Transaction costs and cattle farmers' choice of marketing channels in China

A Tobit analysis

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Abstract

Purpose – The purpose of this study is to examine key factors that affect cattle farmers' selection of marketing channels and draw implications for China's beef supply chain development.

Design/methodology/approach – A questionnaire was designed and face-to-face interviews were conducted with a random sample of 153 farmers located in three major cattle producing regions across China.

Findings – Several variables related to transaction costs (chiefly, in the form of negotiation costs and monitoring costs), as well as socio-economic factors, were identified as of significant influence on farmers' choices of cattle marketing channels.

Research limitations/implications – Further research should be conducted to measure the effects of risk preference in marketing decisions. Caution needs to be exercised when generalising the findings of this study to cattle farmers in other regions that are significantly different from the surveyed ones.

Practical implications – This study will contribute to a better understanding of cattle producers' marketing channel selection. Further, it will contribute to identifying which factors encourage or discourage farmers from using forward contracts; information needed urgently by private and public policy makers.

Originality/value – This paper presents a model and case study that show how transaction cost minimisation affects the adoption of vertical coordination. Studies examining this area for China are scarce and this paper makes an important contribution to the literature.

Keywords Transaction costs, Agriculture, Distribution channels and markets, China

Paper type Research paper

Introduction

The development of cooperative marketing systems in the agricultural products chain is a response to the social and economic pressures, which drive the evolution of the chain and encourage greater vertical and horizontal coordination. The key drivers mainly are the increasing concerns about food safety from consumers and the requirements of low-cost and differentiated products from a highly competitive retail sector.

Similar to other agricultural products, the Chinese beef sector has experienced significant changes in the food chain organisation in the past two decades. An important characteristic of this has been the emergence of vertical coordination systems between producers and processors, shifting from the traditional spot market to short-term or longer-term contract arrangement. Although such coordination

currently only accounts for some ten per cent of total beef production, it is believed that this form of trading relationship will grow in the future.

This case study of the Chinese beef industry investigates the factors that influence an individual producer's choice of sale by forward contract or through the spot market. A literature review is undertaken using earlier studies in the field to identify key variables affecting farmers' choice and develop an analytical framework. This review is followed by a description of the survey instrument. An empirical model subsequently developed to test the impact of various factors on farmers' channel selection. The results are presented and discussed and implications of the findings are presented.

Review of the literature

Industrial organisation theory (Katz, 1989; Williamson, 1989) attributed motivations for vertical integration to avoiding market power in a vertical food system, reducing price volatility or minimising transaction costs. Coase (1937) examined factors affecting the organisation of production systems in a market-hierarchy framework. In such a framework, the organisational criterion is minimisation of production and transaction costs. Transaction cost theoretical advances spurred a profusion of empirical research that continues unabated (Masten, 1996). Frank and Henderson (1992) confirmed the significant relationships between vertical coordination and transaction costs by the vertical coordination index in the US food manufacturing industries. Hobbs (1997) demonstrated a method for measuring the importance of transaction costs on slaughter cattle marketing between live-weight and dead-weight channels in the UK beef industry. Sang (2003) studied vertical coordination in China's vegetable industry and confirmed that food processors prefer dealing with larger commercial farms because of lower transaction costs, while assuring food quality and safety.

In addition to studies on transaction costs related to vertical coordination, many agricultural economics researchers have conducted research on the marketing behaviour of farmers. A significant number of papers have been published in the area of producers' decisions regarding marketing strategies. This body of literature attempts to relate farm and non-farm characteristics and to predict optimal marketing behaviour in many industries. In the grain industry, Shapiro and Brorsen (1988) found that the use of forward pricing was related to education, experience, farm leverage, farm size and off-farm income. Poole *et al.* (1998) studied citrus marketing systems in Spain, and found that the uncertainty concerning prices and payment was important to producers' marketing decisions. In a survey of 13 provinces in China, Guo and Jiang (2005) found that participation in contract production was positively related to farmers' specialisation and commercialisation. In terms of studies in the livestock industry, Zhou and Dai's (2005) research analysed the relationships and contracts of pork farmers in Jiangsu Province in China, and found that factors such as a household's age, farm scale, non-farm production, debt situation and regional discrepancies influenced the decisions of farmers with respect to forward contracting.

While various coordinating devices (from spot markets, contracting and strategic alliances to vertical integration) are at work in the Chinese food market, especially in grain and vegetable production, the structure of the market appears to be shifting from open production toward contracting and vertical integration (Guo and Jiang, 2005; Sang, 2003). More recently, a surge in vertical coordination in the beef cattle industry may follow the path set by the swine industry. In contrast, little research has been devoted to studying marketing channel selection by cattle farmers.

The survey and model selection

Methodology

In order to identify the important factors affecting farmers' marketing decisions, a household survey using a structured questionnaire was conducted of cattle producers. The survey of finished cattle producers provided the primary data for this study. The survey was conducted between January and December 2004 with 153 respondents, who operated in the Inner Mongolia Autonomous region, Anhui province and Shandong province. The survey used face-to-face interviews to administer the questionnaire in order to ensure adequate responses. The sampling frame was derived from the results of the latest *Chinese Agricultural Statistics Yearbook* (2005).

Questionnaire design

The general hypothesis, upon which this analysis is based, is that a farmer's choice of cattle marketing channel is influenced by a number of transaction cost variables, but may also be influenced by the socio-economic characteristics of the farmer or the farm.

The dependent variable selected in this study was the percentage of cattle marketed through the spot market. The higher proportion through the spot market, the less will be the proportion through forward contracting.

The independent variables in this study may be divided into four groups (see Table I). The first group includes extent of price fluctuation, information access and possibility of quality inspection. This group of variables reflects the information costs of cattle farmers, which are expected to be a major problem for individual cattle producers. The more time and energy spent on searching for market information, the higher the information costs. Price fluctuation is a 3-grade ordinal variable, reflecting the changes in transactional prices between cattle farmers and their next linkage trade partners. A large price fluctuation indicates that producers may capture a small proportion of the eventual price. Market information access is a 5-grade ordinal variable, indicating the level of difficulty for small and individual cattle farmers to get market information. Quality inspection refers to testing animal health if buyers require cattle with particular quality specifications. This is measured as a binary nominal variable.

The second group is related to negotiation costs, consisting of payment delay, bargaining power, transport costs and farm specialisation. The delay in payment occurs when cattle are sold and payment is not received simultaneously. Payment delay is a kind of negotiation cost, which is measured in terms of number of weeks the buyer delayed payment to the cattle farmer. An individual producer or a small group of producers is likely to be at a payment-delay disadvantage when facing a meat processor who has the power to establish the price and determine the time of payment delivery. Bargaining power is a 5-grade ordinal variable, which refers to whether farmers passively accept transaction prices or negotiate against their buyers. Transport costs can be seen as an opportunity cost of the producer's time and effort in organising transportation, which is measured in Chinese *Renminbi yuan*. Farm specialisation reflects the asset specificity, which is measured in terms of percentage of household incomes from cattle production.

The third group contains grade uncertainty and farm service, which can reflect monitoring costs. When selling live animals directly to processors, cattle producers may face grade uncertainty, which is determined only after the animal has been slaughtered. Although a price is agreed upon before the cattle leave the farm, the producer's return may be lower than expected if the cattle do not grade as expected. Farm service refers to services provided to the producers, such as technological

Variable	Description	Value	Expected sign
Information costs			
Price fluctuation	How large is the price fluctuation (in a typical week)?	1 = Less than 10%; 2 = 10-30%; 3 = More than 30%	−
Information access	Describe how easy it is for you to get information (such as market, related policy, or new technology)	1 = Very difficult; 2 = Difficult; 3 = Medium; 4 = Easy; 5 = Very easy	−
Quality inspection	Is there a quality inspection before selling the cattle to the next linkage?	1 = Yes; 2 = No	+
Negotiation costs			
Payment delay	Is there a payment delay?	1 = Yes; 2 = No	+
Influence on agreement	Influence on the agreement	1 = Passively accepting price; 2 = Little bargaining power; 3 = Moderate bargaining power; 4 = Nearly equal bargaining power; 5 = Equally negotiating the price	−
Transportation effort	Who usually organizes transportation of your cattle?	1 = Yourself; 2 = Dealer; 3 = Buyer	−
Transportation cost	Cost of transportation	Money spent (*yuan*/head)	+
Farm specialisation	Percentage of household income from cattle	1 = < 10; 2 = 10-19; 3 = 20-29; 4 = > 30	−
Monitoring costs			
Grade uncertainty	If concerned about grade uncertainty when selling deadweight?	1 = Yes; 2 = No	+
Farm service	Extent of service such as technical support, information assistance, etc.	1 = Very little; 2 = Little; 3 = Moderate; 4 = Much; 5 = Very much	−
Socio-economic characteristics			
Cattle sold number	Number of cattle sold, Jan.- Dec. 2004	Number	+
Ownership structure	Ownership	1 = Collective; 2 = Household	+
Feed conversion ratio	Feed conversion ratio[a]	1 = < 1; 2 = 1.1-2.0; 3 = 2.1-3.0; 4 = > 3.1	−
Extent of investment	Investment	1 = Very little; 2 = Little; 3 = Moderate; 4 = Heavy; 5 = Very heavy	−
Age of farmer	Age group	1 = < 19; 2 = 20-29; 3 = 30-39; 4 = 40-49; 5 = 50-59; 6 = > 60	?+
Size of family	Household number	Number: 1-7+	?
Education level	Level of education	Years of education	?−
Raising experience	Years in cattle raising	1 = < 1 Year; 2 = 1-5 Year; 3 = > 5 Year	?

Table I.
Variable description and expectation

Note: [a]Defined as the number of kgs of feed required to produce one kg of live-weight gain

support, information assistance, farm input provision, market service and so on, which is a 5-grade ordinal variable.

The last group measures producer characteristics. Data on the type of farming firm (size, profit, nature of the business, etc.) and the socioeconomic characteristics of the producer (age, education, experience, family size, etc.) were collected.

Farmers in the survey used a combination of market channels to sell their cattle: via the spot market, via intermediaries, or directly selling to processors. The first two channels could be combined as the market-price channel, where market price coordinates marketing behaviour. In contrast, in the channel of direct sale to processors, farmers will have to negotiate pre-sale contracts, either oral or written, with certain specifications such as weights and quality. As such, the relationship between the producers and the processors is much closer, reflecting "vertical coordination". In this sense, the marketing channel selection by farmers could be taken as a binary choice between the spot market channel and the direct market channel to processors.

Marketing channel selection model
The values of dependent variable can be censored as we only have information above zero to one (100 per cent) in the survey. In some settings, the dependent variable is only incompletely observed due to censoring. For example, in survey data, data on incomes above a specified level are often top-coded to protect confidentiality. Compared with the probit model, which is based on the cumulative normal distribution and estimates the probability of the dependent variable lying inside at a 0-1 interval, the Tobit model would be adoptable, as it does not throw away any information on the value of the dependent variable. Therefore, a Tobit model is derived following Tobin (1958) and Rosett and Nelson (1975), the two-limit Tobit model can be estimated according to the following equation:

$$y^* = \beta' x + \mu$$

and

$$y = L_1 \quad \text{if } y^* = L_1 \text{ (Lower bond)}$$
$$y = y^* \quad \text{if } L_1 < y < L_2$$
$$y = L_2 \quad \text{if } y^* = L_2 \text{ (Upper bond)}$$

where y^* is the latent variable; β' is a $k \times 1$ vector of unknown parameters; x represents a $k \times 1$ vector of independent variables; μ are residuals; y is the dependent variable, and L_1 is the lower limit and L_2 is the upper limit.

The likelihood function for this model is:

$$L(\beta, \sigma | y, x, L_1, L_2) = \prod_{y=L_1} \left(\frac{L_1 - \beta' x}{\sigma} \right) \prod_{y=y^*} \frac{1}{\sigma} \phi \left(\frac{y - \beta' x}{\sigma} \right)$$
$$\times \prod_{y=L_2} \left[1 - \phi \left(\frac{L_2 - \beta' x}{\sigma} \right) \right]$$

where $\prod_{y=L_1}$ is the first product over the L_1 lower limit observations, $\prod_{y=y^*}$ is the second product over the non-limit observations and $\prod_{y=L_2}$ is the third product over the L_2 upper limit observations.

When applying this model to data from the cattle farmer survey, the proportion that each farmer sells through the spot market is estimated. The higher the proportion through the spot market, the lower the proportion through forward contracting. The marketing channel selection decision by cattle farmers is a function of a number of independent variables that have been placed under the following four categories: information costs, monitor costs, negotiation costs and social characteristics.

Results

Eighty-one per cent of the surveyed farmers sold either all or at least one of their cattle to the spot market. Descriptive results showed that selling cattle in the spot market was still the main selection by farmers. Thirty-six per cent of the surveyed farmers sold cattle solely through the spot market. Twenty-two per cent sold via a dealer and 15 per cent chose to sell directly to processors. The rest of the farmers (27 per cent) indicated using combined channels. Detailed descriptive statistics are presented in Table II. It is noted that although strong correlation coefficients were not likely because of the cross-sectional data, the coefficients may provide a guide as to the relative strength of the relationships.

The descriptive statistics show that the values of some variables did not vary much across the farmers nor relative to the dependent variable. These could be dropped from

Variable name	Unit	Min	Max	Mean	Std. dev.	Correlation with dependent variable
Dependent variable						
Marketing channels	Proportion of cattle sales	0	1	0.77	0.37	
Independent variables						
Price fluctuation	(1-3)[a]	1	4	1.09	0.51	0.047
Information access	(1-5)[a]	2	5	3.21	0.64	−0.153
Quality inspection	(1-2)[a]	1	2	1.70	0.46	0.387*
Payment delay	(1-2)[a]	1	2	1.71	0.46	0.268*
Bargaining power	(1-5)[a]	1	5	3.18	0.94	−0.222*
Transport effort	(1-3)[a]	1	3	1.95	0.86	−0.242*
Transportation costs	Yuan	9	50	22.7	10.64	−0.376
Farm specialisation	(1-4)[a]	1	4	2.29	1.30	−0.431*
Grade uncertainty	(1-2)[a]	1	3	1.59	0.64	0.221
Farm service	(1-5)[a]	1	5	3.22	0.69	−0.026
Investment	(1-5)[a]	1	5	2.76	1.08	−0.353*
No. of cattle sold	Head	1	3200	68.84	331.62	−0.173**
Ownership	(1-2)[a]	1	2	1.95	0.21	0.173**
FCR	(1-4)[a]	1	4	2.11	0.64	−0.315**
Age	(1-6)[a]	1	6	4	0.72	0.254**
Household size	Number	2	7	4.08	0.77	−0.309
Education	(1-7)[a]	2	5	2.75	0.77	−0.203**
Experience	(1-3)[a]	2	3	2.78	0.41	0.139
Feed conversion rate	(1-4)[a]	1	4	2.11	0.64	−0.318*
Age	(1-6)[a]	1	6	4	0.72	0.255*
Ownership structure	(1-2)[a]	1	2	1.95	0.21	0.250*

Table II.
Dependent and independent variables description

Notes: [a]Categorical variable; *significance at the 1 per cent level; **significance at the 5 per cent levels

the regression analysis even though they seem to be important in theoretical expectations. They are the variables of price fluctuation, information access, farm service, transportation costs and household size. The experience variable did not show a strong relationship to the dependent variable in the correlation matrix. It was kept in the model estimation, as experience is generally believed to have an important impact on farmer's channel selection. The transaction cost variables included in the analysis are: whether there is a quality inspection, payment delay after selling cattle, bargaining power when selling cattle, transport effort, farm specialisation, grade uncertainty after selling cattle, and farm services received. There are a number of socio-economic variables, which were expected to influence the dependent variable. They were the level of investment in cattle, number of cattle sold, education level, feed conversion ratio, the age of the cattle farmer and ownership structure. Hence, 15 transaction cost and social-economic variables were included in the initial model estimation. The EViews software program, version 5.0, was used to carry out the Tobit analysis.

Various model specifications were tried. It was revealed that some variables were insignificant and others, in addition to being insignificant, did not have the expected sign. Finally, the model presented in Table III is accepted; variables in this model satisfied theoretical expectations and yielded significant results except for the variables of farm specialisation and education. The estimated coefficients, Z-statistics and standard errors are reported in Table III. The adjusted R-squared value of 0.83 is very satisfactory given the cross-sectional dataset. This suggests that the independent variables explain a significant proportion of variation in the dependent variable.

Payment delay, bargaining power and farm specialisation all belong to "negotiation costs". Payment delay measures whether farmers have to wait for a payment after the sale of cattle. Farmers that chose to sell cattle through direct sale are subject to payment delays. Payments are generally received immediately after selling cattle to spot markets or intermediaries. Thus, our results suggest that a payment delay of varying length does affect farmers' choice of cattle marketing channels. Nonetheless, some farmers still choose to sell directly to processors because there are price premiums. Thus, better returns encourage farmers to sell directly to processors.

	Coefficient	Std. error	Z-statistic
Constant	−1722.345*	448.853	−3.837
Payment delay	30.132**	11.740	2.567
Bargaining power	−18.220**	7.4191	−2.457
Farm specialisation	67.269*	17.769	3.786
Grade uncertainty	120.078*	38.099	3.152
Ownership[a]	317.458*	84.060	3.777
Investment	60.360*	19.499	3.096
Age	84.746*	15.747	5.382
Education	36.761*	12.065	3.047
Experience	−45.687*	13.998	−3.264
Adjusted R-squared	0.834		
Log likelihood	−56.426		

Notes: [a]Ownership structure: 1 = collective; 2 = household; *significance at the 1 per cent level; **significance at 5 per cent levels
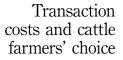
Table III.
Factors affecting cattle
farmers' selection of
marketing channels

Farmers' bargaining power measures their influence on selling agreements. The higher the bargaining power of farmers, the more likely it is that farmers will use forward contracts. In the survey, farmers who elected to sell directly to processors had an 8.9 times larger sale herd size on average than those selling to the spot market and intermediaries. The larger the herd size, the stronger the bargaining power of farmers. As farmers' bargaining power increases, they will use the direct marketing channel to cattle processors. In contrast, those farmers who have a small number of cattle to sell and relatively low bargaining power tend to use the spot market and intermediaries.

The higher the percentage of incomes from cattle raising, the more specialised a cattle farm is. This will lead to spatial monopoly and opportunistic behaviours. In order to avoid some market risks, specialised cattle farmers would choose a closer vertical coordination like selling directly to processors. It was expected that more specialised farms would be more likely to use direct marketing. The results in Table III, however, have the wrong sign for this variable. This may be due to the fact that farm specialisation was highly correlated with grade uncertainty (see Table II) and further investigation is needed.

Grade uncertainty belongs to monitoring costs. Farmers would face grade uncertainty when selling directly to processors as the grade would not be known until the cattle have been slaughtered. The payment received by farmers is based on a final grade result, which creates risks for farmers. Hence, the higher the grade uncertainty, the more farmers are inclined to sell to the spot market, but the less they choose direct sales to processors.

Based on our results, some socio-economic factors also influence the marketing channel selection. Farmers favouring forward contracts are those within a collective, younger farmer, having experience of 1-5 years, higher education and more investment. In the regression results (Table III), the signs of education and investment are contrary to expectations. They are expected to be negatively related to the use of spot market channel as shown in the single correlation matrix and further research is called to verify these relationships.

Conclusions and implications
Our study shows that transaction costs are significant in affecting farmers' marketing channel selections. It also demonstrates a method by which the importance of various transaction cost variables can be measured. Our model results also indicate that there are significant relationships between economic and social variables and choices of cattle marketing channels.

The findings from this study suggest that transaction costs affect importantly farmers' choices of spot market sale or forward contract with processors. High transaction costs (chiefly in terms of negotiation costs and monitoring costs) borne by Chinese cattle farmers have made many of them to use spot market to sell their cattle. Those farmers who are willing, and can afford, to incur higher transaction costs are more likely to choose forward contracts. Information costs did not show a significant influence on marketing decisions. This is because farmers nowadays have better access to market information in China. Socio-economic factors such as collective ownership, younger age and experience tend to influence farmers to choose forward contract sales while further research is needed to verify how higher education and investment affect channel selection.

Government policy markers, beef cattle industry organisations and traders alike need to consider mechanisms for reducing negotiation and monitoring costs borne by farmers, thereby reducing transaction costs. Efforts are also needed to increase cattle farmers' bargaining power and specialisation. A starting point would be to encourage cooperation between farmers. Various farm support programs may be established to foster specialisation in cattle farming. As they become more specialised in beef cattle production, farmers' bargaining power will increase when dealing with processors. Such efforts will significantly encourage farmers to choose direct sales to processors and subsequently will promote the development of a more effective and efficient beef supply chain in China. Benefits resulting from increased vertical coordination in China's beef industry are many and enormous. For example, the implementation of a traceability program will be made possible and easier.

This empirical study focused on marketing channel selection by cattle farmers in China. A natural extension of this work would be to investigate processors' motivations in the choice of their procurement channels and their role in, and perception about, the development of China's beef cattle supply chains, as downstream linkages.

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56

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