



Marketing China's milk: A case study of the sales activity of dairy farmers in greater Beijing

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ARTICLE INFO

Article history:

Received 11 February 2010

Received in revised form 19 September 2010

Accepted 25 September 2010

Available online 11 October 2010

JEL classification:

Q12

Q13

M31

Keywords:

Marketing activity

Dairy farmers

Marketing channel

Greater Beijing

ABSTRACT

Small farmer participation in marketing chains in emerging commodity markets and the determinants of their marketing channel choices are the center of many recent empirical and theoretical papers in the literature. The dairy sector is emerging in China. There are many fundamental questions about how farmers make dairy marketing decisions in China at the farm gate level that are unanswered. This makes the dairy sector in China a good place to study farmers in emerging marketing chains. Based on three sets of unique data collected in the mid-2000s in Greater Beijing, the analyses show that small farmers were the major producers of milk. There is no evidence that small farmers are being excluded from emerging marketing channels. One of the differences of China's dairy sector in the mid-2000s is that its marketing chain itself had many different types of agents that procure milk – and few of them were large; most were individual entrepreneurs. The high level of the competitiveness may be the reason that individual agents do not have monopoly power and why small farmers can operate in the system.

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Before the mid-1990s the lethargy of China's dairy sector was a puzzle (Zhou et al. (2002)). Demand in urban areas grew slowly (Zhou et al. (2002)). Rural consumption per capita was very low, less than 1 kg per capita. Dairy production likewise was nearly stagnant. Internationally, there was little action in terms of exports to China.

The situation changed dramatically, however, after the mid-1990s (Fuller, Huang, Ma, & Rozelle, 2005). After 1995, average per capita consumption of milk and milk products (in fresh milk equivalents – the unit used throughout the rest of this paper) in urban areas grew rapidly, increasing from 8 kg in 1995 to 13 kg in 2000. Between 2000 and 2005, per capita demand jumped to 25 kg. Over the same period, average per capita consumption of milk in rural areas increased from 1 kg to 3 kg.

As domestic milk consumption rose rapidly, the Chinese dairy industry started to expand. The production of fresh milk increased by nearly 5 times from 5.8 million tons in 1995 to 28.7 million tons in 2005 (NBSC (National Bureau of Statistics of China), 2006). During this period of rapid expansion millions of farmers began to purchase cows and produce milk. Clearly, over

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the past decade something triggered the growth of both milk supply and demand. International trade in milk (in the form of imports into China) also rose rapidly (NBSC (National Bureau of Statistics of China), 2007).

In response to this veritable explosion of growth a number of papers have emerged to explain different dimensions of the growth. Zhou, Tian, and Zhou (2002), Rae, Ma, Huang, and Rozelle (2006), Fuller, Beghin, Rozelle, and Hu (2007), Fuller, Huang, Ma, and Rozelle (2007), Ma, Rae, Huang, and Rozelle (2007), Huang, Wu, Zhi, and Rozelle (2008), Huang, Zhang, and Zhu (2008) study the supply side at both the aggregate and micro-levels of milk production. Zhou (2001), Zhou et al. (2002), Fuller et al. (2005), Fuller, Beghin et al. (2007), Fuller, Huang, et al. (2007) examine the dynamics of dairy consumers and their demand characteristics. Huang, Liu, Martin, and Rozelle (2009) describe the history of protection at the border and Zhou et al. (2002) review China's dairy trade. Hu, Fuller, and Reardon (2004), Hu, Reardon, Timmer, Rozelle, and Wang (2004) describe the dairy processing sector and its interaction with the modernization of the downstream segment of China's food supply chain. While many of these studies are limited in their geographical scope and some of them are becoming outdated due to the rapid transformation of the dairy industry (and, as such, more work is still needed), as a group they begin to paint a picture of the fastest growing food sub-sector in China.

Hence, when standing back and looking at dairy in China we are beginning to have a fairly complete picture of dairy in China – except for one glaring omission. To the authors' knowledge, there is little work done on the marketing system that links dairy producers to dairy processors and consumers. Because of this, there are many fundamental questions about dairy marketing in China at the farm gate level that are unanswered. Who is procuring milk from farmers? How is milk delivered from farms to processors? Is the procurement system changing over time? With concerns about food safety in the dairy system (ASG – Wageningen [Animal Sciences Group of Wageningen UR], 2006), is the system responding to address these concerns? And, is the system organized so that it promotes access of small, poor farmers into the dairy sector or does it mainly cater to large, commercial dairies?

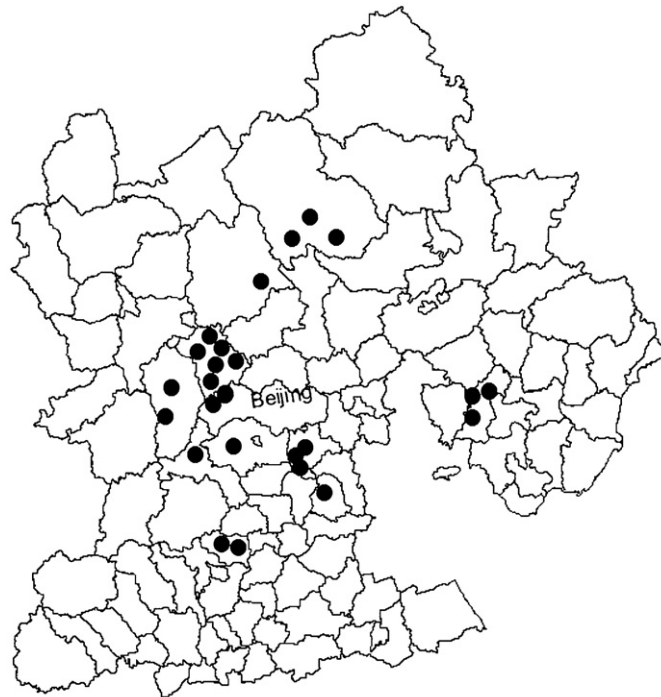
One of the contributions of this paper is that it examines the behavior of small household farmer in a marketing chain that has small farmers at one end of the marketing chain and large processors at the other end. In recent years there is a lot of work that has tried to understand if market power of processors (or other agents along the marketing chain) affect decisions to produce by producers (and what kind of producers) and the rate of growth of the sector. Recent papers by Chau, Goto, and Kanbur (2009) and Gow and Swinnen (1998) theoretically track the role of traders and their natural monopoly power in remote areas when the scale of production is small. Other economists, for example, McMillan, Welch, and Rodrik (2004) and Pokhrel and Gopal (2007), examine the issues in the case of other crops (e.g., cashews) in other countries (e.g., Mozambique). In these cases, market power of some agent along the marketing channel plays a role in keeping out small producers. If this is true in China, it would be additional evidence to the literature that seeks to explain why it is that small producers often are not benefiting from the rise of higher value commodities.

The overall goal of our paper is to try to provide answers to some of these questions and help fill in one of the missing parts of the pictures on China's dairy sector, dairy marketing. The paper will seek to understand if the nature of the marketing channel in China is keeping small producers from entering, which itself may explain the growth pattern of the sector. To do so, we pursue three specific objectives. First, we seek to describe the major players in the dairy marketing sectors – that is, those that are dealing with procurement of milk from farmers. We will introduce their size and the nature of the interaction with farmers (e.g., Do they have contracts? Do they pay with credit? Do they pay attention to food safety?) Second, we will then track the change in the importance of these different players. In doing so, we can then make an assessment about whether or not the system is shifting towards the use of actors that are more formal or informal. We can also analyze whether or not the system is becoming more dominated by participants that are concerned with providing a safe product. Finally, we will try to understand the determinants of the choice of farmers: why do some farmers choose to sell into one part of the marketing chain while others sell to another part. In pursuing this objective we will be able to judge if different types of farmers are being left out of the emerging procurement channels.

There are several limitations to our current work. First, our analysis is limited to Greater Beijing area because of data availability. We conducted two comprehensive village/household surveys (described below) in Greater Beijing area for this study. While we examine all producers in the region, our sampling methods have not discovered any truly large dairies. Clearly, there are large, commercial dairies in China. Our sampling approach, however, did not find any of them. While we do not know why we did not find any (perhaps because there are so few or perhaps because they are concentrated heavily in an area that we did not pick by chance), the dynamics in large commercial firms (and dairies in other areas) quite possibly could be quite different than those sketched in this study. Along these lines, it is possible that if we looked at the dairy sector in Inner Mongolia and Xinjiang that the answer would be different.

We also only look at the marketing system in the very upper segment of the dairy supply chain (in a third processor survey). However, despite having access and using these processing sector data, most of the information in this paper is about the exchange between the dairy farmer and the first buyer in the supply chain. Because of this, when we are looking at issues of marketing power, we are limited to examining the nature of exchange in the upper segments of the marketing channel.

The second shortcoming is that our data collection was completed in 2006 (collecting household/village/trader data for 2004 and processor data for 2006). Unfortunately, this was before the dairy processing crisis that hit China in 2008. Therefore, our observations preceded the time when it was discovered that somewhere along the marketing chain melamine, an industrial compound/additive – melamine – was being introduced into the milk supply and creating health problems for users. Therefore, we are not going to be able to say anything about how the dairy crisis has affected milk marketing. In another sense, however, this could be a strength, since our work should be considered as a comprehensive baseline of the dairy industry before the crisis. In addition, although our comments will be speculative, by carefully documenting China's dairy marketing chains the findings of the paper might help policy makers and scholars understand how such a scandal could have happened.



Scale: 1 inch = 100 kilometers

Fig. 1. Map of Greater Beijing and location of villages with households that keep dairy cows.

The rest of this paper is organized as follows. Section 2 introduces the data, sampling methods and basic information about the surveys. Section 3 describes the basic features of dairy marketing actors in the Greater Beijing sample. Using these features to characterize the nature of the different actors, the rest of Section 3 traces out changes in dairy marketing between 2000 and 2004. The next section then moves to analyze the determinants of the choice of marketing channels by farmers. The final section discusses some of the implications of the findings and concludes.

1. Sampling and data

Data for this study come from three field surveys designed and conducted by the authors. The first two surveys were conducted in a randomly selected set of villages and households. The third survey of all dairy processing firms in the Greater Beijing region was conducted by phone.

The dairy production data from the village and households surveys were collected as part of a larger survey effort (the Greater Beijing Horticulture and Livestock Survey), which examined the production behavior of villages and households in Greater Beijing. The authors conducted the main survey in July and August of 2005. The first round of the surveys covered 50 townships and 200 villages, and is referred to as the Village Survey in the rest of this paper. During the survey (conducted in 2005) we collected data from farmers and village leaders about their dairy activities in 2000 and 2004.

The sample of villages in which we conducted the Village Survey was selected through a carefully designed sampling approach. With detailed maps (see Appendix Fig. 1) and a compass, five concentric circles (with radii of 40, 60, 80, 100, 140 km) were drawn, centered at the geographical center of Beijing (Tian'anmen). The concentric circles were further divided into 10 wedges by drawing 10 "spokes" (140 km in length) from the center (Tian'anmen) to the edge of the outermost circle. Each wedge was defined by two spokes that created a 36° angle. The spokes cut every concentric circle into 10 arcs, creating a total of 50 arcs (see Appendix Fig. 2). On every 36° arc, one randomly selected point was marked (see Appendix Fig. 3). The township geographically located linearly closest to the randomly selected point was included in our sample population. In total, 50 townships were randomly selected with the aid of a GIS mapping program that was available at the Chinese Academy of Science's Institute of Geographical Science and Natural Resource Research. Within each township, 4 villages were then randomly selected to create a sample population of 200 villages.

One of the main tasks of enumerators during the Village Survey was to interview the village leader about the changes in the community's horticultural/livestock (including dairy) economy between 2000 and 2004. Among other things, during a several hour-long, sit-down questionnaire session with enumerators, village leaders recounted information about production trends of their village's major commodities. The leaders also provided information on the most common ways that products were procured

Table 1

Contractual relationships between dairy farmers and agents of four different types of marketing organizations in Greater Beijing sample, 2000 and 2004.

First buyers in the dairy supply chain ^a	2000				2004			
	No. of obs.	% of sales by farm household	Share of dairy farmers with written or oral contracts	Share of dairy farmers that sell to buyers on credit (that is, buyer pays at end of month)	No. of obs.	% of sales by farm household	Share of dairy farmers with written or oral contracts	Share of dairy farmers that sell to buyers on credit (that is, buyer pays at end of month)
Direct consumer sales	11	25	0.0	0.0	5	4	0.0	0.0
Sales to small brokers	7	16	0.0	14.3	25	19	0.0	76.0
Private milk collection stations	20	45	5.0	35.0	94	72	8.5	51.1
State-owned milk collection stations	6	15	16.7	66.7	6	5	33.3	50.0

Data source: Authors' survey.

^a First buyer is the agent of the organization in the supply chain that is the one that directly purchases milk from the farmer.

from farmers – including the type of buyer that purchased the product from the farmer. In total we identify eight main types of buyers. Finally, we also asked leaders to tell us the nature of the contractual arrangement – either explicit or implicit – between the farmer and first-level buyers.¹ In the case of dairy villages (see later discussion) we asked the respondents to provide information about the number of cows for the typical dairy household, the number of households and the timing of when they entered the market. Enumerators also asked village leaders about the characteristics of their communities (for example, income per capita; cultivated land per capita; location; etc.).

A follow up survey called the Household Survey was conducted (also in 2005) to collect information on dairy households. This survey re-visited a randomly selected set of 50 (of the 200) villages from the Village Survey. Within each selected village we visited 10 randomly selected households (further discussed below). Importantly, in the case of almost all of our variables, the aggregated averages of the answers from the household respondents were close to those provided by the village leader in the Village Survey. Hence in our study, we divided all 200 villages into two groups: dairy villages (there were 25 of them) and non-dairy villages (175). Data were collected for the years 2000 and 2004. The locations of the 25 dairy villages are shown in Fig. 1.

Among the 25 selected dairy villages, we randomly selected dairy cow and non-dairy households as follows. First, all households in each village were divided into two groups based on whether or not they owned cows. In the most common dairy villages (i.e., those with more than seven dairy producers), we randomly selected ten households from each village, of which seven households owned dairy cows and three households did not own dairy cows. If there were less than seven dairy households in the whole village, all of the dairy households were included in our survey. In villages with more than 50 dairy households, the sample size was doubled from 10 to 20 and we surveyed 14 dairy households and 6 non-dairy households. In the final analysis of the 25 dairy villages, we surveyed a total of 145 dairy households and 95 non-dairy households. The household survey for the dairy households covered a large number of details about the history and current production of each household's dairy activities. In this study, because we are studying the marketing behavior of those households that are producing and selling dairy products, we only focus on the 145 dairy households.

Finally, we found all dairy processors in the Greater Beijing from China's Dairy Industry Yearbook (MOA (Ministry of Agriculture), 2006). After this, we called each of them to get their location, the year in which the processor began business and the scale of each processor's facilities. Based on the information on the locations, we marked each dairy processing firm on a map and measured the distance of each village in which we conducted the survey.

2. Who is procuring China's milk?

During our field work we identified four main ways that farmers marketed their milk. First, and more traditionally, farmers who owned a cow and produced more milk than what they needed for their own consumption sometimes sold their surplus to fellow villagers or to local urban residents that come to their farm. We call this channel *direct consumer sales*.

Another informal channel that farmers traditionally used was selling their surplus milk to a small, independent broker or petty trader. These brokers typically drove a small cart – mostly diesel engine driven – from village to village and directly purchase milk from farmers. All of the milk that they purchased during the day fit into a 200 to 1000 l tank on the back of their vehicle. The milk was usually taken directly by the small broker to a processor (or in some cases a larger broker or to a milk station). We call this channel *sales through small brokers*. Direct consumer sales and sales through a small broker were both categorized for our study as *informal channels*. When farmers sold directly to consumers or when small brokers were buying and selling milk, they typically did not have an official place of business (besides their home) and almost never had a business license.

In the 1990s there emerged a more formal form of marketing – the *private milk collection station*. In many villages, towns or at intersections of major roads, private entrepreneurs set up milk collection stations. These stations typically had a storage tank – in most cases refrigerated – that could hold between 1 and 5 t of milk. In most cases, each milk station was independently owned and

¹ In our study, we differentiate between two types of buyers of commodities in the dairy economy. First-level buyers are those that are engaged in the transaction directly with farmers. The second buyers are those to whom the first-level buyers sell. They represent the first and second link in the marketing chains when starting from the dairy.

operated. In many of the operations that we visited, the owner and workers were all family members or at most there were one or two workers that were hired for a wage. In many cases the private collection station had an agreement with a single processor. In other cases, they sold their milk to different buyers each day. Many private milk stations (although not all) owned their own truck to move their milk from the storage tank in the station to the processor. In some cases, the processor or a larger trader brought a truck to the private milk collection station.

Finally, there were also large, well-established *state-owned milk collection stations*. The most defining characteristic of these procurement organizations was their ownership: they were ultimately owned by a township or county government agency (although in some cases there was a manager that ran the business on behalf of the publically-owned enterprise under a bonus-based contract). These types of procurement stations typically had been in operation for at least several decades. They were often located near county seats or not far from old processing plants. The tanks in the state-owned milk collection stations that we visited were several times bigger than those in the typical private milk collection stations. According to our typology for this study, whereas direct consumer sales and sales through small brokers are informal channels, we treat private and state-owned milk collection stations as formal channels.

According to our data, the largest and fastest growing type of marketing institutions that is procuring milk from farmers are private milk collection stations (Table 1, columns 1 and 4). Between 2000 and 2004 the number of farmers selling their milk to private milk collection stations more than tripled from 20 to 94. The second fastest growing type of milk procurer was small brokers, rising more than 200% from 7 households to 25 households. Sales to direct consumers and state-owned milk collection stations either fell or were stagnant. Clearly, Table 1 (column 4) answers the question about who is procuring China's milk: in 2004 72% of the households that produce milk sell their output to private milk collection stations; 19% of household sell their milk to small brokers; the rest of the households sell their milk to consumers and state-owned milk collection stations. Note that a more comprehensive description of who is procuring China's milk is presented below. In that analysis we examine the share of milk (measured in volume terms, not by number of households, which is how the data are presented in Table 1).

3. Food safety, contracts and alternative marketing channels

In the rest of this section (in the next two subsections) we provide evidence from our survey data about the nature of the four different marketing channels through which dairy farmers sell their milk. In the first table that we look at in this section we examine the nature of the relationship between the buying agent and the dairy farmer in terms of whether or not there was a contract and terms of payment for the milk (whether it was a spot market transaction or whether the buyer purchased the milk on credit and paid the dairy farmer once each month). This will help us understand more about the formality of the relationship between the dairy farmer and the agents that operate through the different marketing channels. In the second table we examine how much effort is put in by the buying agent to take actions that can be construed to make for a safer product. When we understand more about the nature of the different marketing channels, we will be able to better assess the direction of the marketing arm of the industry when we see how the patterns of marketing sales are shifting over time.

3.1. Contractual relationships

Table 1 shows formal contracting (between the milk buyers and farmers) in a small share of the cases was one way that formal marketing channels could be distinguished from informal ones. The data show, however, that contracting was not the main distinguishing characteristic of milk marketing. In our entire sample, in both 2000 and 2004, there were no formal contracting agreements – either oral or written – that regulated the relationship between dairy farmers and agents in either of the two informal marketing channels (i.e., direct consumer sales or sales to small brokers). All dairy transactions were basically done on a transaction by transaction basis with the price being set by the current market price.

In contrast, in the case of both formal marketing channels – private and state-owned milk collection stations – there were more contracting activities between dairy farmers and the buyer (Table 1). In 2000 5% of private collection stations signed contracts with dairy farmers; 16.7 of state-owned milk collection stations did. In the case of both types of milk collection stations in 2004, the share rose slightly. While the shares in the formal sector were larger than the shares in the informal sector (which were zero), perhaps the best interpretation of the number is that there is little contracting in the dairy sector at the farm level at all. But such a finding is not surprising. In the study of horticultural crops in Wang, Dong, Rozelle, and Huang (2009) in Great Beijing and in the study of fruit in Huang, Wu, et al. (2008), Huang, Zhang, and Zhu (2008) in Shandong Province it was found that there was almost no contracting between buyers and farmers.

There was one way that the initial marketing transaction between dairy farmers and buyers differed with that between horticultural farmers and buyers (as described in Wang et al., 2009; Huang, Wu, et al., 2008; Huang, Zhang, & Zhu, 2008). In the horticultural industry virtually all marketing transactions occurred as spot market, cash transactions. Cash payment was handed to the farmer exactly at the same time that the fruit was transferred to the buyer. However, as seen in Table 1 (columns 4 and 8), there was considerably higher incidence of more complicated delayed payment schemes in both the informal (in the case of sales to small brokers) and formal marketing channels. In fact, by 2004 more than 50% of all transactions (except in the case of direct consumer sales) were made under a delayed payment scheme. In other words, in most transactions with farmers, the buyer took the milk and did not pay until the end of the month. The high incidence of such suggests that the ties and trust between seller and buyer were deepening somewhat during this time. Note that while there were differences between dairy and non-dairy (e.g.,

horticulture) sectors — especially in terms of the method of payment, there were not differences between informal and formal marketing channels within the dairy sector.

3.2. Food safety schemes

Unlike in the case of contracting (with dairy farmers), there was a sharp distinction that can be made between informal and formal marketing channels when examining the efforts of buyers to take actions to ensure food safety (Table 2). Specifically, none of the farmers in our sample in either 2000 or 2004 that sold their milk in informal channels reported that the buyer tested their milk for antibiotics. In contrast, more than half of the farmers in both 2000 and 2004 said that buyers in the private and state-owned milk collection stations tested their milk for antibiotic residues. According to our data, the incidence of testing in the formal sector was rising slightly over time.

Confidence in the safety of the milk (at least in the case of antibiotic contamination) was substantiated by our data. We asked farmers who had their milk tested whether or not the buyer purchased the product anyhow or rejected the shipment. In almost all cases in both 2000 and 2004 the buyer would not accept product that had tested positively for antibiotics. Clearly, although imperfect, there appears to have been a gradual rising of awareness that food safety was important. Although we are not sure why this was happening, it may have to do with the fact that the product ultimately went to processors who themselves may have been starting to enforce food safety standards. This was not true, however, in the horticultural industry. In Huang, Wu, et al. (2008), Huang, Zhang, and Zhu (2008) we found that there was almost no testing of horticultural crops — either fruits or vegetables — for food safety. Moreover, the concern over antibiotics (which was one of the major issues in 2004/2005) also obviously did not translate into concern for contamination by other additives, such as melamine. For this reason (especially in hindsight writing after the 2008 dairy scandal) the rise of awareness of the importance of food safety was at best at its earliest stages. More likely, concerns by buyers/farmers were not due to some change in attitude that food safety was inherently important, but the emerging concerns were only due to the fact that there was a positive probability that their product's antibiotic count would be detected as exceeding the maximum set level (by either an industry inspector or food processing firm) and buyers were taking precautions to keep their milk shipments from being rejected.

4. The formalization and privatization of farm gate dairy marketing

One of the most important sets of findings of our study that help fill in the picture of China's dairy marketing can be found in Figs. 2 and 3. In these figures we have tracked the flow of milk from the dairy farmer through the first buyer to the second buyer. We enumerated information about the second buyer by providing the dairy farmer with a special set of questionnaires (a short ¼ page form) that the dairy farmer asked of the first buyer with whom the farmer dealt. With this information, we were able to track where the milk went after the first buyer left the dairy farm (or the collection station).

According to our data, China's farm gate dairy marketing in the mid-2000s was both in midst of privatizing and formalizing. In Fig. 2, we can see that as late as 2000, the largest share of milk being purchased from farmers was from state-owned dairies. Fully 41.9% of the milk of farmers flowed through state-owned milk collection stations. Another 24.9% (15 + 9.9) of the milk produced by dairy farmers were sold in the informal channels, either directly to consumers or sales to small brokers. Slightly less than one-third (33.1) of the milk was sold through private milk collection systems.

By 2004 things had changed dramatically (see Fig. 3). Within four years, almost three quarters (73.0%) of all milk sold by dairy farmers in Greater Beijing were going through private milk collection stations. Because of this steep rise, while simultaneously the share of milk going through both direct consumer sales and sales through small brokers was dropping (to 15.3% — 7.0 + 8.3), it is

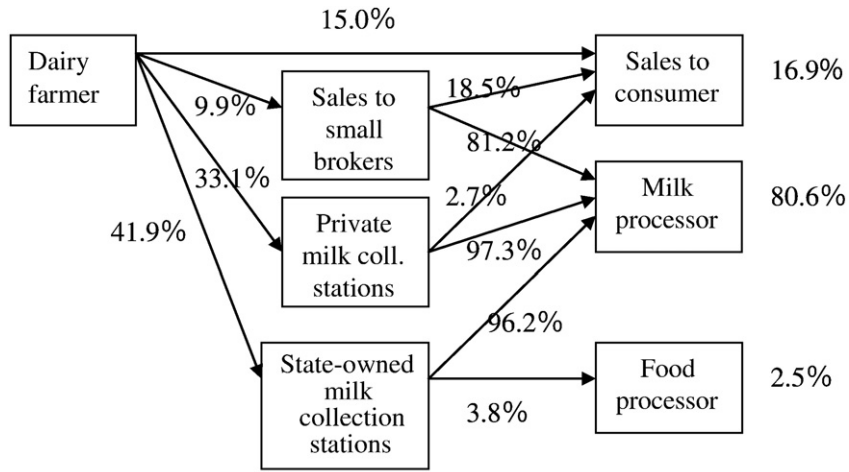
Table 2

Efforts by buyers from different marketing channels to test for antibiotic residues in milk from dairy farmer sales in Greater Beijing, 2000 and 2004.

	First buyers ^a	No. of obs.	Testing for antibiotic residues in milk		Absence of testing for antibiotic residues in milk
			Share of farmers who were tested	When test positive, share when milk was rejected (not purchased)	Share of farmers who were not tested
2000					
	Direct consumer sales	11	0.0	0.0	100.0
	Sales to small brokers	7	0.0	0.0	100.0
	Private milk collection stations	20	60.0	60.0	40.0
	State-owned milk collection stations	6	50.0	50.0	50.0
2004					
	Direct consumer sales	5	0.0	0.0	100.0
	Sales to small brokers	25	0.0	0.0	100.0
	Private milk collection stations	94	69.1	62.8	30.9
	State-owned milk collection stations	6	66.7	50.0	33.3

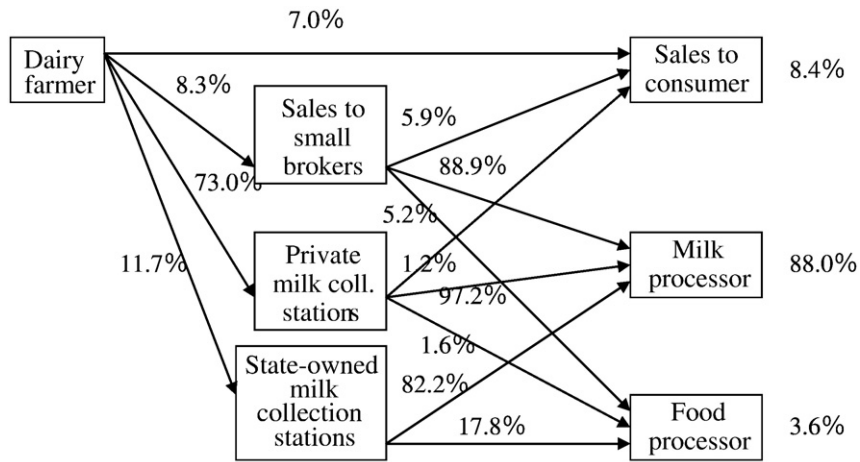
Data source: Authors' survey.

^a First buyer is the agent of the organization in the supply chain that is the one that directly purchases milk from the farmer.



Data sources: Authors' survey

Fig. 2. Share of milk volume by marketing channels for dairy through the first two buyers in Greater Beijing, 2000.



Data sources: Authors' survey

Fig. 3. Share of milk volume by marketing channels for dairy through the first two buyers in Greater Beijing, 2004.

clear that the system was becoming more formal. At the same time, the share going through state-owned milk collection stations fell sharply from 41.9% to only 11.7%. This means that the role played by the private sector expanded sharply between 2000 and 2004.

While the composition of the marketing chain at the first buyer level changed significantly, the composition at the second level has been steadier (Figs. 2 and 3). The main shifts were seen in the fall (from 16.9 to 8.4%) of the directly consumed percentage (that is, consumed without processing). At the same time, the percentages that were used for dairy and general food processing rose a bit (8 percentage points for milk processing and 1 percentage point for food processing).²

² Importantly, because the contamination of China's dairy products by melamine almost certainly occurred at the second level of the marketing chain or above (because of the relatively complicated technical nature of how melamine was added – it was too difficult of a process for an individual farmer to do), the origins of the crisis (which occurred at large-scale collection station level and processing level) were already mostly in place in 2000 and the changes in marketing patterns at the farm level (which occurred most likely due to the explosion of dairy cow ownership at the farm household level in the late 1990s and early 2000s) should not be blamed.

Table 3
Descriptive statistics regarding dairy farmer characteristics and marketing channels.

	Number of observations	Shares by marketing channels (%)				Total
		Direct consumer sales	Sales to small brokers	Private milk collection stations	State-owned milk collection stations	
<i>Category 1. Whether or not there is a dairy processing firms within 30 km of the sample villages (at a period of time three years prior to the time each household started raising dairy cows)</i>						
No	71	18.9	31.0	47.3	2.8	100
Yes	103	3.7	10.2	77.8	8.3	100
<i>Category 2. Dairy processing capacity (in tons) of dairy processing firms within 30 km of the sample villages (at a period of time three years prior to the time each household started raising dairy cows)</i>						
<10	71	18.9	31.0	47.3	2.8	100
10–400	91	3.3	7.1	80.2	9.4	100
>400	12	7.0	33.3	59.7	0.0	100
<i>Category 3. Number of dairy cows per household (in 2000)</i>						
≤5	152	7.4	21.4	67.9	3.3	100
5–10	14	22.9	0.0	60.7	16.4	100
>10	8	34.3	0.0	25.0	40.8	100
<i>Category 4. Cultivated land per capita (in 2000 – mu)</i>						
≤1.3	49	21.7	18.4	49.8	10.1	100
1.3–2.3	59	3.6	16.9	72.7	6.8	100
≥2.3	66	6.8	20.5	70.3	2.4	100
<i>Category 5. Assets per capita for each household (in 2000 – yuan)</i>						
<4000	60	5.1	14.2	77.2	3.6	100
4000–11000	56	18.8	12.5	61.6	7.1	100
>11000	58	6.4	29.3	56.7	7.6	100
<i>Category 6. Distance from village to nearest road in 2000 (km)</i>						
<1	101	11.3	14.4	73.4	1.0	100
≥1	73	8.0	24.7	54.3	13.1	100
<i>Category 7. Distance from village to county seat in 2000 (km)</i>						
<15	55	26.6	7.3	58.9	7.2	100
15–25	61	4.3	6.6	83.3	5.9	100
>25	58	0.0	42.2	52.6	5.2	100

Note: The sample includes all dairy households that sold milk in 2004 (130 households) and all dairy households in 2000 (44 households), a total of 174 observations.

5. Determinants of marketing choices

In this section we seek to answer the question whether or not access by dairy farmers has shifted as the dairy sector has become more formal and private. To look at this, we first look at a set of descriptive statistics. Second, we use Linear Probability Model (LPM), Probit and Tobit to analyze the determinants of the marketing channel decision.

5.1. Descriptive statistics

5.1.1. Dairy size (and asset holdings)

When we look at the different types of dairy households that live in different types of environments and the relationship to the marketing channels, there were some revealing findings (Table 3). From an equity point of view the data show that small farmers were not being excluded from the newly emerging marketing channel, private milk collection stations in the early to mid-2000s (categories 3 to 5). Specifically, when we look at small dairy farms according the number of cows (household raises less than 5 dairy cows), while they tended to make sales to small brokers more than any other group (21.4 of their sales – versus none for larger farmers), we see that most small dairy households (67.9%) sold to private milk collection stations. They clearly were not being excluded.

Likewise, when we look at the marketing decisions of small farmers in terms of cultivated land size (less than 1.3 mu per capita of cultivated land) and asset value of the household (less than 4000 yuan per household), we also see that both of these types of households made most of their sales to private milk collection stations.

In contrast, while larger, well-off farmers made most of their sales to private milk collection stations, they also are the ones that used the large, traditional state-owned milk collection stations. Since the state-owned marketing channel was shrinking in size in a relative sense and since the private, formal milk collection station marketing channel was expanding, our descriptive data suggest that the dairy marketing sector was beginning to be welcoming to (or did not erect barriers against) small, poor farmers during the study period.

Table 4
Determinants of milk marketing channels in Beijing 2000–2004 (OLS Models).

	Consumer	Broker	Private station	State station
<i>Herd size, farm size and assets:</i>				
Herd size in 2000 (number)	1.58 (0.43)***	−1.59 (0.54)***	−1.91 (0.71)***	1.92 (0.32)***
Cultivated land in 2000 (mu)	−1.97 (1.66)	1.94 (2.11)	0.52 (2.76)	−0.48 (1.26)
Per capita asset in 2000 (10,000 yuan)	−1.51 (1.94)	3.22 (2.46)	−2.65 (3.22)	0.94 (1.47)
<i>Market and transportation conditions</i>				
Dairy processing capacity of firms within 30 km in 3 years ago (100 t)	2.31 (1.48)	−3.76 (1.88)**	3.64 (2.47)	−2.19 (1.13)*
Village distance to nearest dairy processing firms in 3 years ago (km)	0.41 (0.12)***	0.21 (0.15)	−0.46 (0.19)**	−0.17 (0.09)*
Whether their milk was refused by buyers in 2000, 1 = yes, 0 = no	−0.17 (5.23)	6.34 (6.64)	−3.59 (8.70)	−2.59 (3.98)
Village distance to county road (km)	−1.79 (2.11)	7.15 (2.68)***	−10.50 (3.51)***	5.13 (1.60)***
Village distance from county (km)	−0.48 (0.21)**	1.42 (0.27)***	−1.08 (0.35)***	0.15 (0.16)
Village herd size (number)	−0.00 (0.00)	−0.01 (0.01)	0.01 (0.01)	0.00 (0.00)
<i>Household characteristics:</i>				
Age (years)	−0.47 (0.23)**	0.72 (0.29)**	−0.13 (0.38)	−0.12 (0.17)
Education (years)	0.44 (0.67)	0.13 (0.85)	−1.14 (1.12)	0.57 (0.51)
Off-farm labor share in 2000 (%)	−0.06 (0.07)	0.29 (0.09)***	−0.12 (0.11)	−0.11 (0.05)**
Constant	23.00 (15.23)	−55.37 (19.34)***	125.08 (25.34)***	7.29 (11.58)
Observations	174	174	174	174
R ²	0.28	0.38	0.27	0.35

Notes: All numbers in parentheses are robust standard errors. ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively. The sample includes all dairy households that sold milk in 2004 (130 households) and in 2000 (44 households), a total of 174 observations.

5.1.2. Location of dairy villages – transportation characteristics

Although our data clearly show that private milk collection stations were expanding rapidly and they were servicing all types of dairies, we found that there still was a role for the sales through small broker channel (Table 3). According to our data, when households were in villages that had relatively poor access to roads (greater than 1 km), they sold more frequently to small brokers (category 6). This pattern of marketing was similar to the results from horticultural studies (e.g., Wang et al., 2009) which found that small brokers allowed farmers in remote areas to become linked to markets.

Dairy farmers also sold a lot of their milk (42.2%) to small brokers when they lived in villages that were far from the county seat (more than 25 km – category 7). This result is consistent to the findings in fruit and vegetable studies; small brokers were willing to service niche markets in more remote villages. However, it is also important to note that, in fact, even more farmers in these outlying villages sold their milk to private milk collection stations (52.6%). This pattern was almost certainly due to the fact that competition had induced private milk collection station owners and operators to set up their facilities in ever more remote locations. Because of their smaller size (relative to state-owned milk collection stations), by 2004 small milk collection stations apparently had been successful in penetrating these smaller, less accessible markets. And, as a result, farmers in more remote villages were able to take advantage of their services.

5.1.3. Nature of dairy processing sector

Our data also show that the emergence of dairy processing was an important determinant of marketing channel choice (Table 3, categories 1 and 2). When there was no dairy processing firm in the nearby region (within 30 km) or if there was only a small processing firm (less than 10 t of processing capacity within a 30 km circle), as we might expect, direct consumer sales rose. Likewise in these villages that were in regions without a developed processing industry, farmers also sold relatively more of their output to small brokers.

When the dairy sector emerged (i.e., when there were processing firms close by – Table 3, category 1; and the size of the firms are relatively large – category 2), however, we see that there was a shift of marketing preference towards selling to private milk collection stations. In both of these types of regions, farmers were able to (and chose to) sell their milk to private collection stations. While we are not sure which came first, the processor or the private milk collection stations, spatially in our data, these two part of the supply chain were closely correlated.³

³ While purely speculative, these results also suggest that focusing on regulating the processing sector may be one way to try to influence the nature of the dairy marketing and production sectors (in China's current on-going attempts to build a new dairy sector after the 2008 dairy scandal). Interestingly, in our current field work (which is being done in preparation of launching another post-crisis survey now), we find the policy makers are also attempting to intervene (not always successfully) into the production and local marketing sectors.

5.2. Multivariate analysis – determinants of marketing channel use in China's dairy sector

Because descriptive statistics may not allow us to isolate the marginal impact of a particular explanatory variable on the choice of which marketing channel a dairy farmer in our sample uses, in this section we will use multivariate regression analysis. In specifying the empirical model, we use two approaches to specify the explanatory variables that are used in the analysis. First, we rely on the descriptive analysis above. Second, we consult the empirical literature on the determinants of marketing channel choice (e.g., Gebreyesus & Sonobe, 2009; Ramaseshan & Patton, 1994; Reardon & Berdegue, 2002). In doing so, our main model of interest is:

$$\text{Marketing Channel Choice}_{ijk} = a_0 + a_1 \text{Dairy Size}_{ijk} + a_2 \text{Nature of the Dairy Processing Sector}_k + a_3 \text{Location of Dairy Villages}_k + a_4 \text{Other Control Variables}_{ijk} + e, \text{ for each } i \quad (1)$$

where variable for Marketing Channel Choice is one of four variables. In Eq. (1), the subscript i denotes which marketing chain is being chosen. When i is equal to 1, the dairy farmer has chosen to market his/her milk by direct consumer sale. When i is equal to 2, the dairy farmer has chosen to market his/her milk by sales to small broker. When i is equal to 3, the dairy farmer has chosen to market his/her milk to private milk collection stations. And, when i is equal to 4, the dairy farmer has chosen to market his/her milk to state-owned milk collection stations. In our analysis we will analyze the determinants of each of the four marketing choices.

In defining our marketing channel choice we have two choices. We can explain why the farmer chose a particular channel (yes = 1; no = 0). In the rest of this paper we call this the *Marketing Channel Choice* variable. We can also explain the share of his/her milk output that was marketed into each channel (henceforth, *Marketing Channel Share* variable). The share for each channel ranges from 0 to 1. If each farmer sold all of his/her output into only one marketing channel, the variables for both ways that we can define marketing channel choice would be the same. In our sample, about 15% of the farmers sell to two or more marketing channels. Therefore, we need to consider two different types of marketing choice variables.

In addition, the main explanatory variables in Eq. (1) – Dairy Size, the Nature of the Dairy Processing Sector and the Location of Dairy Villages categories – are the same as those that were used and discussed in the descriptive section above (as well as Table 3). We also include an additional explanatory variable that measures the size of the herd in the entire village (*Village herd size*). This variable can control for the potential impact of dairy production clusters (or, alternatively for the collective market power) on the marketing channel choice of dairy farmers. It is important to note the nature of the other subscripts. In Eq. (1), j stands for each dairy household and k stands for each village. In our estimating equation, while the marketing channel choice variables and the dairy size variables all vary by household, the variables that are in the nature of the dairy processing sector and the location of the dairy village categories only vary by village.

In addition, we also include four control variables. First, we include a variable if a dairy farmer had ever had his or her milk refused by the agent of the marketing channel under analysis. For example, in the sales to small broker channel equation (column 2 in Tables 4, 5 and 6), this is a dummy variable that is equal to 1 if a small broker had ever refused to purchase a farmer's milk for whatever reason at some time in the past. Our logic is that if a farmer is getting rejected in one particular marketing channel, it may not be worth it for him/her to continue to sell into that channel. In addition, we also control for the age of the household head of the dairy farming household (measured in years), the level of educational attainment of the household head of the dairy farming

Table 5
Determinants of milk marketing channels in Beijing 2000–2004 (Probit Models).

	Consumer	Broker	Private station	State station
<i>Herd size, farm size and assets:</i>				
Herd size in 2000 (number)	0.12 (0.03)***	−0.29 (0.10)***	−0.07 (0.03)**	0.16 (0.06)***
Cultivated land in 2000 (mu)	−0.08 (0.17)	0.22 (0.13)*	0.00 (0.10)	−0.25 (0.27)
Per capita asset in 2000 (10,000 yuan)	0.11 (0.17)	0.36 (0.16)**	−0.11 (0.11)	0.23 (0.28)
<i>Market and transportation conditions</i>				
Dairy processing capacity of firms within 30 km in 3 years ago (100 t)	0.37 (0.13)***	−0.16 (0.12)	0.18 (0.09)**	−0.61 (0.37)
Village distance to nearest dairy processing firms in 3 years ago (km)	0.02 (0.01)**	0.01 (0.01)	−0.01 (0.01)**	−0.04 (0.05)
Whether their milk was refused by buyers in 2000, 1 = yes, 0 = no	0.24 (0.43)	0.71 (0.41)*	−0.06 (0.31)	−0.21 (0.66)
Village distance to county road (km)	0.09 (0.16)	0.53 (0.18)***	−0.31 (0.12)**	0.60 (0.32)*
Village distance from county (km)	−0.07 (0.02)***	0.06 (0.02)***	−0.04 (0.01)***	0.08 (0.05)*
Village herd size (number)	−0.00 (0.00)	−0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
<i>Household characteristics:</i>				
Age (years)	−0.10 (0.03)***	0.06 (0.02)***	−0.00 (0.01)	−0.03 (0.04)
Education (years)	0.05 (0.07)	0.04 (0.06)	−0.02 (0.04)	0.08 (0.11)
Off-farm labor share in 2000 (%)	−0.00 (0.01)	0.02 (0.01)***	−0.00 (0.00)	−0.02 (0.01)
Constant	1.82 (1.24)	−6.60 (1.63)***	2.29 (0.89)**	−2.03 (2.26)
Observations	174	174	174	174
Log Likelihood Ratio	−41.34	−44.17	−83.17	−16.47

Notes: All numbers in parentheses are robust standard errors. ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively. The sample includes all dairy households that sold milk in 2004 (130 households) and in 2000 (44 households), a total of 174 observations.

Table 6
Determinants of milk marketing channels in Beijing 2000–2004 (Tobit Models).

	Consumer	Broker	Private station	State station
<i>Herd size, farm size and assets:</i>				
Herd size in 2000 (number)	7.67 (2.04)***	−20.17 (7.28)***	−3.28 (1.25)***	11.38 (3.89)***
Cultivated land in 2000 (mu)	−7.16 (11.37)	15.73 (8.81)*	0.43 (4.06)	−23.02 (18.26)
Per capita asset in 2000 (10,000 yuan)	1.89 (12.50)	20.18 (10.39)*	−3.50 (4.68)	8.14 (18.57)
<i>Market and transportation conditions</i>				
Dairy processing capacity of firms within 30 km in 3 years ago (100 t)	17.60 (8.77)**	−10.65 (8.20)	5.57 (3.64)	−35.57 (21.43)*
Village distance to nearest dairy processing firms in 3 years ago (km)	1.22 (0.53)**	1.14 (0.81)	−0.65 (0.29)**	−1.73 (2.20)
Whether their milk was refused by buyers in 2000, 1 = yes, 0 = no	16.19 (29.60)	50.65 (29.48)*	−3.49 (12.74)	−0.29 (47.30)
Village distance to county road (km)	−2.31 (10.58)	36.21 (12.82)***	−16.19 (5.44)***	39.58 (18.21)**
Village distance from county (km)	−4.92 (1.70)***	4.44 (1.32)***	−1.69 (0.52)***	5.83 (3.23)*
Village herd size (number)	−0.01 (0.05)	−0.05 (0.04)	0.02 (0.01)*	0.06 (0.05)
<i>Household characteristics:</i>				
Age (years)	−5.22 (1.86)***	3.70 (1.41)***	−0.27 (0.55)	−1.87 (2.82)
Education (years)	3.93 (4.27)	4.36 (4.06)	−1.73 (1.62)	5.96 (8.24)
Off-farm labor share in 2000 (%)	−0.56 (0.47)	1.17 (0.43)***	−0.17 (0.16)	−1.60 (0.90)*
Constant	103.41 (81.32)	−474.55 (119.38)***	146.58 (36.84)***	−186.86 (173.82)
Observations	174	174	174	174
Log Likelihood Ratio	−180.72	−223.14	−682.73	−82.46

Notes: All numbers in parentheses are robust standard errors. ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively. The sample includes all dairy households that sold milk in 2004 (130 households) and in 2000 (44 households), a total of 174 observations.

household (measured in years) and the share of household members that had employment off the farm. All of the control variables vary by household. A table that includes the mean and standard deviations of all of the variables used in Table 4 (and our other analyses) is included in Appendix Table 1.

To model the marketing choice of our sample's dairy farmers (as either Marketing Channel Choice or Marketing Channel Share), we used three methods and compared their results. First, we estimated the four equations (one for each marketing channel) for Eq. (1) in three separate ways by using Linear Probability Model and the results are reported in Table 4. And then we used Probit model to analyze the marketing channel choice of farmers. The results using a Probit model are reported in Table 5. Finally, when using the Marketing Channel Share variable as our dependent variable, since it is continuous between 0 and 1, we used a Tobit approach. The results using a Tobit model are reported in Table 6.

5.3. Results

The results of our three sets of equations are reported in Tables 4 to 6 and perform well with many coefficients as expected. The R-square, goodness of fit, statistics in the LPM version of the estimated equations (Table 4, bottom row) range between 0.26 and 0.36, levels that are not low for cross sectional production/marketing analyses. In addition, a number of the coefficients for the control variables can be explained reasonably. For example, in the Sales to Small Broker equation (Table 4, column 2), the positive sign on the age and off farm employment variables are positive and significant. One logical explanation of these coefficients is that those dairy households with older household heads and with more of its members working off the farm decide to, *ceteris paribus*, use sales to small brokers more frequently. In three of the four equations the sign on the coefficient of the “refused to purchase milk in the past” variable are negative (albeit they are insignificant).

More importantly, the results in all equations and in all three sets of tables are consistent with the findings from our discussion of our descriptive statistics. Taken as a set they also help us understand how China's dairy sector is evolving in a healthy direction. In particular, when we look at the results of the coefficients from the variables in the set of Dairy Size variables, we find that indeed, small farmers are not being excluded from the most vibrant marketing channel — private milk collection stations. In Tables 4 to 6, column 3, row 1, the sign on the herd size variable is negative and significant. This means that smaller farmers are the ones that are deciding to sell to this increasingly dominant form of dairy marketing institution. Smaller farmers also choose to make their sales to small brokers. This result is likely because the cost of carrying small volumes of milk to a collection station can often be high and it makes sense to sell to a broker. In contrast, larger farmers tend to sell as direct consumer sales and to state-owned milk collection stations. Interestingly, since these two types of channels are shrinking the fastest, larger farmers may need to begin to find alternative channels in the future.

Equally important, land size and asset holdings also are almost completely uncorrelated with the choice of marketing channels, especially in the case of the decision to sell to private milk collection stations. In a few of the regressions we actually see farmers with more land and higher assets choose to make sales to small brokers. While perhaps a bit counter intuitive, during interviews we often found larger, wealthier dairy farmers less willing to make the trip each day to the milk collection station. The small brokers may be providing a service that saves them both time and effort that can either be put into other farming activities or leisure.

The two variables measuring the nature of the emergence of the dairy industry produce results that are also similar to our descriptive findings (Tables 4 to 6, rows 4 and 5). When a village of dairy farmers is nearer a dairy processor and when a village of dairy farmers has a

larger processing factory near it, they are more likely to sell to private milk collection stations. Clearly this result is similar to our finding that private milk collection stations are expanding with the dairy processing sector. Since our variable for dairy processing are from 2000 and our private milk collection station dependent variables are from 2004, this is some evidence that the dominant form of farm gate milk marketing (private milk collection stations) are reacting to the expanding processing sector.

Finally, our multivariate analysis finds that there is specialization occurring in the marketing segment of the dairy industry at the farm gate level (Tables 4 to 6, rows 6 and 7). Clearly, in villages that are remote from the county and from roads, households sell relatively more to small brokers. In contrast, farmers in more centrally located villages choose to sell to private milk collection stations. This is somewhat different result than what was found in the descriptive results. However, if we rely on the regression results, we see that small brokers play a role in servicing remote villages. Policy-wise the challenge is to try to make these small brokers more interested in food safety and more service-oriented to the industry needs.

Interestingly, when we add village herd size, there is almost no effect (Tables 4 to 6, row 9). The coefficients in all of the regressions are not significantly different from zero except for one in the set of regressions using Tobit (Table 6, row 9, column 3). In the one regression in which the coefficient on the variable is significantly different from zero at 10% level. In other words, there is no evidence that the size of the herd in the village affects the marketing channel choices of dairy farmers.

6. Summary and conclusions

In this paper we have sought to provide a picture of one of the most under-studied parts of the dairy industry, the dairy marketing sector at the farm gate level. Using data from a representative sample of Greater Beijing, we have provided information to answer a number of questions: Who are the actors that participate in China's dairy marketing? What are their characteristics? What has been the shift in the importance of each different marketing channel? What are the determinants of marketing choice? Are small, poor farmers in remote villages able to access dairy marketing chains?

In our empirical study we have found that many of the same features that characterize other parts of China's agriculture are present in China – e.g., horticulture and livestock market (Wang et al., 2009; Huang, Wu, et al., 2008; Huang, Zhang, & Zhu, 2008; Bi, Rozelle, & Huang, 2008). There also are many different choices of marketing channels for dairy farmers to sell into – direct sales to consumers; sales to small brokers; private milk collection stations and state-owned milk collection stations. Many of the actors are small in size: small brokers are typically individuals or family business. Private milk collection stations are run by individual entrepreneurs. Most transactions are not based on well-defined contracts.

While many of our findings are consistent with what is happening in the marketing of other sub-sectors of China's agriculture, there are some special characteristics of China's emerging dairy marketing. First, unlike the case of horticulture, more than half of the sales transactions are not done on cash, spot market bases. Although, the price is a current market price, in most of the cases, farmers are paid at the end of the month. In addition, there appears to be more emphasis on food quality. There is more testing for antibiotic residues and when the residues are found, the milk is almost always rejected. These findings show that although dairy marketing is developing with Chinese characteristics, there is a trend for becoming more formal and safety conscious.

In addition, the shift in the pattern of marketing channels supports this conclusion. In the past, dairy marketing was dominated by direct consumer sales, sales to small brokers and marketing to state-owned milk collection stations. By the mid-2000s, however, increasingly the market was dominated by private milk collection stations. This is evidence that China's dairy marketing is becoming privatized and more formal.

Finally, while the results of our previous work – which shows the dominance of small dairies run by relatively poor households in remote villages in production – might be in danger of being overturned (that is, if small, poor households in outlying villages could not access the new marketing channels), clearly this is not the case. In fact, small, poor farmers are the ones that are mostly using private milk collection stations. There is no evidence that these more vulnerable groups of farmers were being excluded.

With all of this evidence and findings, of course, the policy implications would seem clear: China needs to support the emergence of this new sector. The old state-owned sector is fading. There seems to be no real reason to try to prop up this part of the marketing system unless it can survive on its own. Small brokers are also falling in relative importance. However, small brokers, according to our results, do play a positive role in servicing dairy households in remote villages. While they might not want to be the top priority in terms of policy support, their special role should mean that they should not be suppressed. Effort should be made to make them more responsive to the demands of the processing sector.

This study is perhaps most valuable in its role as building a baseline for trying to rebuild the sector after the dairy crisis in 2008. There are lessons. Although our paper most clearly shows that dairy marketing was improving at the local level, bad things were still happening with negative consequences for food safety. Obviously more needed to be done (than was happening in the early 2000s). Our work provides some clues about what might be done. It appears as if farmers and local marketers could not have been part of the problem and it appears as if these grass root agents of the dairy sector were following leads of the processing sector. If this is the case (and admittedly we need more evidence before this statement can be verified), policy reform in the dairy sector may want to focus on the food processing sector, its procurement system and foremost. More work also needs to be done to see what is actually happening on the ground in China's post-crisis dairy industry. But, it appears as if more effort (or at least a lot of effort) is going into directly controlling dairy production when it is not at all clear that this is where the problem lies.

The paper also appears to assuage concerns that small producers are being excluded from marketing chains that are being dominated by agents that have marketing power and force out small producers. China in this way is clearly unlike the scenarios raised elsewhere in the literature (e.g. Chau et al., 2009) that shows it is possible that when there are monopolies that dominate marketing channels that small farmers can suffer. Why is this the case? While this is beyond the scope of this paper, it may be that

there are policy implications in the way that China has a fairly unregulated marketing system in the agricultural sector. As stated above, this may be changing and it may have implications for the future structure of China's dairy production sector. But, when the study was carried out, this paper shows that small farmers will enter and market their milk in a system that is dominated by many different players. Competition, at least in this case, appears to be the friends of small producers.

It could also be that there are other dynamics that explain the rise of small producers – although our paper did not find this evidence. In the same way that there is a small enterprise-driven segment of the industrial sector, a household-based dairy industry may be facilitated by clustering (Huang, Wu, et al., 2008; Huang, Zhang, & Zhu, 2008) and the institutions (such as, informal financing) that allows the emergence of a robust set of innovative, fast-growing small firms (Ruan & Zhang, 2009).

Acknowledgements

We would like to thank financial supports from the Chinese Academy of Sciences (KSCX2-YW-N-039), National Natural Science Foundation of China (70963008), and Center for Agricultural and Rural Development of the Iowa State University. We also would like to thank Xiaoxia Dong, Ying Liu, Yu Liu, Zijun Wang, Haiqing Zhang, Heping Zhan from the Center for Chinese Agricultural Policy and many others who participated in field survey and Zhigang Xu for his comments in the earlier draft of this paper.

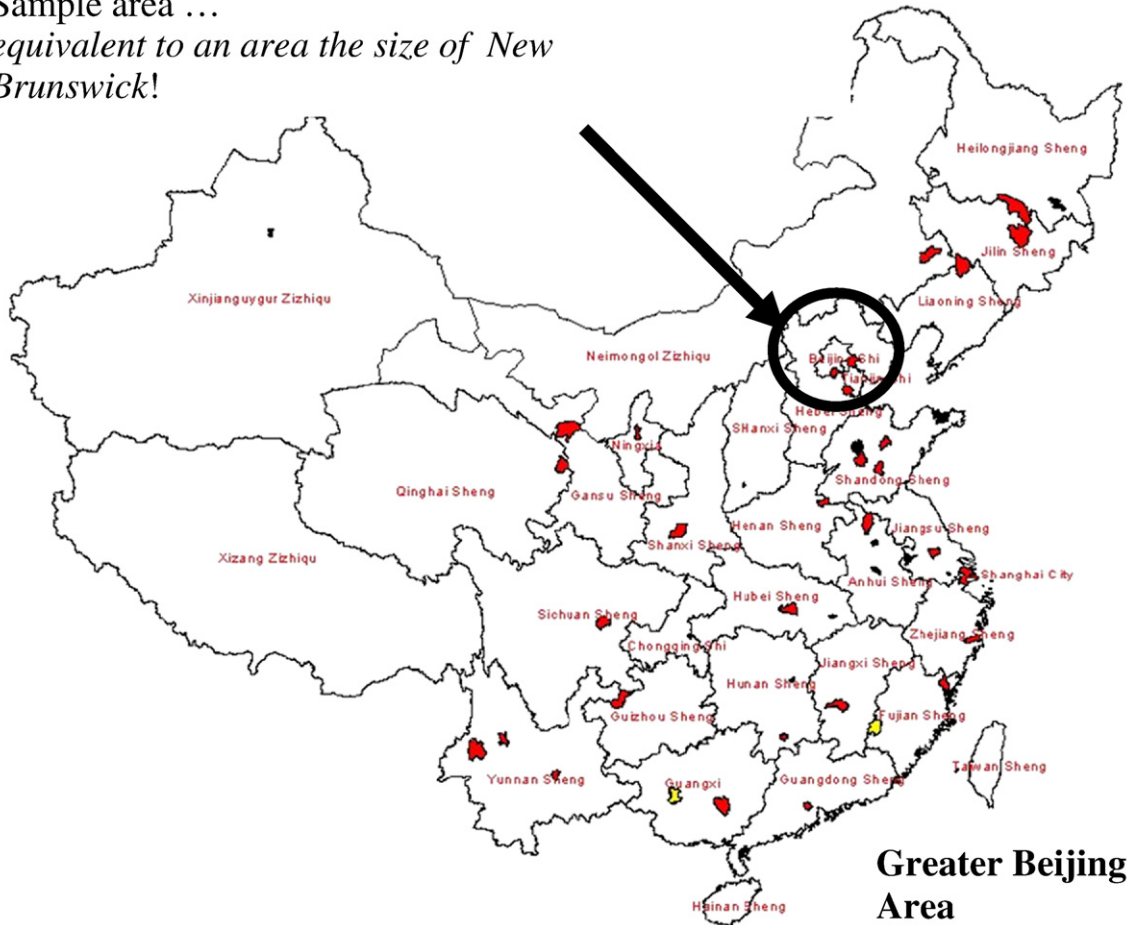
Appendix A

Descriptive statistics of all variables used in the analysis of the determinants of milk marketing channels.

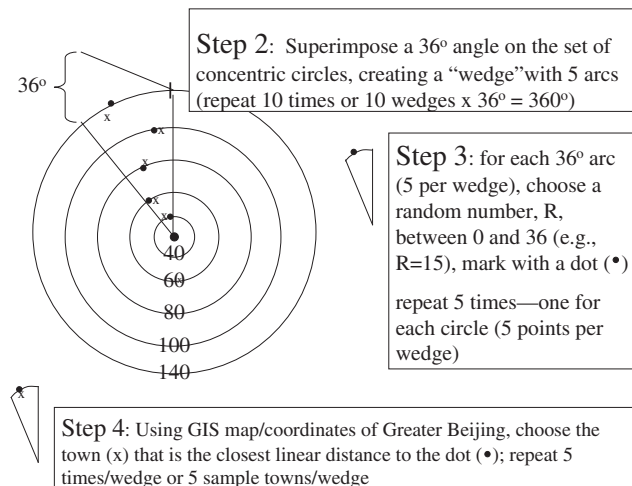
	Mean	Standard deviation
Consumers (the percentage of milk sales that the dairy farmer sells to consumer directly)	9.90	28.42
Brokers (the percentage of milk sales that the dairy farmer sells to brokers)	18.68	38.90
Private Stations (the percentage of milk sales that the dairy farmer sells to private collection stations)	65.35	46.91
State-owned Stations (the percentage of milk sales that the dairy farmer sells to state-owned collection stations)	6.07	22.74
Herd Size in 2000 (numbers)	2.91	4.89
Cultivated land per capita in 2000 (mu)	2.09	1.25
Per capita assets in 2000 (10,000 yuan)	1.02	1.04
Dairy processing capacity of firms within 30 km 3 years prior to the time of marketing channel decision (100 t)	1.74	1.93
Village distance to nearest dairy processing firms 3 years prior to the time of marketing channel decision (km)	33.78	25.27
Whether or not farmer's milk was ever refused by buyers in 2000, 1 = yes, 0 = no	0.17	0.38
Village distance to county road (km)	0.76	1.00
Village distance from county seat (km)	19.49	11.71
Total number of herds in village (numbers)	149.70	385.51
Age (in years)	43.41	8.68
Education (in years attained)	6.91	3.09
Off-farm labor share in 2000 (%)	26.89	29.64

Note: The sample includes all dairy households that sold milk in 2004 (130 households) and all dairy households in 2000 (44 households), a total of 174 observations.

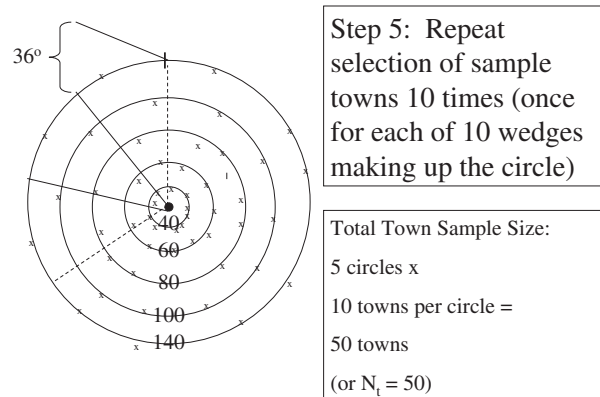
This is the outer ring of our Study's Sample area ...
equivalent to an area the size of New Brunswick!



Appendix Figure 1. Location of the sample region of the Greater Beijing study. Step 1 is defining the study area.



Appendix Figure 2. Steps 2 to 4 on choosing a sample for Greater Beijing study area.



Note: Population of ALL towns in each strata is used for sample weighting.

Appendix Figure 3. Fifth and final step in sample selection for Greater Beijing study area.

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