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Evidence from China**

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*Contributed Paper prepared for presentation at the International Association of
Agricultural Economists Conference, Beijing, China, August 16-22, 2009*

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Smallholder Incomes, Vegetable Marketing and Food Safety: Evidence from China*

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Abstract

Great changes have taken place in China's agricultural and food markets in the past several decades. However, the impact of the transformation brought by modern supply chains on the welfare of farmers in China is unclear. This paper attempts to understand whether or not the recent changes in China's food economy have contributed to an improvement in the welfare of small, poor farmer. It also seeks to identify whether or not the main marketing institutions in China's horticultural economy are consistent with a system that can deliver food safety. To achieve our objectives, we use a data set collected in 2007 by ourselves which includes representative tomato- and cucumber-production farmers in Shandong Province. We use the information from the survey to describe the emergences of production systems and marketing structures. The data are also used to examine whether the small or large farmers (or rich or poor ones) are participating in the expanding horticultural economy, and if so through which different types of marketing channels. We also examine several indicators of producer-trader behavior to understand whether China's horticultural marketing channels is able to guarantee a safe and traceable vegetable product. The results show that despite the dramatic evolution of the downstream segment of China's horticultural economy, most Shandong tomato and cucumber-producing farmers are selling through traditional marketing channels. Moreover, small/poor farmers are not being excluded.

Keywords

supply chain, smallholder, China

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* We acknowledge the support of FAO, CATSEI and IIED's Regoverning Markets Project. We also want to thank the Horticultural Survey Team in the Center for Chinese Agricultural Policy, Chinese Academy of Sciences.

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1. Introduction

China's agricultural and food markets have experienced substantial changes during the past several decades and have become increasingly efficient and competitive (Park et al., 2002). Although there is no clear evidence about what has been behind the rise of these markets, China's food economy has a number of characteristics that may have facilitated the emergence of competitive, efficient and integrated market (Rozelle and Huang, 2007). There are few regulations. There is easy entry. There are literally thousands of traders in every market. In the 1990s these traders formed themselves into supply chains (henceforth, traditional supply chains) and were the primary conduit through which food was being channeled from farms to consumers.

The changes in China's food markets present significant impacts on mid- and downstream segments. Several recent studies in China have shown that the most defining characteristics of changes in both the downstream and midstream segments of food markets is the emergence modern supply chains (Bi et al., 2004; Hu et al., 2004; Goldman and Vanhonacker, 2006; Huang et al., 2007). In the downstream segment of China's food supply chain the supermarket revolution arrived in China in the 1990s and spread as fast as or faster than anywhere in the world (Hu et al., 2004). There also have been changes in the midstream segment; wholesale markets have emerged and have evolved steadily (Wang et al., 2006; Dong et al., 2006).

While there is a lot of evidence that modern supply chains have begun to transform retail and wholesale markets, it is unclear what effect these changes have had on upstream farmers who are producing and selling in the competitive marketing environment that pervades the upstream segment of food markets. In fact, this question is of interest to more than those who are working on China's food economy. Internationally, in recent years there has been a debate on the impact on farmers of the rapid rise of modern supply chains. Many scholars and policy makers have been concerned that the rise of supermarkets and other new marketing institutions could have an adverse effect on small farmers in the developing countries (Maertens, Colen, and Swinnen, 2008). For example, there are case studies in Latin America, Central and Eastern Europe, Mexico, Brazil and Kenya that suggest that it is the rich and large farmers that benefit

from the rise of demand for fruit and vegetables and the emergence of supermarkets (Reardon and Timmer, 2007; Berdegúe et al., 2005; Schwentesius et al, 2002). As a consequence, the rise in the demand for horticultural and other high-valued commodities in the consumption basket of consumers, and the concomitant emergence of supermarkets, have created concern among the international community about the possible adverse consequences on small farms and poor farmers (Reardon and Timmer, 2007).

Concern about these issues has led to a number of empirical studies on the impact of the emergence of modern supply chains on the welfare of farmers in China. The findings, however, are mixed. Studies based on supermarket or processor surveys often show that the new supermarket chains and special supply companies (two of the actors in modern supply chains) could have a significant—although ambiguous—impact on small farmers. Some studies have shown positive effects (Hu. et al 2004; Hu et. al., 2006); other studies have shown negative effects (Zuo and Zhang, 2003).

Amongst the initial wave of papers examining the effect of the emergence of modern supply chains on farmers, there is a set of papers that were conducted at the farm level that come to a fundamentally different conclusion (Wang et al., 2006; Dong et. al., 2006; Wu et al., 2007). These studies—based on large household surveys in the Greater Beijing region—found that, although there have been significant changes in the downstream segment of horticultural marketing chains, these shifts have not penetrated into the upstream segment. While the work from Greater Beijing is convincing, given the study's limited focus geographically, there is still a question about whether or not the findings are generalizable to other areas of China, especially to major vegetable producing areas. It is possible that Beijing is special in that it is a mega-consumption center and most of its food is not produced locally.

At the same time, there are other concerns on the demand side. 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 also is concern about the safety of China's food. With rising incomes urban consumers should be expected to be steadily increasing their demand for safe food. The purpose of this paper 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, based on a representative tomato and cucumber survey in Shandong Province in China, we describe the emer-

gence of the production and marketing structures of our sample. Next, we examine who are selling through different types of marketing channels and their implication on food safety issues in China.

2. Data

The data for this study come from a stratified random survey on tomato and cucumber in Shandong province. By ranking all 140 counties in Shandong in terms of unit farm production of tomato, we select 74 counties (of them) as they contribute 90 percent of total tomato production in Shandong. We then divide the 74 counties into 5 groups – 2 high production regions, 2 medium and 1 low production regions – and randomly select one county in each region. Following the similar sampling strategy, township and villages were selected. In each village, we selected 7 tomato households and 3 non-tomato households.² Finally, 329 households of 35 villages in 18 townships (in 5 counties) were surveyed.

3. Research Findings

Description of marketing channels

As Figure 1 and Figure 2 shown, in 2001 and 2006, approximately 80 percent of vegetable marketing at farm gate was conducted by wholesalers. Supply chain at farm gate experiences minor penetration through modern suppliers – namely supermarket, restaurant, specialized suppliers, processing firms, or export companies; the figure climbs from 0.03 in 2001 to 0.3 in 2006. We do not observe robust trend of supermarketization that has been described in many other developing countries (Reardon, Timmer, Barrett, & Berdegue, 2003).

Are small/ poor farmers excluded?

When looking at who is selling to modern marketing chains based on both the first and second buyers, the only linear relationship we can find is that between farm size and the

² As counties differ in their size and type, the number of selected towns varies across ranked regions. In fact, in each of the 2 high production regions, five townships were selected – two high production townships, two medium ones and one small town; in each of the 2 medium production regions, three townships were selected – one high, one medium and one low production township; in the sole low production region, one (relatively) high production town and one low production town were selected, respectively.

share sold to non-modern channels through wholesalers. This share falls from 57.3% to 51.8% to 42.8% as the farm size increases from below 5.5 mu to between 5.5 and 8.5 mu to above 8.5 mu in 2001 (Table 1, column 3). The trend is even more significant in 2006, moving from 57.8 % to 41.5% to 38.6% (Table 1).

Even when looking at the analysis that examines the first and second buyers in the tomato supply chain, the same general results are found (Table 2, rows 3 and 4). Small and large farmers have equal access to modern supply chains (Table 2, column 3, 6 and 9). Likewise, there is no evidence that relatively rich farmers (or those with more per capita assets) have any greater propensity to participate in any type of marketing channel, including modern marketing channels. In fact, in the modern marketing channel equations (columns 3, 6, and 9), the sign on the coefficient of the per capita asset variable is negative and significant (and is clearly not positive, which would be the sign if richer farmers were more likely to be involved in modern marketing channels).

Wholesale market and farm association

As shown in Table 2, wholesale market has been evolved into a determining catalyst of the emergence of modern supply chain. The nearer wholesale markets are located and the earlier they are established, the better the marketing of vegetable is integrated by the modern supply chain. In addition, increased distance (from farm gate) to the nearest country road restrains the development of modern supply chain; market infrastructure is critical to thicken the pro-poor market institutions.

Farm association and producer organization are found not facilitating the vertical coordination of agro-food market. Literally titled as Farmer Professional Associations (FPA), their presence in rural economies does not form bottom-up collective action. China's farmers, on the whole, are making production and marketing decisions mostly on their own or relying on informal associations within their villages (Shen, Rozelle, & Zhang, 2006), and such a pattern may constrains farmers' access to technologies, market information and institutionalized insurance to hedge risks.

Contractual arrangements and food safety issues

While we do not have any direct measures of how safe China's tomatoes and cucumbers 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 tomato and cucumber

channels to guarantee a safe product: Did you have a written contract with the buyer? 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? Was it on the basis of more observable traits, such as the size and/or color of the vegetables? 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 paper 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 vegetables that are 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 pesticides or whether China's vegetables are 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. In short, there is almost no activity based on contracts. In the case of tomatoes, there were only two pairs of buyers and sellers that engaged in contracting (out of the hundreds of observations in our study). There were also no implicit contracts for inputs—all seed, fertilizer and credit were obtained by the farmer from the market on his/her own. Extension services also were never observed to be provided by buyers.

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 tomato- and cucumber-growers stated that the price was determined mostly on some combination of the size of the vegetable, its color (ripeness) and the absence of blemishes. Regardless to whom farmers sold their crop, in less than 1% of the time was there ever any attempt by tomato buyers (those in traditional or non-traditional channels) or cucumber buyers (including processors) to assess whether there was any pesticide residue on the vegetables that they were purchasing. Not one farmer that we ever met in any of our interviews or surveys had ever had his tomatoes or cucumbers tested. In fact, when we interviewed traders in wholesale markets, we likewise never found even one person who said that their tomatoes or cucumbers had been tested.

On this basis we conclude that ensuring safety of China's tomatoes and cucumbers 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 vegetables 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.

4. Conclusions

Although downstream 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 farm gate. As found in other farm-level studies, in our sample of farmers from provincially representative tomato-growing and cucumber-growing households, most Shandong farmers are selling their tomatoes and cucumbers into traditional marketing channels. Despite the rise of supermarkets and restaurants, there is zero penetration into China's villages.

The good news of the emergence of such a marketing environment is that small, poor farmers in Shandong are participating at equal levels of participation as larger, richer farmers in vegetable production and marketing. In fact, there are almost no growers with farms that are larger than one hectare. On average, tomato and cucumber farmers cultivate less than 10 mu (less than 2/3 of a hectare). However, this small- and poor-farmer friendly horticultural economy that is 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 tomatoes and cucumbers are passed to traders in exchange for cash. We can not say anything about the real level of food safety, but, if there were any farmers using unsafe chemical inputs, since there is little or no testing on the farm or in the wholesale market, any contaminant would be difficult to detect and also difficult to keep out of the supply chain. If contaminated vegetables were detected at some point further down the supply chain there also would be no way to determine where they 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. On one hand, 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. On the other hand, 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 as a barrier keeping small farmers out of the market. Evidence from the rest of world shows that the policies which 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 (such as highly toxic pesticide) out of the supply chain altogether.

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Tables and Figures

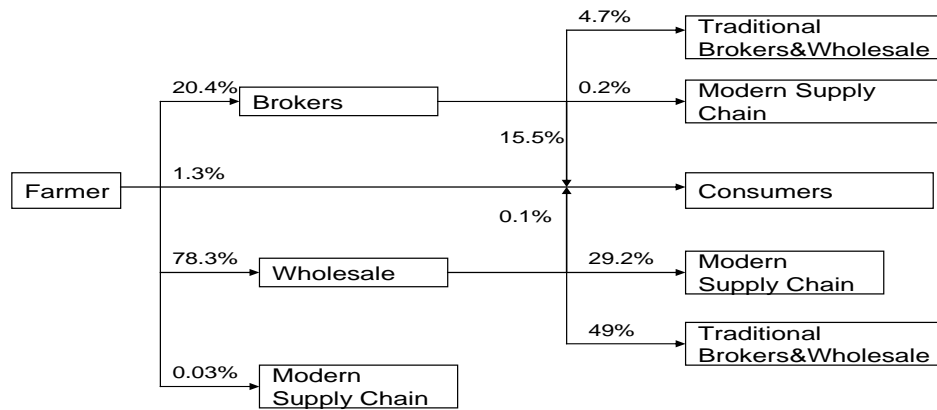


Figure 1 Market channel of vegetable in 2001

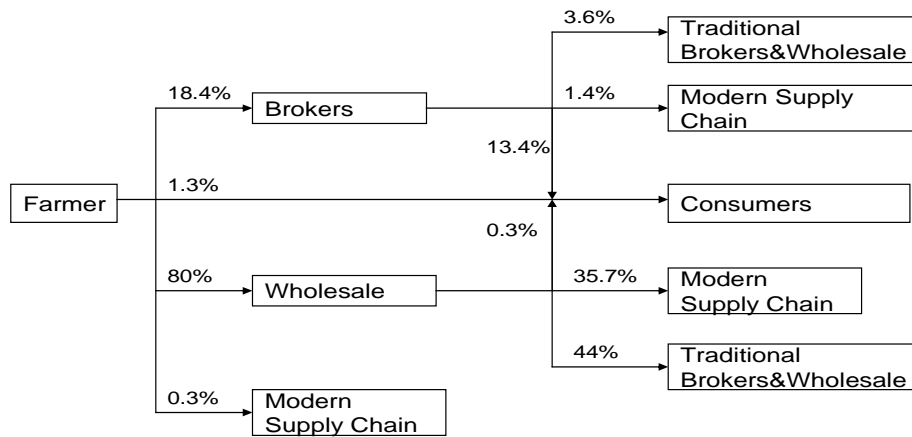


Figure 2 Market channel of vegetable in 2006

Table 1 Selected farms characteristics and marketing chains of tomatoes based on the first and second buyers in 2001 and 2006

	2001					2006				
	Sample Number	Shares by marketing channels (%)				Sample Number	Shares by marketing channels (%)			
		Brokers→ non-modern	Wholesalers → Non-modern	Modern Channels ^a	Total		Brokers→ non-modern	Wholesalers → Non-modern	Modern Channels ^a	Total
Household cultivated land in 2001										
<=5.5 mu	62	26.2	57.3	16.5	100	82	14.1	57.8	28.1	100
5.5-8.5 mu	61	12.9	51.8	35.3	100	73	13.3	41.5	45.2	100
>8.5 mu	63	24.1	42.8	33.1	100	74	23.9	38.6	37.5	100
Per capita asset in 2001										
<=2100 yuan	62	14.1	57.9	28.0	100	78	18.0	45.2	36.8	100
2100-5120 yuan	66	22.2	41.6	36.2	100	71	13.6	40.1	46.3	100
>5120 yuan	58	27.9	50.0	22.1	100	80	24.3	48.6	27.1	100

Note: Modern channels include: i) brokers → modern; ii) wholesalers → modern; and iii) directly sold to modern channels.

Table 2 Determinants of tomato marketing chains based on both the first and second buyers in Shandong, 2001-2006

	OLS (w/ weight)			Tobit (w/o weight)			FE (w/ weight)		
	Chain 1 ^b	Chain 2 ^b	Chain 3 ^b	Chain 1 ^b	Chain 2 ^b	Chain 3 ^b	Chain 1 ^b	Chain 2 ^b	Chain 3 ^b
Incentives:									
Distance from county road (km)	1.7 (1.3)	-1.1 (1.3)	-0.6 (0.8)	7.8 (2.1)***	-4.4 (1.7)***	1.0 (2.4)	-0.9 (2.0)	4.3 (5.3)	-3.4 (5.9)
Off-farm labor share ^c (%)	-0.2 (0.1)**	0.3 (0.1)*	-0.03 (0.11)	-0.6 (0.2)**	0.4 (0.2)**	-0.1 (0.2)	0.02 (0.06)	0.1 (0.1)	-0.1 (0.1)
Farm size and assets:									
Cultivated land ^c (mu)	-0.8 (0.9)	-0.9 (0.9)	1.7 (0.7)**	0.5 (1.5)	-0.7 (1.2)	1.9 (1.6)	-1.1 (0.8)	0.7 (0.8)	0.4 (0.9)
Per capita asset ^c (10,000 yuan)	3.3 (6.1)	9.9 (6.3)	-13.2 (5.7)**	17.9 (10.3)*	9.3 (8.1)	-32.5 (12.2)***	3.7 (2.5)	0.1 (2.6)	-3.8 (2.3)*
Farm household head:									
Age (years)	-0.1 (0.3)	-0.6 (0.3)**	0.7 (0.3)***	0.2 (0.6)	-0.3 (0.4)	-0.2 (0.6)	-0.6 (1.0)	-1.7 (2.1)	2.3 (2.1)
Education (years)	-0.4 (1.2)	-0.5 (1.3)	0.9 (1.1)	-1.0 (2.2)	1.2 (1.7)	-3.2 (2.3)			
Village and policy shifters									
Village per household tomato area _{t-6} (mu)	-1.6 (1.5)	-2.5 (1.5)*	4.1 (1.5)***	2.0 (3.5)	-6.3 (3.0)**	9.2 (3.5)***	-5.6 (2.7)**	-2.1 (3.5)	7.7 (3.9)*
“Vegetable Base” in past 5 years (yes=1; no=0)	-14.0 (7.1)**	16.1 (7.5)**	-2.1 (5.9)	-21.3 (12.7)*	14.0 (9.3)	3.2 (12.9)	-68.8 (22.5)***	68.7 (22.2)***	0.1 (2.3)
Farmer association (yes=1; no=0)	-3.0 (6.6)	21.6 (7.6)***	-18.6 (6.8)***	-4.9 (14.3)	33.7 (10.8)***	-35.6 (15.3)**	-14.2 (7.2)**	11.1 (7.7)	3.1 (3.6)

Table 3 Determinants of tomato marketing chains based on both the first and second buyers in Shandong, 2001-2006 (cont'd)

	OLS (w/ weight)			Tobit (w/o weight)			FE (w/ weight)		
	Chain1 ^b	Chain 2 ^b	Chain 3 ^b	Chain1 ^b	Chain 2 ^b	Chain 3 ^b	Chain1 ^b	Chain 2 ^b	Chain 3 ^b
Other Control Variables:									
Distance from wet market (km)	1.2 (0.9)	-1.2 (0.9)	-0.1 (0.7)	-0.2 (1.3)	0.5 (1.1)	-1.8 (1.5)	0.1 (0.2)	0.8 (1.1)	-0.9 (1.1)
Distance from wholesale market (km)	-0.8 (0.3)**	1.2 (0.3)***	-0.5 (0.2)**	-2.0 (0.6)***	1.6 (0.5)***	0.1 (0.6)			
Years from wholesale market established	0.6 (0.2)**	-0.7 (0.3)***	0.1 (0.2)	1.2 (0.5)**	-1.2 (0.4)***	0.2 (0.6)	0.9 (0.8)	0.9 (2.0)	-1.8 (2.0)
Sale tax in periodic market (yes=1; no=0)	12.2 (6.1)**	-0.5 (6.5)	-11.7 (5.4)**	30.4 (11.2)***	-7.5 (8.6)	-16.4 (11.5)	-18.4 (10.2)*	4.3 (5.2)	14.1 (11.3)
Regulation on marketing (yes=1; no=0)	-19.0 (7.3)***	-19.5 (11.1)*	38.5 (9.8)***	-50.4 (21.8)**	-10.5 (15.8)	49.7 (20.1)**			
Constant	27.5 (19.7)	79.5 (19.7)***	-7.0 (16.2)	-58.8 (34.9)*	51.3 (27.3)*	8.6 (37.1)	101.7 (34.8)***	-2.5 (48.1)	0.8 (44.5)
Observations	415	415	415	415	415	415	344	344	344
R-squared	0.11	0.16	0.22				0.93	0.93	0.93

Note: a: All numbers in parentheses are robust standard errors except for those under OLS regression, which are standard errors. ***, ** and * represent statistically significant at 1%, 5% and 10%, respectively.

b: Chain 1 is “brokers→non-modern”, Chain 2 is “wholesalers→non-modern”, Chain 3 includes i) brokers → modern; ii) wholesalers → modern; and iii) directly sold to modern channels.

c: In the OLS (w/ weight) and Tobit (w/o weight) models we use the base year (2001) data of off-farm labor shares, per capita cultivated land and per capita asset in regression, while in the FE (w/ weight) model we use data from both years (2001 and 2006) of these 3 variables in regressions.