

Small Holder Incomes, Food Safety and Producing, and Marketing China's Fruit*

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One of the most wrenching changes in China's agricultural economy over the past decade and a half has been the rise of horticulture in the cropping sector. Between 1990 and 2006 cash crops have risen from 35% of sown area to 47% (NSBC). Fruit and vegetable area are responsible for most of the growth. Between 1990 and 2005 vegetable sown area nearly tripled, increasing from 6.34 million hectares to 18.22 million hectares. Fruit area also nearly doubled, expanding from 5.32 million hectares to 10.12 million hectares during this time period.

Whether a cause or an effect or whether they emerged simultaneously due to a different (or similar) set of drivers, during this same time period modern supply chains have also emerged. From its start in the early 1990s, supermarkets achieved over \$55 billion in sales in the mid 2000s (Hu et al.). The restaurant industry has also experienced high growth for most of the past two decades (Ma et al.).

These two trends, while indicative of a rapidly growing economy that is catering to a consumer base with more and more wealth, also has created two

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concerns—one on the supply and the other on the demand side. Internationally, one of the most controversial issues is that the rise of supermarkets and production of fruits and vegetables could have negative effects on inequality. Several studies have suggested that the poor would suffer from this process (e.g., Elizabeth, Farina, and Reardon). In China, this concern has already dampened the initial enthusiasm of some of those who believed the rise in the demand for high-valued horticulture and other commodities would provide opportunities for farmers to move into the production of goods that could provide them with a higher level of income (Yu; Yuan).

Despite these early predictions, recent research suggests that there could be another side to the argument. Dries, Reardon, and Swinnen; Minten, Randrianarison, and Swinnen; and Maertens and Swinnen find that the emergence of modern supply chains for producing food crops has resulted in increased interaction between buyers and poor farmers in developing countries. In a study of the horticulture economy in the Greater Beijing area, Wang et al. also demonstrate that almost all of the increased supply since the 1990s is being produced by small, relatively poor farmers.

Although comparisons of China's retail venues between 1990 and 2005 make it abundantly clear that the breadth of choice of fresh food has expanded and the price of food, in general, has fallen, there is also concern about the safety of China's food. With rising incomes urban consumers should be expected to steadily increase their demand for safe food. However, recent reports in the news—with regards to both export and domestic markets—raise concerns that the current food system is not able to guarantee the food on the average consumer's plate is safe.

The purpose of this article is to try to understand whether the recent changes in China's food economy have exacerbated or contributed to an improvement in poverty reduction (or betterment of small farmers) and/or food safety. To do so, we will draw on a dataset that we collected in 2007 of representative apple and grape farmers in Shandong province, one of the fruit baskets of China. Using these data, we describe the emergence of the production and marketing structures of our sample. Next, we examine whether it is small or large farmers (or rich or poor ones) that are entering the horticultural economy through different types of marketing channels. Finally, we examine several indicators of producer-trader behavior that will help us understand whether or not China's horticultural marketing channels are able to guarantee that the consumer is purchasing a safe, traceable product.

Data

We selected apples and grapes in Shandong province as the focus of our analysis for a number of reasons. First, the production of apples and grapes are the number one and number six most prevalent fruit commodities in China. Second, the production of both apples and grapes increased significantly in the past 15 years. Between 1990 and 2006 apple production in China increased by more than six times (from 4.3 to 26.1 million tons); grape production rose by even more on a percentage basis, increasing 7.3 times from 0.86 to 6.3 million tons (NBSC). Finally, we chose Shandong since it is the largest fruit producing

province in China and since it historically has been a marketing leader for apples, grapes, and other commodities.

The data for this study come from a stratified random survey in Shandong province. This survey is a representative sample of apple and grape growing counties, townships, villages, and households in the province. The first step in conducting the survey involved identifying the study population and creating sampling frames of county-level apple production and county-level grape production. With knowledge of the total production environment in Shandong for both apples and grapes (from the Shandong Department of Agriculture), we ranked all 140 counties in Shandong by their levels of apple or grape area per farm population. Based on the rankings, we kept the top seventy-four counties for both apples and grapes as part of our sample, which accounted for more than 90% of the province's total apple and grape production.

After defining the study's sampling frame, we then chose a stratified sample. To do so, we first divided the seventy-four counties into five groups: two high production groups, two medium production groups and one low production group for both apples and grapes. For each type of fruit, one county was randomly selected from each of the above five groups. Hence, in total, we have five sample counties for each commodity. The farm population in each set of counties provided data for our weighting system, which is used to create point estimates for the provincial averages of each of our variables.

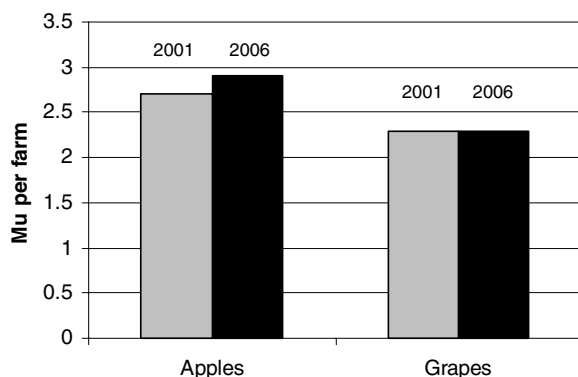
The rest of the sampling (for towns and villages) proceeded on a basis similar to that used to selecting counties. In total, the survey teams visited eighteen townships for each crop. In total there were ten townships in the two highest producing counties, six in the two middle producing counties, and two in the lowest producing county. In the eighteen townships, we chose a total of thirty-five villages (twenty-two in high production counties; ten in medium production counties; and three in low production counties). The population shares for all townships and villages are used in the weighting schemes.

The last step of the sampling process involved selecting the sample households from the sample villages. In each village, we divided all households into two groups: households with apple (grape) production and those without. Except when there was not enough of a certain type of household, we randomly selected seven apple-producing (grape-producing) households and three nonapple-producing households in each village. In all villages, we obtained estimates of the total number of apple-producing (grape-producing) and nonapple-producing households, which are used in the weighting system.

After choosing the sample households in this way, we collected data on 338 sample households. In total, 279 households in the sample are apple-producing households and fifty-nine are nonapple-producing households. In the case of grapes, we interviewed 329 households. Of this total, 232 are grape-producing households and 97 are nongrape-producing households.

The Production and Marketing of Apples and Grapes in Shandong

Unlike the large fruit orchards and plantations that characterize fruit production in some countries, fruit production in China (or more precisely

Figure 1.

Shandong province) is dominated by small farms. Part of the reason for this is certainly traceable back to the nature of land tenure in China. All households have land contracted from their villages with 30 years use rights. Every farm family in a village was given land. In China's densely populated villages, this means that, on average, household farm size in our sample was only 4.4–5.1 mu (1 mu = 1/15th hectare). Among all households surveyed, the largest farm size was only 30 mu in the apple-producing villages and 40 mu in the grape-producing villages.

Similar to the trends in apple and grape production at the national level, fruit production has increased since 2001—but the growth in our villages has come from different sources. The number of apple growers was almost unchanged between 2001 and 2006 (from 226 to 229). As figure 1 shows, however, the average size of apple farm rose from 2.7 to 2.9 mu. In contrast, while the growth of the average size grape farm was static (2.3 mu in both 2001 and 2006), the number of grape farmers rose from 200 to 232 during the study period.

Household Apple and Grape Marketing Choices

One of the most important findings of the survey comes from information on the nature of the sales transactions between apple- and grape-producing households and their buyers. Most simply, our survey of the marketing behavior of producers shows that most fruit, in particular apples, are moving through traditional supply channels and there is little penetration of the types of players that are emerging prominently in the downstream segment of the marketing chain (e.g., supermarkets—table 1). In the case of apples, during the sample period apple-producing households sold over 90% of their apples in traditional channels (columns 1 and 2). Brokers (or small, itinerant traders that visit villages and procure apples directly from farmers) account for between 20% and 25% of sales between 2001 and 2006 and small-scale wholesalers account for about 70%.

Only a small share of apples was marketed to processors or other modern supply chain agents (table 1, columns 3 and 4). Modern channels, which mainly include processing firms and special suppliers, together accounted for only 7% (2.6% + 4.4%—row 1) in 2001. Our data do show a slight upward trend between

Table 1. Marketing channels of apple- and grape-producing households in Shandong province, 2001 and 2006

	Sample Size ^a	Shares by Marketing Channels (%)				Total
		Brokers ^b	Wholesalers	Processing Firms	Other Modern Channels ^c	
Apple-producing households						
2001	263	23.8	69.2	2.6	4.4	100
2006	275	21.9	67.0	3.3	7.9	100
Average	–	23.1	68.4	2.8	5.7	100
Grape-producing households						
2001	151	30.0	28.4	31.4	10.1	100
2006	224	25.5	26.1	30.2	18.2	100
Average	–	27.7	27.2	30.8	14.3	100
All villages						
2001	414	25.8	56.1	11.9	6.3	100
2006	499	23.8	48.2	15.6	12.6	100
Average	–	24.8	52.7	13.5	9.0	100

^aThe numbers of sample households are slightly less than those for the apple- and grape-producing production households presented in tables 1 and 2 because there were a few very small fruit farms that did not sell any of their output (i.e., they produced for home consumption only).

^bThe numbers under the “broker” category also include farmers that directly sold their fruit to consumers in local periodic and wet markets.

^cThe other modern channels for apples include special suppliers (3.2% in 2001 and 5.9% in 2006), restaurants (0.7% in 2001 and 0.2% in 2006) and export companies (0.4% in 2001 and 1.8% in 2006). The other modern channels for grapes include special suppliers (10.0% in 2001 and 18.1% in 2006), restaurants (0.1% in both 2001 and 2006), and supermarkets (0.00% in 2001 and 0.02% in 2006).

Note: All numbers are weighted averages.

2001 and 2006, although by the end of our sample period, total sales to agents from modern market channels only reached 11.2% (3.3% + 7.9%—row 2). Hence, in the case of apples, it can be concluded that, despite a lot of restructuring in the downstream segment of fruit markets, these shifts have not significantly penetrated into the locations at which farm procurement occurs.

The case of grapes is somewhat different than that of apples. The share of grape-producing households selling to wholesalers accounted for 27.2% of sales. While much less than in the case of apples, the total share of grapes sold to small traders (brokers and wholesalers) was still high and exceeded half of all sales (55% or 27.7% + 27.2%—row 6, table 1).

Unlike apples, there was a significant, and somewhat growing, share of grape-producing households that sold their grapes to processors and other agents from modern marketing channels. The data from the grape-producing villages show that actors in the midstream segment of the modern supply changes reaches down to the farmgate. Processing firms procure more grapes than any other type of buyer (30.8%), although the share is not rising between the first and last year of our study. Although only a relatively small share of grape-producing households sell their grapes to specialized suppliers (which are typically procurement agents from large wineries), the share has been rising

between 2001 and 2006 (from 10.1% to 18.2%). Interestingly, this pattern of marketing is different from that in Greater Beijing where no penetration of any kind (even in grape-producing villages) was found in horticulture-producing villages (Wang et al.; Dong et al.).

While there are significant increases in grape sales to nontraditional buyers, these new types of buyers are not much different from traditional buyers. Most of the sales to nontraditional buyers are to traders who (according to our farmer and trader surveys) represented small local wineries and small local cold storage operations. In interviews we discovered that in at least some cases the buyer was either a family member, relative, or friend of the owner of the winery/cold storage facility. Another interview found the buyers for the wineries were agents working on commission. Once the wine grape-buying season was over, these agents would move on to another industry. Therefore, an alternative interpretation of such an agent is that he/she, in fact, was really just a small broker. From this point of view, even many of the so-called nontraditional buyers do not truly represent a significant change in the nature of their buyers. Consistent with this interpretation is the fact that, despite the rise of supermarkets in urban areas, there is no evidence that employees or contractors of supermarkets have penetrated to the village level. In fact, there were zero purchases by agents of supermarkets in our sample villages.

Who is Selling into Traditional and Modern Supply Channels?

In this subsection we examine differences in the characteristics among apple- and grape-producing households that sell their produce into traditional and modern supply chains (table 2). In the first set of rows of each part of the table, we look at the size of farms (comparing how small and large farms market their apples and grapes). In the second set of rows, we look at their assets (comparing how poor and rich farmers market their apples and grapes).

According to our data, there is no evidence that small apple-producing households are relegated to traditional supply chains or excluded from modern supply chains (table 2, first set of rows). When the farm sizes of apple-producing households vary from less than 4 mu (lower tercile) to 4 to 7 mu (middle tercile) to more than 7 mu (upper tercile), the share of each group of farmers (based on their farm size) that sells to brokers varies from 26.2% to 13.9% to 34.1%. There is no clear linear relationship. The same is true for all of the other categories—sales to buyers in wholesale markets, processors, and other modern marketing channels. In other words, there is no discernible relationship between farm size and the choice of marketing channel.

The same appears to be true when examining the relationship between wealth and the choice of the marketing channel of apple-producing households (table 2, second set of rows). In the case of brokers and buyers in wholesale markets, poor farmers and rich farmers participate in similar ways. The same is true with participation in modern marketing chains. In fact, according to descriptive statistics based on our data, small and poor apple-producing households are not being relegated to traditional marketing channels. Similarly, although activity between apple-producing households and the agents of modern supply chains is limited, small and poor households are not being excluded.

Table 2. Household size, wealth, and marketing channels in apple- and grape-producing villages in Shandong province, 2001 and 2006

	Sample	Shares by Marketing Channels (%)				Total
		Brokers	Whole-salers	Processing Firms	Other Modern Channel	
Apple-producing households						
Household cultivated land in 2001						
<4 mu	149	26.2	70.9	1.7	1.2	100
4–7 mu	247	13.9	72.2	3.2	10.8	100
≥7 mu	142	34.1	62.8	2.0	1.0	100
Per capita assets in 2001						
<4,000 yuan	296	22.4	64.6	2.7	10.4	100
4,000–7,000 yuan	104	20.1	74.5	3.0	2.4	100
>7,000 yuan	138	25.2	67.3	3.3	4.2	100
Grape-producing households						
Household cultivated land in 2001						
<4 mu	80	56.0	19.4	17.9	6.6	100
4–7 mu	136	54.7	20.7	18.2	6.4	100
≥7 mu	159	47.5	30.2	15.8	6.6	100
Per capita assets in 2001						
<4,000 yuan	142	55.3	30.5	10.1	4.0	100
4,000–7,000 yuan	76	35.3	24.2	24.5	16.0	100
>7,000 yuan	157	57.0	12.6	22.1	8.3	100

Note: All numbers are weighted averages.

Largely the same story is true for grape-producing households (table 2, bottom half of the table). Although there is a slight linear trend that shows small grape-producing households are more likely to sell to brokers than larger ones, the opposite is true for small and large grape-producing households and their sales to wholesalers. There is no evidence that small farmers are getting less access to modern chains. The same is true for levels of wealth.

Hence, from the above descriptive analysis several points are clear and provide evidence that can help clarify one of the debates about the effect of the rise of the horticultural economy and changes in the downstream segment of the marketing chain. First, in the same way as was found in Wang et al., there were almost no large farmers in a fully representative sample in the survey area that were producing apples or grapes. Second, also consistent with Wang et al., by far the largest majority of buyers are either small brokers or small traders in wholesale markets. Finally, and most importantly, when we look at who is selling to the different chains, there are no distinguishable differences in terms of size or wealth level. In other words, according to our descriptive statistics, poor, small farmers face few if any barriers in China's apple and grape markets.

Traceable and Accountable of Food Safety

While we do not have any direct measures of how safe China's apples and grapes are, we are able to observe the nature of the transactions between the buyers and the sellers. Specifically, during our survey we asked farmers several questions that we use as a basis of our analysis of the ability of China's domestic apple and grape channels to guarantee a safe product: Did you have a written contract with the buyer? What was the nature of the exchange? Was it for cash in a spot market? Or, was there some longer buyer-seller relationship that involved the provision of inputs/technology by the buyer to the seller? Finally, on what basis was the final purchase price determined? Was it on the basis of more observable traits, such as the size and/or color of the fruit? Did the sale or the price depend on results from any formal or informal testing for pesticide residues? Our assumption in this part of the article is that if there is no contractual relationship, and/or if transactions all occur on spot markets, and/or if there is no attempt *ex ante* to determine whether or not the fruit that is being purchased has been sprayed with toxic pesticides (or are otherwise contaminated), then it is difficult for the system to guarantee a safe product. Again, it is important to reiterate that our findings do not say anything about whether China's farmers are using toxic levels of pesticides or whether China's fruit is unsafe.

Based on these assumptions and using our data, we find that there is great challenge for China's horticultural economy to ensure delivery of a safe product. One basis for the statement comes from our data on contracting between sellers and buyers; in short, there is almost no activity based on contracts (table 3). In the case of apples, there is zero. In none of our sample villages did apple-producing households operate with either a written or oral contract. There were also no implicit contracts for inputs—all seed, fertilizer, and credit were obtained by farmers from the market on their own. While there is more contracting in the case of grape-growing households (farmers in 24% of grape-growing villages have written contracts), farmers are still largely on their own for purchasing their inputs. Extension services also are almost never

Table 3. Contracting arrangements in the apple- and grape-producing villages in Shandong, 2005 (all figures in percent)

	Apple Villages			Grape Villages		
	Formal Contracts	Oral Contracts	No Contract	Formal Contracts	Oral Contracts	No Contract
Shares by different contracts	0	0	100	24	5	76
Services provided by buyers						
Seed	0	0	0	10	0	0
Fertilizer	0	0	0	0	0	0
Credit	0	0	0	0	0	0
Extension	0	0	0	3.6%	0	0

Source: Authors' survey.

provided by buyers (zero in the case of apples and only 3.6% in the case of grapes).

In such a contractual environment, it is little surprise that almost all transactions in China's apple and grape economy are spot market-based. All apples are sold to buyers for cash; payment is made in more than 90% of the cases at the same time as the transaction. In the case of grapes, there are a few more cases of longer term payment schedules (around 20% of the time), but, even for grape-growing households in 2006 all transactions were in cash and more than 80% of the time the transaction was settled immediately.

So what do farmers believe they are being rewarded for in the market? When asked to give their opinion about what factors contributed to higher prices, nearly all apple- and grape-growers stated that the price was determined mostly on some combination of the size of the fruit, its color (ripeness), and the absence of blemishes. Regardless of who farmers sold their crop to, less than 1% of the time was there ever any attempt by apple buyers (those in traditional or nontraditional channels) to assess whether there was any pesticide residue on the fruit that they were purchasing. Also in only 1% to 2% of the time (including transactions between grape-growers and processors), did a grape buyer even attempt to assess whether there was any pesticide residue on the fruit that was being purchased. No farmer we interviewed or surveyed ever had his apples or grapes tested. Similarly, when we interviewed traders in wholesale markets, not a single respondent said that their apples or grapes had been tested.

On this basis, we conclude that ensuring safety of China's apple and grapes is a challenging task. With only a few contractual relationships, with only few long-term buyer-seller relationships and given the nature of the marketing system—thousands of traders buying from thousands of farmers in each county—it would be impossible for any shipment of fresh or processed fruit that originated from the farms in our sample to be traced back to the farm. After selling their output on the spot market, farmers in China's horticulture economy are free from all accountability.

Conclusions

Although upstream segments of the marketing chain in China have evolved dramatically in the past 15 years, there is little evidence that this is directly moving down to the farmgate. As found in other farm-level studies, in our sample of farmers from provincially representative apple-growing and grape-growing households, most Shandong farmers are selling their apples and grapes into traditional marketing channels. Despite the rise of supermarkets and restaurants, there is zero penetration.

According to our results, when compared to larger, better off households, it is equally likely that small, poor apple- and grape-growing farmers in Shandong participate are producing and marketing fruit. In fact, there are almost no growers with farms that are larger than one hectare. On average, apple and grape farmers cultivate less than 3 mu (less than 1/5th of a hectare). Clearly, the results found in Wang et al. that China's horticultural economy is best characterized by millions of traders buying from tens of millions of farmers, including the poor, is supported by the findings of our study in Shandong.

However, this small- and poor-farmer friendly horticultural economy producing enormous amounts of fruit and vegetables at lower prices is vulnerable to food safety problems. With most of the transactions being characterized as pure spot market, there is almost no traceability in the system. Farmers are not accountable once their apples and grapes are passed to traders in exchange for cash. We cannot say anything about the real level of food safety. Because there is little or no testing on the farm or in wholesale markets, it would be difficult to detect if farmers were using unsafe chemical inputs or to keep unsafe food out of the supply chain. If contaminated fruit were detected further down the supply chain, there also would be no way to determine where it came from.

China's challenge, then, is great. On the one hand it wants to keep its market accessible to small, poor farmers. In such an environment there are a number of things for policy makers to do. First, continued management of the market in the current hands-off way is appropriate. Markets at all levels are competitive and food is being provided to the cities in an efficient and inexpensive way. Small, poor farmers are participating. However, when a market is dominated by traders in traditional marketing channels, there is big challenge in meeting the growing demand for food safety. Increased regulation and testing might help, but, if regulations become too strict they might act to keep small farmers out of the market. Evidence from the rest of world shows that policies that foster cooperatives and more participatory systems of marketing (that is, institutions that keep the farmer involved in the supply chain for longer periods of time) may help to improve the system. An alternative strategy may be to leave the farmer side of the marketing supply chain alone and try to better control those that supply input markets. For example, it could be that more regulation is needed on the production and import sides of the pesticide industry. Such a strategy would be based on the idea of keeping dangerous elements out of the supply chain altogether.

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