 0 \qquad (7b)$$

where Y_1 represents net returns, if the first marketing contract option is chosen (*j*=1), and Y_0 is net returns derived from choosing other marketing contract options ($j \neq 1$); *X* is a vector of exogenous variables that affect the net returns; φ_1 and φ_0 are error terms, with zero mean and normal distribution. The ESR model addresses the issue of selection bias resulting from unobservable factors as a missing variable problem. In particular, after estimating a probit model using the selection equation (7), the inverse Mills ratios λ_1 and λ_0 and the covariance terms, $\sigma_{\eta 1} = cov(\eta_1, \varphi_1)$ and $\sigma_{\eta 0} = cov(\eta_1, \varphi_0)$ can be calculated and plugged into equations (7a) and (7b):

$$Y_1 = X\beta_1 + \sigma_{\eta 1}\lambda_1 + \xi_1 \quad if \;\; C_1 = 1 \qquad (8a)$$

$$Y_0 = X\beta_0 + \sigma_{\eta 0}\lambda_0 + \xi_0 \quad if \;\; C_0 = 0 \qquad (8b)$$

where λ_1 and λ_0 control for selection bias resulting from unobservable factors such as the local institutional environment for the produce market and farmers' inherent ability; the error terms ξ_1 and ξ_0 have conditional zero means. The full information maximum likelihood (FIML) method suggested by Lokshin and Sajaia (2004) is used to estimate the selection and outcome equations simultaneously. The approach overcomes the drawback of estimating the equations separately, which generates residuals that are heteroskedastic.

The correlation coefficients, $\rho_{\eta 1}(\sigma_{\eta 1}/\sigma_\eta \sigma_1)$ and $\rho_{\eta 0}(\sigma_{\eta 0}/\sigma_\eta \sigma_0)$ of covariance terms between the error terms η_1, φ_1 and φ_0 have econometric interpretations. If $\rho_{\eta 1}$ or $\rho_{\eta 0}$ is significant, this would indicate the presence of selection bias from unobservable factors. Moreover, $\rho_{\eta 1} > 0$ implies negative selection bias, indicating that farmers with below average net returns are more likely to choose the given marketing contract, while $\rho_{\eta 1} < 0$ implies positive selection bias (Lokshin and Sajaia 2004). The consistent estimation also requires that

the correlation coefficient $\rho_{\eta 1}$ in ESR model and the coefficients of the significant selectivity bias terms $m(P_j)$ in BFG model for the given marketing contract option have opposite signs. The effect of marketing contract on farm net returns is examined by specifying expected values of the outcomes. The change in net returns due to a specific marketing contract relative to another contract is specified as the difference between the marketing contracts. These estimates are termed average treatment effects on the treated (ATT).

The ATT τ_{ATT}^{ESR} in this case is:

$$\tau_{ATT}^{ESR} = E[Y_1|C_1 = 1] - E[Y_0|C_1 = 1] = X(\beta_1 - \beta_0) + \lambda_1(\sigma_{\eta 1} - \sigma_{\eta 0}) \qquad (9)$$

3.5 The PSM technique

PSM compares outcomes between only a given marketing contract users ("treated") and those using other marketing contract alternatives ("controlled") that are similar in terms of other observable characteristics, thus reducing the bias that would otherwise occur when the two groups are systematically different (Dehejia and Wahba 2002). It involves two stages. First, we generate propensity score (i.e. the probability) of choosing the given marketing contract using a probit model. Second, we calculate the average treatment effect on the treated (ATT) based on the estimated propensity score. PSM can be expressed as:

$$\Pr(X_1) = \Pr(C_1 = 1|Z_1) = E(C_1|Z_1) \qquad (10)$$

where $C_1 = \{0, 1\}$ is the indicator for choosing the given type of marketing contract (j=1) and Z_1 is the vector of pre-choice characteristics.

After estimating the propensity scores, the ATT, τ_{ATT}^{PSM} can then be estimated as:

$$\tau_{ATT}^{PSM} = E_{P(Z_1)|D_1=1}\{E[(Y_1|D_1 = 1, P(Z_1)] - E[(Y_0|D_1 = 1, P(Z_1)]\} \qquad (11)$$

Several techniques have been developed to match the given marketing contract users and non-users of similar propensity score. In this study, we employ the most commonly used techniques including nearest neighbor matching (NNM), kernel-based matching (KBM) and radius matching methods to estimate the ATT.

4. Data and description

The data employed in the present study come from a farm household survey that was conducted between September and December 2013 in three main apple growing provinces (Gansu, Shaanxi and Shandong) in China. A multistage random sampling procedure with purposive selection of provinces and counties based on the intensity of apple production and random selection of villages and households was employed to select 422 farmers for the survey. Farmers were asked to provide detailed information on personal and farm level characteristics, asset ownership, financial situation, access to information, as well as marketing activities. Only 7.58% of the farmers who used marketing contracts choose different types of contracts. In these cases, we classify their contract type as the type of the contracts with larger proportion of production contracted in order to simplify the analysis. The final dataset of marketing contracts includes records for 179 written contract users, 71 oral contract users and 172 no contract users (i.e. spot market sellers).

The dependent variables considered include written contracts, oral contracts and no contracts, which gives the value of 1 if a given marketing contract was chosen, and 0 otherwise. The outcomes refer to farm net returns, which are measured as the difference between the value of apple yields and variable input costs per mu [1]. The inputs included fertilizer, pesticide, hired labor, films for land moisture conservation and apple coloring, bags, and irrigation. The independent variables employed to explain the determinants of marketing contract choices are based on the existing literature (Katchova & Miranda, 2004; Wang, Wang, & Delgado, 2014).

Table 1 presents descriptive statistics for the survey households. It can be observed that 42% and 17% of farmers choose written contracts and oral contracts, respectively. The rest opted for spot market contracts. Farmers in the sample are smallholders with an average orchard size of 5.22 mu. Apple production and marketing contribute 75% of total household incomes averagely,

[1] 1 mu=1/15 hectare.

and the average net returns per mu is 7110 yuan[2]. In our sample, only 19% of farmers use cooperative organization as a primary marketing channel. 30% of households are observed to acquire output marketing information from their neighbors. More than half of the households are not credit constrained in the survey year. These are households that did not require additional credit for the farming activities.

Table 2 presents differences in the characteristics between written contract users, oral contract users and no contract users. In particular, written and oral contract users are younger than no contract users. The orchard size of oral contract users is about 84% larger compared to no contract users. The orchard size of written contract users is much larger, which is more than double that of no contract users. Compared with no contract users, written contract users are 31% less likely to be credit constrained, while oral contract users are 27% more likely to be capital constrained. Both written and oral contract users have lower market perception of apple demand, compared with no contract users. There are also marked differences in output price and supply quantity between marketing contract users and no contract users. In particular, both written and oral contract users tend to obtain higher prices and sell larger quantities of the produce. The lower part of Table 2 also reveals that the average net returns for written contract users is 2.71% lower than that for no contract users, while the average net returns for oral contract users is much lower than that for the counterpart by 14.38%. Overall, the results presented in Table 2 indicate that written contract users, oral contract users and no contract users are systematically different.

5. Empirical results

5.1 Multinomial logit results on the choice of marketing contracts

The parameter estimates of the choice of marketing contracts used by apple farmers are presented in Table 3. Note that the base group for comparison is farmers selling with no

[2] yuan is Chinese currency unit ($1=6.14 yuan).

contracts. The MNL regression was used to model the farmer's choice of marketing contracts such as written contracts, oral contracts or no contracts, which was conducted in Stata 12.0. As indicated previously, the magnitudes of the coefficients from MNL model is difficult to interpret, we therefore use the marginal effects to interpret the determinants of farmer's marketing contract choices.

The marginal effects of cooperative sale variable are positive and statistically significant for oral contracts, indicating that trust mechanism developed between apple farmers and cooperative organizations contribute to the use of informal oral contracts. As indicated by Guo & Jolly (2008), oral contracts tend to be used by the cooperatives, as underwriting and enforcement may rely on the network and norms of smallholders. The cooperative variable has a negative and significant impact on no contracts, but no impact on written contracts. Farmers who are not liquidity constrained are more likely to choose written contracts and less likely to use oral contracts. The positive and significant marginal effects of the timely payment variable for written contracts indicate that farmers who preferred timely payment are more likely to choose written contracts, while the negative and significant effects for no contracts suggest those who can accept delayed payment are more likely to use no contracts. This is because that timely payment can improve the situation of written contract users, especially resource-poor farmers, although delayed payment may be compensated by higher prices to some extent. Relative to their counterparts in Shandong province (reference division), apple farmers in Gansu and Shaanxi provinces appear to favor the use of written contracts, while they are less likely to use no contracts. The significance of location variables indicates the importance of spatial effects. The volumes of apple sold have a negative, but statistically insignificant effect on oral and no contracts. However, a positive and statistically significant coefficient is observed for written contracts. The estimates also reveal that longer distance to reach buyers is positively and significantly associated with oral contracts. Finally, the variables such as age, education, orchard size, ownership of farming vehicle and computer, extension contact, access to

information through neighbor, and the transacted prices did not appear to influence apple farmers' choice of marketing contracts.

As indicated earlier, another purpose of the MNL selection estimates of marketing contract choices is to account for the unobserved heterogeneity that could bias the results of the coefficients in the net returns equations. Thus, the MNL selection equations need to include one or more valid instruments for model identification, which should strongly influence farmer's choices of marketing contracts, but do not influence the net returns. In this study, we employed a variable representing farmers' perception of apple market demand as an instrument. As evident from the Table A-1 in the Appendix, the employed instrument is uncorrelated with net returns. However, it is highly significant in MNL selection equations, suggesting that it is a valid instrument. Besides, the significant marginal effects of market perception variable also indicate that farmers with perception of higher market demand for produced apples are less likely to use both written and oral contracts, but are more likely to use no contracts, suggesting that marketing contracts are more likely to be used to deal with sluggish markets.

5.2 Impact of marketing contract choice on net returns: BFG estimation

The estimates of the impact of marketing contract choice on net returns are presented in Table 4. As indicated previously, the net return equations are estimated using OLS, in which selection bias correction terms derived from the MNL model are automatically included. The three types of marketing contracts generate three selectivity correction terms, denoted in Mills 1-3, which are used to control for selectivity effects. The estimator variances are all bootstrapped with 100 replications to deal with heteroskedasticity (Huesca and Camberos 2010).

The results reveal that the selectivity correction terms are significant in the choice of written contracts and no contracts, indicating the presence of sample selectivity effects in these specifications. Hence, accounting for selectivity is essential to ensure unbiased and consistent estimates of the coefficients in the net returns equations. For the written contract specification, the estimated coefficient of the selectivity correction term related to no contracts is significantly

negative, indicating lower than expected net returns (downward biased) for written contract users relative to a randomly chosen apple producer. Thus, for farmers that obtained net returns from using written contracts, switching from written contracts to no contracts leads to a negative and significant impact on their farm net returns. This finding also indicates that apple farmers with worse unobserved attributes are more likely to sell their products with written contracts rather than sell with no contracts. For instance, farmers who perceived lower competitiveness of their apple quality in spot markets may be more likely to choose written contracts in order to stabilize marketing channel and reduce marketing risks. In addition, the BFG estimation reveals that all selectivity correction terms are insignificant in the choice of oral contracts, indicating the absence of selectivity effects, and that OLS is appropriate for identifying factors influencing net returns in the oral contract specification.

With regards to the factors influencing selection towards net returns, both the age and education variables tend to have a negative and statistically significant impact on net returns of written contract users. Orchard size appears to have negative and statistically significant impact on net returns of marketing contract users, indicating larger orchard size obtained significantly lower net returns than smaller farms. The finding is consistent with earlier studies by Chen, Huffman, & Rozelle (2011) and Abdulai & Huffman (2014). Interestingly, we found that the variables representing selling apples primarily through cooperative organizations have positive and statistically significant impact on net returns of both written and no contract users, but positive and insignificant impact on that of oral contract users, indicating the growing importance of agricultural cooperatives in providing apple circulation service towards increasing farm net returns. Contact with extension agents tends to have a positive and significant effect on net returns for written contract users, but a negative and significant effect on net returns of no contract users. The extension contact variable has no significant impact on net returns for oral contract users. The finding indicates the important role of extension service in enhancing net returns for marketing contract users, especially written contract users.

Transacted quantities and prices also seem to positively influence the choice of marketing contracts.

The estimates for the first-stage BFG approach are presented in Table 3, while the second-stage results are presented in Table 4. The results provide insights of the important factors that influence the choice of marketing contracts and the related net returns. However, in order to understand the causal effects of marketing contract choice on net returns, some further estimations are required. In particular, given the evidence of significant selectivity correction terms resulting from unobservable factors for written contract specification in Table 4, this study employs ESR model to estimate the related causal effects (Lee 1978). However, since we find no significant selectivity effects in the oral contract specification in Table 4, indicating the absence of selection bias caused by unobservable factors, we use PSM technique to estimate the related causal effects (Rosenbaum and Rubin 1985).

5.3 Impact of written contract choice on net returns: ESR estimation

The estimates of the impact of written contract choice (treatment group) on net returns are presented in Tables 5 and 6, where the control groups are no contract users and oral contract users, respectively. As indicated previously, the FIML approach estimates both the selection and the outcome equations jointly. Considering the primary purpose of ESR estimation in this study is to estimate the causal effects of written contract choice on net returns, the interpretation of detailed results in Tables 5 and 6 is not put forward. It is worthy to note here that the coefficients of variables in the written contract choice equations in Tables 5 and 6 usually have the similar sign and significance with the variables estimated from MNL model in Table 3.

An interesting finding in Tables 5 and 6 is the sign and significance of the correlation coefficients ($\rho_{\eta 1}$ and $\rho_{\eta 0}$) of covariance terms between the error terms in the selection and outcome equations. In particular, the results show that the correlation coefficients ($\rho_{\eta 1}$) for the written contract users in both Tables 5 and 6 are statistically significant, indicating the

presence of selection bias resulting from unobservable factors. Hence, taking into account both observable and unobservable factors is essential to obtain unbiased treatment effects (ATT). Moreover, the positive sign for $\rho_{\mu 1}$ indicates a negative selection bias, suggesting that farmers with lower than average net returns have a higher probability to choose written contracts. The negative selection bias here is consistent with the interpretation of negative and significant selectivity term in the net return equation for written contract specification in Table 4, confirming that BFG selectivity model proposed by Bourguignon, Fournier, & Gurgand (2007) is appropriate for the analysis of different types of marketing contract choices.

The estimates for the average treatment effects on the treated (ATT), which shows the causal effects of written contract choice on net returns, are presented in Table 7. The ATT estimates account for selection bias arising from both observable and unobservable factors. The results reveal that the choice of written contracts tends to significantly increase net returns by 2.46%, when no contract users are treated as the control group. Moreover, the causal effect of written contract choice on net returns is much higher when it is against the use of oral contracts, with a 5.43% increase in net returns. These findings suggest that promoting the use of written contracts in fresh apply supply chain can be beneficial to farmers' welfare by contributing to higher net returns.

5.4 Impact of oral contract choice on net returns: PSM estimation

Given the absence of selection bias resulting from unobservable factors for oral contract specification in BFG estimation in Table 4, we employ the PSM technique to assess the causal effects of oral contract choice on net returns. PSM includes two steps. In the first step, a probit model has been employed to predict propensity score (i.e. the probability) of choosing oral contracts. The estimated propensity score is given in Table A-2 in the Appendix, which shows that 83.65% of the sample observations are correctly predicted. The propensity score only serves as a device to balance the observable distribution of covariates across the oral contract

users and non-users (Lee 2013).

Table 8 presents the results estimated for the causal effects of oral contract choice (treatment group) on net returns, where the control groups are no contract users and written contract users, respectively. As indicated previously, the ATT is estimated with the nearest neighbor matching (NNM), Kernal-based matching (KBM) and Radius matching methods. The results generally indicate that the choice of oral contracts exerts a negative and statistically significant impact on net returns. The finding is surprising, because the use of oral contract is also expected to increase net returns. This is possibly due to the fact that oral contracts enable farmers to receive advance payments (i.e. deposit), which can help them overcome short-term capital constraints. However, advance payments normally result in lower product prices, resulting in lower net returns. Moreover, the choice of oral contracts also appears to negatively and significantly decrease net returns by 1.94-2.50% as well, when the control group is the written contract users. This finding is consistent with the finding presented in lower part of Table 6, showing the higher predominance of written contracts in enhancing farm net returns, compared to oral contracts.

6. Conclusions

This study examined the determinants of choosing marketing contracts disaggregated by written contracts, oral contracts and no contracts, as well as the related impact on farm net returns, using data collected from apple farmers in Gansu, Shaanxi and Shandong provinces between September and December 2013 in China. Given the nature of multiple discrete choices of marketing contracts, a two-step BFG model based on the multinomial logit model was employed to address the issue of sample selectivity effects. The results did suggest the presence of selection bias, indicating that accounting for selection bias is a prerequisite for unbiased and consistent estimation.

The empirical findings of the multinomial logit model on determinants of marketing contract choices revealed that the choice of written contracts is positively and significantly

influenced by access to credit, timely payment, and the transacted quantities. The choice of oral contract is positively associated with cooperative sales and distance to markets. With regards to the factors that influence selection towards farm net returns, we observed that written contracts were positively affected by cooperative sales, extension contact, as well as transacted quantities and prices, while oral contracts were exclusively positively influenced by the transacted quantity.

The results of the MNL with selectivity estimation showed significant and negative selection bias correction term in net return model for written contract specification, indicating that the expected net returns for written contract users was downward biased. This is because farmers who are better suited with written contracts switched from written contracts to no contracts leading to a significant negative impact on their farm net returns. The result clearly suggests that unbiased and consistent evaluation of net returns due to certain marketing contract choices must take selectivity effects into account, which confirm that BFG approach is appropriate for such analysis.

On the basis of BFG estimation, we employed an endogenous switching regression model to estimate the causal effects of written contract choice on net returns, as well as a propensity score matching technique to assess the causal effects of oral contract choice on net returns. The results generally showed that the choice of written contracts was to increase net returns by about 2.46% and 5.43%, respectively, when the no contract users and oral contract users are treated as the control groups. However, the choice of oral contract tends to decrease net returns, no matter the control group is no contract users or written contract users. In particular, the causal effect of oral contract choice was to decrease net returns by 2.16-2.28% and 1.94-2.50%, respectively compared with no contract users and written contract users. Overall, the results indicate that marketing contracts functioned to enhance net returns increases only if written contract was chosen, and oral contract users tended to benefit more than no contract users from the use of marketing contracts.

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Table 1 The definitions of the variables used in the analysis.

Variables	Description	Mean (S.D.)
Written contract	1 if farmer chose written contract for apple marketing, 0 otherwise	0.42 (0.49)
Oral contract	1 if farmer chose oral contract for apple marketing, 0 otherwise	0.17 (0.37)
No contract	1 if farmer sold apples with no contract, 0 otherwise	0.41 (0.49
Net returns	Gross revenue minus variable input costs (yuan/1000/mu[a])	7.11 (3.69)
Age	Age of respondent (years)	48.47 (10.46)
Education	No. of years of schooling	7.48 (2.95)
Orchard size	Total fruiting Fuji apple orchards (mu)	5.22 (3.27)
Specialization	The value of total apple yields divided by the total household incomes (%)	0.75 (0.22)
Farming vehicle	1 if farmer owns farming vehicle, 0 otherwise	0.91 (0.29)
Computer	1 if farmer owns computer, 0 otherwise	0.29 (0.45)
Cooperative sales	1 if farmer sold apples mainly through agricultural cooperatives, 0 otherwise	0.19 (0.39)
Extension contact	1 If farmer visited extension service, 0 otherwise	0.39 (0.49)
Access to credit	1 If farmer is not liquidity constrained, 0 otherwise	0.52 (0.50)
Timely payment	1 if farmer received timely payment, 0 otherwise	0.82 (0.38)
Neighbors	1 if farmer acquired output marketing information from neighbors, 0 otherwise	0.30 (0.46)
Market perception	Apple market demand situation last year (1=Bad; 2=Fair; 3=Good)	2.24 (0.85)
Distance	Distance to markets (km)	0.72 (2.66)
Quantity	Quantity of total apple sold (kg/1000)	18.02 (10.67)
Price	Average apple selling price (yuan/kg)	3.72 (0.83)
Shandong	1 if farmer is located in Shandong province, 0 otherwise	0.37 (0.48)
Gansu	1 if farmer is located in Gansu province, 0 otherwise	0.19 (0.39)
Shaanxi	1 if farmer is located in Shaanxi province, 0 otherwise	0.44 (0.50)

[a] yuan is Chinese currency (1$=6.14 yuan); 1mu=1/15 hectare.

Table 2 Difference in characteristics between the users of written contracts, oral contracts and no contracts

Variables	Written contract (N=179)	Oral contract (N=71)	No contract (N=172)
Age	45.17 (10.31)	46.44 (8.51)	52.75 (9.88)
Education	7.80 (2.66)	7.21 (3..32)	7.24 (3.05)
Orchard size	6.97 (3.09)	5.82 (2.80)	3.17 (2.36)
Specialization	0.84 (0.17)	0.70 (0.22)	0.68 (0.22)
Farming vehicle	0.89 (0.31)	0.92 (0.28)	0.92 (0.27)
Computer	0.41 (0.49)	0.31 (0.47)	0.15 (0.36)
Cooperative sales	0.11 (0.31)	0.38 (0.49)	0.20 (0.40)
Extension contact	0.55 (0.50)	0.51 (0.50)	0.19 (0.39)
Access to credit	0.63 (0.49)	0.35 (0.48)	0.48 (0.50)
Timely payment	0.80 (0.40)	0.73 (0.46)	0.89 (0.31)
Neighbors	0.22 (0.41)	0.25 (0.44)	0.40 (0.49)
Market perception	2.05 (0.85)	1.92 (0.92)	2.58 (0.68)
Distance	0.58 (2.23)	0.97 (3.80)	1.26 (3.07)
Quantity	23.51 (11.39)	17.54 (9.61)	12.52 (6.73)
Price	3.83 (1.01)	3.86 (0.60)	3.55 (0.64)
Net returns	7.17 (37.27)	6.31 (3.86)	7.37 (3.54)

Note: Standard deviation in parentheses.

Table 3 Marginal effects based on Multinomial logit selection estimates of marketing contract choices

Variable	Written contract		Oral contract		No contract	
	Marginal effects	Z-Value	Marginal effects	Z-Value	Marginal effects	Z-Value
Age	-0.001 (0.004)	-0.22	-0.004 (0.003)	-1.04	0.004 (0.005)	0.88
Education	0.021 (0.014)	1.53	-0.018 (0.011)	-1.67*	-0.003 (0.017)	-0.18
Orchard size	-0.001 (0.017)	-0.09	0.024 (0.015)	1.61	-0.023 (0.023)	-0.97
Specialization	0.052 (0.208)	0.25	-0.444 (0.167)	-2.66***	0.392 (0.264)	1.48
Farming vehicle	0.014 (0.109)	0.13	0.058 (0.090)	0.64	-0.072 (0.141)	-0.51
Computer	0.001 (0.087)	0.00	-0.001 (0.074)	-0.02	0.001 (0.117)	0.01
Cooperative sales	-0.010 (0.098)	-0.10	0.404 (0.091)	4.43***	-0.394 (0.091)	-4.31***
Extension contact	0.063 (0.073)	0.87	0.064 (0.062)	1.03	-0.127 (0.087)	-1.46
Access to credit	0.175 (0.072)	2.44**	-0.135 (0.061)	-2.20**	-0.040 (0.090)	-0.45
Timely payment	0.171 (0.073)	2.36**	0.066 (0.073)	0.91	-0.237 (0.113)	-2.10**
Neighbor	-0.079 (0.076)	-1.03	-0.058 (0.061)	-0.96	0.137 (0.096)	1.43
Gansu	0.662 (0.107)	6.16***	-0.087 (0.085)	-1.02	-0.575 (0.076)	-7.55***
Shaanxi	0.774 (0.060)	13.01***	0.073 (0.061)	1.21	-0.848 (0.050)	-17.04***
Distance (log)	-0.008 (0.010)	-0.75	0.022 (0.009)	2.60***	-0.015 (0.013)	-1.10
Quantity (log)	0.194 (0.099)	1.96*	-0.015 (0.082)	-0.18	-0.179 (0.120)	-1.49
Price (log)	0.063 (0.179)	0.35	0.115 (0.154)	0.75	-0.178 (0.249)	-0.71
Market perception	-0.155 (0.044)	-3.55***	-0.087 (0.037)	-2.37**	0.241 (0.054)	4.47***

Notes: Base group is no contract sellers;

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

Table 4 Impact of marketing contract choices on net returns: BFG estimation

	Written contract (N=179)		Oral contract (N=71)		No contract (N=172)	
Variable	Coefficients	Z-value	Coefficients	Z-value	Coefficients	Z-value
Constant	2.286 (1.178)	1.94*	1.093 (1.868)	0.59	3.447 (1.106)	3.12***
Age	-0.012 (0.004)	-2.68***	-0.008 (0.013)	-0.59	0.001 (0.005)	0.21
Education	-0.033 (0.016)	-2.13**	-0.045 (0.052)	-0.86	-0.014 (0.013)	-1.07
Orchard size	-0.102 (0.017)	-5.86***	-0.167 (0.046)	-3.67***	-0.174 (0.059)	-2.94***
Specialization	-0.026 (0.342)	-0.07	-0.030 (0.757)	-0.04	0.002 (0.190)	0.01
Farming vehicle	0.021 (0.098)	0.21	-0.192 (0.356)	-0.54	0.039 (0.107)	0.37
Computer	0.107 (0.082)	1.29	0.184 (0.201)	0.92	0.054 (0.091)	0.59
Cooperative sales	0.528 (0.211)	2.50**	0.677 (0.646)	1.05	0.503 (0.122)	4.12***
Extension contact	0.203 (0.0712)	2.84***	0.047 (0.186)	0.25	-0.192 (0.126)	-1.52
Access to credit	-0.157(0.123)	-1.27	-0.052 (0.367)	-0.14	-0.135 (0.086)	-1.57
Timely payment	-0.098 (0.097)	-1.01	-0.250 (0.200)	-1.25	-0.041 (0.124)	-0.33
Neighbor	-0.052 (0.092)	-0.57	-0.076 (0.175)	-0.43	0.016 (0.064)	0.25
Distance (log)	0.009 (0.014)	0.68	0.018 (0.035)	0.52	0.371 (0.138)	2.69***
Quantity (log)	0.762 (0.100)	7.63***	0.952 (0.261)	3.65***	0.021 (0.009)	2.25**
Price (log)	0.793 (0.127)	6.24***	0.353 (0.577)	0.61	0.612 (0.120)	5.11***
Mills 1	-0.368 (0.262)	-1.40	0.493 (1.186)	0.42	0.551 (0.211)	2.61***
Mills 2	0.979 (0.668)	1.47	0.682 (0.610)	1.12	-0.380 (0.560)	-0.68
Mills 3	-0.797 (0.402)	-1.99**	0.541 (0.688)	0.79	1.201 (0.424)	2.83***
Observations	179		71		172	

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

The dependent variables is the logarithm of farm net returns;

Location fixed effects includes in the estimation, but not reported here.

Table 5 The impact of written contract choice on net returns: ESR estimation

Variable	Selection	Net returns	
		Written contract users (N=179)	No contract users (N=172)
Constant	-8.912 (3.114)***	-0.057 (0.800)	2.484 (0.750)***
Age	0.005 (0.014)	-0.007 (0.003)***	0.004 (0.004)
Education	0.073 (0.045)	-0.005 (0.010)	0.004 (0.011)
Orchard size	-0.085 (0.073)	-0.136 (0.012)***	-0.157 (0.017)***
Specialization	-0.337 (0.716)	0.354 (0.153)**	0.252 (0.127)**
Farming Vehicle	0.260 (0.341)	-0.017 (0.084)	-0.020 (0.104)
Computer	0.146 (0.278)	0.118 (0.055)**	0.094 (0.081)
Cooperative sales	0.373 (0.420)	0.212 (0.087)**	0.302 (0.072)***
Extension contact	0.112 (0.236)	0.145 (0.052)***	-0.181 (0.074)**
Access to credit	0.660 (0.261)**	0.060 (0.051)	0.037 (0.063)
Timely payment	0.387 (0.276)	-0.016 (0.066)	0.056 (0.106)
Neighbor	-0.228 (0.286)	-0.026 (0.063)	0.008 (0.059)
Gansu	2.733 (0.493)***	0.634 (0.236)***	0.493 (0.210)**
Shaanxi	3.718 (0.508)***	0.402 (0.243)*	0.367 (0.373)
Distance (log)	-0.005 (0.034)	-0.008 (0.008)	0.004 (0.007)
Quantity (log)	0.706 (0.353)**	0.878 (0.079)***	0.642 (0.070)***
Price (log)	0.119 (0.569)	0.766 (0.109)***	0.592 (0.167)***
Market perception	-0.409 (0.141)***		
$Ln\sigma_1$		-1.140 (0.069)***	
$\rho_{\eta 1}$		0.704 (0.348)**	
$Ln\sigma_0$			-1.108 (0.071)***
$\rho_{\eta 0}$			0.368 (0.775)
Log likelihood	-172.70		
Likelihood ratio test for independent equations $x^2(1)$	2.79*		
Observations	351		

Notes: The dependent variable is the log form of apple net returns measured in yuan/mu (1$=6.14 yuan);

In selection equation, it takes the value of one if farmers used written contract, 0 otherwise;

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

Table 6 The impact of written contract choice on net returns: ESR estimation

Variable	Selection	Net returns	
		Written contract users (N=179)	Oral contract users (N=71)
Constant	-3.379 (2.926)	0.371 (0.733)	0.590 (1.024)
Age	-0.003 (0.011)	-0.007 (0.002)***	-0.002 (0.005)
Education	0.036 (0.040)	-0.007(0.010)	-0.0221 (0.015)
Orchard size	-0.006 (0.05)	-0.133 (0.012)***	-0.178 (0.020)***
Specialization	1.095 (0.610)*	0.436 (0.154)***	0.246 (0.244)
Farming Vehicle	-0.229 (0.351)	-0.032 (0.084)	-0.116 (0.157)
Computer	0.061 (0.244)	0.105 (0.054)*	0.155 (0.110)
Cooperative sales	-0.526 (0.316)*	0.144 (0.090)	0.299 (0.136)**
Extension contact	0.033 (0.210)	0.143 (0.051)***	0.0236 (0.077)
Access to credit	0.691 (0.212)***	0.0704(0.052)	0.096 (0.108)
Timely payment	0.341 (0.254)	-0.024 (0.066)	-0.183 (0.104)*
Neighbor	0.117 (0.239)	0.008 (0.060)	-0.077 (0.092)
Gansu	0.611 (0.563)	0.436 (0.213)**	0.281 (0.183)
Shaanxi	1.025 (0.507)**	0.152 (0.206)	-0.069 (0.170)
Distance (log)	-0.074 (0.030)**	-0.011 (0.008)	0.002 (0.013)
Quantity (log)	0.291 (0.328)	0.852 (0.076)***	0.977 (0.122)***
Price (log)	0.368 (0.520)	0.750 (0.108)***	0.229 (0.275)
Market perception	-0.677 (0.158)***		
$Ln\sigma_1$		-1.152 (0.066)***	
$\rho_{\eta 1}$		0.523 (0.273)*	
$Ln\sigma_0$			-1.220 (0.118)***
$\rho_{\eta 0}$			-0.401 (0.410)
Log likelihood	-154.99		
Likelihood ratio test for independent equations $x^2(1)$	3.65*		
Observations	250		

Notes: The dependent variable is the log form of apple net returns measured in yuan/mu (1$=6.14 yuan);

In selection equation, it takes the value of one if farmers used written contract, 0 otherwise;

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

Table 7 Average treatment effects of written contract choice on net returns: ESR estimation

	Mean Outcome [a]				
	Written contract users (N=179)	No contract users (N=172)	ATT	t-Value	Change (%)
Net returns	8.74 (0.44)	8.53 (0.40)	0.21	8.91***	2.46
	Mean Outcome [a]				
	Written contract users (N=179)	Oral contract users (N=71)	ATT	t-Value	Change (%)
Net returns	8.74 (0.44)	8.29 (0.48)	0.45	25.71***	5.43

Notes: ATT, average treatment effect on the treated;

*, ** and *** denote significance at 10%, 5% and 1% levels, respectively;

[a] As the dependent variable in the ESR outcome equation is the log form of net returns measured in yuan/mu, the predictions are also given in log forms.

Table 8 Average treatment effects of oral contract choice on net returns: PSM estimation

Matching algorithm	Mean Outcome [a]		ATT	t-Statistics	Change (%)
	Oral contract users (N=71)	No contract users (N=172)			
NNM	8.59	8.79	-0.20	-1.72*	-2.28
KBM (Bandwidth=0.4)	8.59	8.78	-0.19	-1.78*	-2.16
Radius (caliper=0.3)	8.59	8.79	-0.20	-1.87*	-2.28
Matching algorithm	Mean Outcome		ATT	t-Statistics	Change (%)
	Oral contract users (N=71)	written contract users (N=179)			
NNM	8.59	8.81	-0.22	-2.06**	-2.50
KBM (Bandwidth=0.4)	8.59	8.76	-0.17	-1.71*	-1.94
Radius (caliper=0.3)	8.59	8.77	-0.18	-1.78*	-2.05

Notes: ATT, average treatment effect on the treated;

*, ** and *** denote significance at the 10%, 5% and 1% levels, respectively;

[a] As the outcomes used are the log form of net returns measured in yuan/mu, the predictions are also given in log forms.

Appendix

Table A-1 Correlation between instrument variable and outcome

Outcome	Instrumental variable	Correlation	P-value
Net returns	Market perception	0.0630	0.1967

Table A-2 Probit estimates of propensity score for the choice of oral contracts

Variable	Coefficient	Standard error	Z-value
Constant	1.195	2.094	0.57
Age	-0.015	0.010	-1.55
Education	-0.067	(0.031	-2.18**
Orchard size	0.054	0.040	1.34
Specialization	-1.350	0.461	-2.93***
Farming vehicle	0.113	0.295	0.38
Computer	-0.016	0.207	-0.08
Cooperative sales	1.172	0.215	5.44***
Extension contact	0.169	0.173	0.98
Access to credit	-0.622	0.174	-3.58***
Timely payment	-0.039	(0.220	-0.17
Neighbor	-0.158	0.188	-0.84
Gansu	0.707	0.333	2.12**
Shaanxi	0.745	0.303	2.46**
Distance to markets (log)	0.057	0.023	2.49**
Quantity (log)	-0.111	0.228	-0.49
Price (log)	0.295	0.425	0.69
Pseudo-R2	0.181		
Log likelihood	-156.658		
Correctly classified	83.65%		
Observations	422		

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