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Producing and Procuring Horticultural Crops with Chinese Characteristics: The Case of Northern China

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Summary. — The main goal of our paper is to understand what types of farmers have been able to participate in the horticultural revolution, how they interact with markets and how supply chains affect their production decisions and incomes. We also want to understand if the rise of supermarkets has changed supply chains. Our analysis uses spatially sampled data from 200 communities and 500 households in the Greater Beijing area. In contrast to fears of some researchers, we find small and poor farmers actively participate in the emergence of China's horticulture economy. Moreover, there has been almost no penetration of modern wholesalers or retailers into rural communities.

Key words — China, horticulture, wholesale markets, supermarkets, modern supply chains, farmers

1. INTRODUCTION

The supermarket revolution has arrived in China and is spreading as fast as or faster than anywhere in the world. As the demands for vegetables, fruit, nuts and other high valued products have risen, urban retailers are finding new venues from which they can sell to the increasingly prosperous city residents. From its start in the early 1990s, today supermarkets have over $55 billion in sales (Hu, Reardon, Rozelle, Timmer, & Wang, 2004); a sizeable share of which is in food. China's supermarkets already sell much higher levels of fresh fruits and vegetables to domestic consumers than exporters sell into overseas markets (although traditional retail venues remain important). This development has been driven by factors shared by other developing countries—urbanization, income growth and liberalization of foreign direct investment in retailing—as well as a number of China-specific policies (e.g., government investment in the sector and policies promoting conversion of wetmarkets to supermarkets—Bi, Dong, Huang, Hu, & Rozelle, 2004; Hu *et al.*, 2004). Although there has been no systematic study of the penetration of procurement into rural areas, researchers have written about signs that supermarket procurement systems have begun to shift away from the traditional wholesale system toward the use of centralized distribution centers, specialized/dedicated wholesalers operating preferred supplier systems, and private standards for quality and food safety. Clearly, the spread of supermarkets, in particular, and the rise of the demand for horticultural products, more generally, present opportunities for China's agricultural producers to diversify into activities with higher income prospects.

The experience internationally, however, suggests that there could be serious distributional impacts of the rise of supermarkets. For example, there are case studies in scale-dualistic agrarian structure countries in Latin America, Central Europe, and Africa that suggest that for some horticultural products, the larger farmers that benefit from the rise of demand for fruit and vegetables and the emergence of supermarkets (Alvarado & Charmel, 2002; Berdegué, Balsevich, Flores, & Reardon, 2005; Dries, Reardon, & Swinnen, 2004; Farina, 2002; Neven, Odera, Reardon, & Wang, 2009; Schwentesius & Gómez, 2002). Because of the high transaction costs involved with purchasing from millions of small farmers and difficulties in monitoring quality and food safety, it is often assumed that supermarkets and their agents (e.g., specialized wholesalers and preferred suppliers) will, especially in

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scale-dualistic agrarian situations where there are both large and small farmers to source from, turn to larger farmers. As a consequence, the rise of demand for horticultural and other high-valued commodities in the consumption basket of consumers and the concomitant rise in supermarkets have created concern among the international community about the possible adverse consequences on small, poor farmers (Reardon & Timmer, 2007, chap. 55).

In many respects, the process that will allow China's procurement systems to mature and spread over larger regions faces similar, if not more severe, challenges than those faced by food retailers in other countries. The average farm size in China is small, less than 0.6 hectare per household (CNSB, 2005). Farmers are not well organized, since historically cooperatives and associations have not been encouraged (Shen, Zhang, Huang, & Rozelle, 2005). Households that are engaged in mostly farming (i.e., full time-farmers) are among the absolute poorest in China and live in relatively poor parts of the nation (Rozelle, 1996; World Bank, 2005). Hence, the typical farm family might face significant challenges in meeting the demanding product attributes if supermarket retailers in China were as demanding as they are in other parts of the world. Indeed, the rise of supermarkets, like elsewhere in the world, has also generated a concern among policy makers about their impact on the small, poor farming sector (Reardon & Swinnen, 2004). In fact, in China this concern has already dampened the initial enthusiasm of some of those that 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, 2003; Yuan, 2004).

Surprisingly, given the importance of this topic, there has been little, if any, systematic empirical analysis of the effect of the rise of demand for high-valued farm commodities and/or the rise of the supermarket sector that is promoting these high-valued goods on the welfare of farmers in China. The work that has been done (e.g., Hu *et al.,* 2004; Yu, 2003; Yuan, 2004), while interesting and providing important insights, is unable to answer a few key questions in a systematic way: where are the new high-valued crops being cultivated and who is cultivating them? Are the farmers that are supplying most of the demand rich and large? Are farmers that are poor and small able to benefit? What is the nature of the supply chains that facilitate the procurement of crops from the farmers? Are these supply chains imposing new quality and food safety standards on farmers? How is the rise of supermarkets affecting China's food supply chain? As the share of fruits and vegetables that are sold through supermarkets rises, through what procurement channel is demand met?

The main goal of this paper is limited to one major theme: getting the facts right regarding the emergence of supply chains and the participation of farmers in China's rapidly evolving horticulture economy. To meet this goal, we have three main objectives. First, we sketch a picture of who is producing the horticultural products that are supplying the market in China. Second, we describe the patterns of marketing chains in China's rural areas, examining who is procuring vegetables, fruits and nuts from farmers, where the transactions are taking place. Finally, we seek to understand if there is any descriptive evidence about how the rise of supermarkets has affected the marketing chains and how changes in the marketing supply chains are affecting the way farmers are producing horticulture crops. We do this based on spatially-sampled community- and household-level survey that was done in Greater Beijing and on information from a community-level survey in Shandong Province. We also conducted surveys and interviews in wholesale markets in Beijing and Shandong and with procurement agents from supermarkets in Beijing.

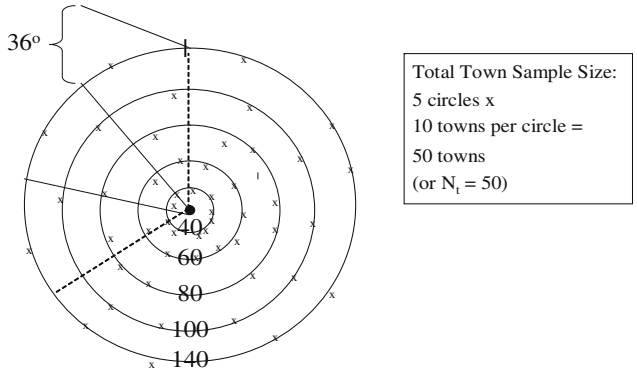
Even given such a circumscribed set of objectives, we still must further recognize the limitations of our work. First, while our sample is spatially sampled and is able to produce a representative view of China's horticultural economy in rural areas, we are still only looking at two regions, the greater Beijing metropolitan region and Shandong Province (although it is arguable that these are two of the most important horticulture-producing regions in China). More work is needed to understand if the results that we find in Northern China are similar to those in other parts of China. We also use our rural community and household data to only look at the first two links in the marketing chain. Hence, our findings using these data are not able to trace the entire marketing paths of vegetables, fruits, and nuts all the way to the consumer. In order to overcome in part this limitation we conducted surveys and interviews in wholesale market surveys as a way to extend the picture of how the rest of the marketing chain is organized. Finally, because exports are such a small part of total horticulture production (only around 2%), we are almost exclusively focusing on the domestic side of the industry. Hence, we are unable to answer many questions about the dynamics of the export segment of the market, which in many cases may be expected to behave quite differently.

To meet our objectives, the rest of the paper is organized as follows. Section 1 describes our data. Section 2 examines the production side of China's horticultural economy (from the rural community's point of view). Section 3 examines the supply chain. We do so by documenting the flow of horticultural crops from two angles: (a) to whom farmers are selling their crops; and (b) from whom actors in the downstream segments of China's horticulture markets are buying. Most of our data are from buyers in wholesale markets, although we supplement them with interviews with procurement agents from supermarkets. In this way we want to triangulate on the channels through which horticultural crops flow from farm to retailer. The final section concludes.

2. DATA

The data set, collected by ourselves, is composed of two main parts and covers two main producing regions. The first part (*the extensive survey*) is comprised of observations on 201 villages and 500 households (from 50 of the villages) in the greater Beijing metropolitan region. The sample was chosen spatially as shown in Figure 1. In the summer of 2005 enumerators visited each of the villages and interviewed village leaders about the horticultural economy from the village's point of view during 2000–04. Among other things, during a several hour-long, sit-down questionnaire session with enumerators, village leaders recounted information about production trends of their community's major horticultural commodities. The leaders also provided information on the most common ways that horticultural goods are procured from farmers—including the type of buyer that purchased the crop from the farmer. In total we identify eight main types of buyers. Finally, we asked leaders to tell us the nature of the contractual arrangement—either explicit or implicit—between the farmer and first-time buyers. Enumerators also asked village leaders about the characteristics of their communities (e.g., income *per capita;* cultivated land *per capita; location).*

Because we were concerned that village leaders would not be able to have accurate information about the horticulture



Note: Four sample villages were randomly chosen from complete list of all villages in each township (N_v =200). Numbers on circle represent kilometers from Tiananmen Square.

Figure 1. *Schematic illustration of spatial sampling procedure.*

production and marketing activities of their villagers, we also conducted a follow-up study (henceforth called the *intensive survey*). This survey re-visited a randomly selected set of 50 (of the 201) villages from the extensive survey. Within each intensive survey village we visited 10 randomly selected households—some of them horticultural producing, others not. [1] In the case of almost all of our variables, the aggregated average of the answers of the household were close to that of the level of the variable produced from information provided by the village leader. At the very least the trends over time were the same. In some of the analysis that follows we use and present information from both the extensive and intensive surveys. The bottom line of the data collection exercise that collected both village- and household-level data was, however, that village leaders know what is going on in their villages and data based on surveys of leaders provides relatively accurate information about village horticulture activities.

Because of concerns about how representative Greater Beijing was of China's major producing areas, we supplemented this primary data set with a follow-up survey in Shandong Province. Shandong Province, while accounting for about 7% of China's cropping land, accounted for nearly 12% of its horticulture area in 2004 (CNSB, 2005). This percentage has been rising over time. Moreover, since the number of greenhouses is higher than average and since the level of commercialization is typically thought to be higher than the rest of China (and so almost certainly yields are higher), it is safe to assume that in fact the share of the Shandong's total production is higher than it area share. At the very least, relying on surveys that interviewed village leaders and randomly selected farmers, the data set can be used to create a production and marketing profile in Shandong Province, China's vegetable basket.

While in some rural economies our stratification (and weighting) strategy—which depends on counts of farmers—might be of concern (since it is possible that a small share of farmers might have extraordinarily large farms and account for an inordinate share of production), in China the distribution of farm size among our sample farmers demonstrates that such concerns are unjustified. In fact, the ranges of farm size in both vegetable and fruit sectors are very narrow. The average size vegetable farm is only 0.034 ha with a standard deviation of only 0.04 ha. The largest vegetable producer farmed only 0.184 ha. While somewhat larger (as might be expected), fruit farmers are equally tightly grouped. The average size frui farm is only 0.276 ha with a standard deviation of only 0.20 ha. The largest fruit producer farmed only 0.933 ha. In other words, in our entire sample there was not one horticultural producer—either producers of vegetables or fruit—that cultivated more than 1 ha.

Finally, we also interviewed individuals in the downstream segments of the market. We ran one set of surveys and conducted interviews in three representative wholesale markets in Greater Beijing. We also ran a set of surveys (with random selection of wholesalers) in wholesale markets in Shandong Province. Finally, we also interviewed several procurement agents in Beijing supermarkets in order to create of profile of their procurement channels (although our sample is not representative).

3. WHO ARE PRODUCING CHINA'S VEGETABLES, FRUITS AND NUTS?

The rise of demand for horticultural crops that have been observed in the demand statistics is beginning to show up in changes in the production patterns of farmers from grain into other crops in the greater Beijing area after 2000 (Table 1, columns 1 and 2). The total sown area of grain during 2000–04 fell from 68% to 58%. [2] In contrast, cash crops (which include mainly crops, such as cotton and peanuts, crops that are *not* the focus of our study) rose by 4 percentage points. During the same period, the area sown to horticultural crops rose by more than cash crops—7 percentage points (from 22% in 2000 to 29% in 2004). Vegetables rose by 2 percentage points; fruit—by far the crop category accounting for the largest share of horticultural crops in Greater Beijing—rose by 3 percentage points; and nuts rose by 2 percentage points.

While the overall rise in the share of cropped area that is devoted by horticultural crops should not be surprising (given the rise in demand), based on descriptive statistics, one of the most significant findings is that farmers in poor villages and poor farmers are increasing their share of the production of horticulture crops (Table 2). To show this, we divide villages into quartiles, according to each village's reported income *per capita. During 2000–04* we find that farmers in the very poor and poor village categories (i.e., those farmers living in villages with incomes below the median income level) have increased their share of total sown area of horticultural crops, in general (top row). In fact, by 2004 farmers in very poor and poor villages produced more than half (23 + 32 = 55%) of horticultural crops in Greater Beijing. Even more significantly, farmers in the very poor villages increased their share of vegetables, fruits, and nuts during 2000–04 from 15% to 22% (rows 2–4, columns 1 and 2).

A similar picture emerges when examining different categories of horticultural crops (Table 2, rows 2–4). For example, in the case of fruit, production is dominated by the farmers in the

Table 1. *Cropping patterns and the role of horticultural crops in Greater Beijing, 2000 and 2004*

Crops	2000 (%)	2004 (%)
Grain	68	58
Cash crop	10	14
Horticultural crops[a]	22	29
Vegetables	4	6
Fruit	13	16
Nuts	5	7

Data source: Authors' survey. Data are from 201 villages included in the extensive village-level survey.
[a] Sown area for horticultural crops includes area sown to vegetable, fruit, and nut orchards.

Table 2. *Contribution (in share of cultivated area) of farmers in villages of different income levels (with villages divided into income quartiles) to horticultural production in Greater Beijing, 2000 and 2004*

Crops	Very poor First quartile (1–25)		Poor Second quartile (26–50)		Above average Third quartile (51–75)		Rich Last quartile (76–100)	
	2000 (%)	2004 (%)	2000 (%)	2004 (%)	2000 (%)	2004 (%)	2000 (%)	2004 (%)
Village-level data								
Horticultural crops	15	23	31	32	33	25	20	19
Vegetables	9	12	25	29	53	47	12	12
Fruit	16	25	37	37	34	24	14	14
Nuts	21	30	17	19	8	9	54	42
Household-level data								
Horticultural crops	22	35	27	28	22	23	29	14

Data sources: Rows 1–4—Authors' survey. Data are from 201 villages included in the extensive village-level survey; Row 5—Authors' survey. Data are from 500 households that were interviewed as part of the intensive survey. The 500 households were selected from 50 villages (out of the 201 villages in the extensive village-level survey).

very poor and poor villages. In contrast, farmers in average income villages produce most of the vegetables. Of course, one of the most interesting findings of Table 2 is that the farmers in the richest village are not the driving force (or beneficiary) of vegetables, fruits, or nuts.

Hence, according to our data, we have evidence the rise of horticultural production in the greater Beijing area is not following the trends that have been observed in some other developing countries (e.g., Farina & Machado, 1999). Clearly, our data show that farmers in very poor and poor villages are not being left out. In fact, especially in the case of farmers in the very poor villages, they are the driving force behind the rise in the supply of fruit and nuts. Moreover, there is no evidence—even for vegetable crops—that farmers in richer villages are dominating production. Indeed, farmers that live in the relative well-off villages (above average and rich) have lost production shares in all categories of horticultural crops (e.g., 65–59% for vegetables, 48–38% for fruit, and 62–51% for nuts). In 2004, farmers in the 25% of the villages that are the richest only cultivated 19% of the region's horticultural area.

(a) *Household-level data*

According to household-level data collected as part of the intensive survey, we find that our results are consistent—poorer households in the Greater Beijing area account for the largest share of horticultural crops (in terms of area) and the share is growing. We use household-level data in Table 2, row 5 (in addition to the village-level data that are used in Table 2, rows 1–4) in order to alleviate concerns that village-level data were provided by village leaders (who might not know about the details of farmer production and marketing transactions). We also want to make sure that we capture the distributional trends of individual farmers. In fact, we find that the information supplied by village leaders and the use of village-level data are consistent with household-level data. The very poorest farmers are the ones that increase their share (from 22% to 35%) and the richest farmers are the ones that decrease their share (from 28% to 14%). The middle two quartiles remain virtually unchanged.

(b) *Multivariate analysis*

The main objective of this section is to explore further and with more rigor whether farmers in poor villages and whether poor farmers are participating in the boom of the horticultural economy. To this end we examine two sets of relationships. First, using the village-level data we want to see that, *holding all other factors constant*, whether those farmers in poor villages are able to participate in the production of horticultural crops. Second, using the household-level data, we want to see that, holding all other factors constant, whether poor farmers are able to participate in the production of horticultural crops.

To examine what factors, including income, facilitate the participation of farmers in the horticulture economy (as well as what factors keep farmers from doing so), we specify a simple, descriptive multivariate model:

$$\begin{aligned} &\textit{Horticultural area} \\ &\quad = f(\textit{income};\ \textit{income} * \textit{year};\ \textit{sample location and} \\ &\qquad \textit{geographical factors};\ \textit{socio} - \textit{economic factors}) \end{aligned} \tag{1}$$

where *horticultural area* is the dependent variable, which is measured as the total amount of village land (in mu) that is allocate to horticultural production.[3] Using the village level data, horticultural area is measured at the village level; using the household level data set, horticultural area this is measured at the household level.

The independent variable of interest, income, is measured as a set of quartile income dummy *variables* (where the very poor have average *per capita* incomes in the villages less than 985 Yuan in 2000; the *poor* have *per capita* incomes between 986 and 1,900; the *above average* income villages have *per capita* incomes between 1,901 and 2,718; and the rich villages have average *per capita* incomes above 2,719). In the household level equations we construct wealth quartiles using assets per household. In order to measure the increasing or decreasing importance of income, the income variables are interacted with a year-*2004* dummy variable (which is equal to 1 if the year is 2004 and 0 if the year is 2000). Because of concerns that income might be endogenous, we are careful to interpret the coefficients on the income variables are correlations and not causations.

The model also includes a number of control variables to hold constant the effects of sample location and geography (a set of concentric ring dummies; and a variable that measures the distance of the village from the nearest all-weather road—distance_to_road; dummy variable which indicates the village is in mountainous area—mountains equals 1, otherwise 0) and socio-economic variables (total land area of the village—in mu; share of cultivated area in the village that is irrigated; share of laborers in the village that work as migrant_share; and the share of households in the village that are engaged in running their own self-employed business

share). The control variables are the same in the household-level equation except that there is no measure for irrigated area or the household's participation in a self-employed business.

In the multivariate analysis, we estimate the model in Eqn. (1) four ways. As stated above, we estimate the equation at the village-level and the household level. For each of these, we also use two approaches. First, we use a standard Ordinary Least Squares (OLS) estimator. Second, because 45 of the villages produce no horticultural crops, we also account for the limited dependent nature of the explanatory variable by using a Tobit estimator.

The model using village-level data performs well in several dimensions (Table 3, columns 1 and 2). First, although the R-square of the OLS version of the model is 0.1, this is a level that is normal for such cross section regression analyses. Second, and more importantly, many of the coefficients on the control variables are as expected. For example, the sign on the *migrant* variable is negative in both the OLS and Tobit equations, which suggests that those farmers that have high opportunity costs for their time, spend relatively more time working off the farm and cultivated less horticultural crops. We also find that the sign on the coefficient of the self-employed business share variable is negative (and significant in the Tobit version of the equation). There also are several other interesting, more general findings. For example, our results demonstrate that villages that are in mountainous areas are relatively more likely to enter the horticulture economy. This may be a sign that the economy is reacting to market signals since farmers in mountainous areas may have a comparative advantage (though not necessarily an absolute advantage) producing fruit and nuts in their villages.

Above all, however, our results show that over time the poor are participating increasingly more from the rise of China's horticulture economy. Specifically, we find that when looking the *income quartile dummies* in the year 2000, villages in the very poor category, *ceteris paribus,* were not participating as much as villages in the other income quartiles. Since the very poor villages were acting as the base set of villages, the positive sign on the coefficients in both the OLS equation (column 1) and the Tobit equation (column 2) means that farmers in very poor villages allocated less of their land to horticultural crops in the year 2000 (the base year). The signs are significant on all of the income quartile dummies in the Tobit equation.

However, while farmers in very poor villages were participating less in 2000, during 2000–04 the results suggest that many these farmers were able to significantly expand their area. When looking at the interaction terms, we find that the only coefficient that is positive and significant is that for the very poor villages (Table 3, columns 1 and 2, row 4, columns 1 and 2). Hence, since 2000, a time when the horticultural economy has boomed, we see that, holding all other things equal paribus, it is the farmers in the poorest villages that have expanded their area relatively to other villages.

Similar results are found using household data (Table 3, columns 3 and 4). Likewise, in 2000 (the base year), the positive sign on all of the quartile dummies are positive. However, the signs on the interaction terms of the "very poor quartile times 2004 year dummy" (row 4) are positive and significant and are larger than the other quartile dummy–year interaction terms

Table 3. *Ordinary Least Squares (OLS) and Tobit analysis of the determinants of horticulture area in Greater Beijing, 2000–04*

Explanatory variables	Dependent variable: Horticultural Area			
	Village-level data		Household-level data	
	OLS	Tobit	OLS	Tobit
Quartile income dummies				
Poor	309.08 (2.29)**	430.33 (2.09)**	1.25 (1.76)*	1.71 (1.70)*
Above average	233.68 (1.14)	382.11 (1.82)*	0.62 (0.95)	1.79 (1.76)*
Rich	149.59 (0.84)	517.31 (2.32)**	2.60 (1.78)*	1.78 (1.66)*
Interaction of income dummies and Year-2004 dummy				
Very poor	156.58 (1.66)*	342.79 (1.68)*	3.80 (4.62)***	4.58 (4.82)***
Poor	−8.20 (0.05)	80.82 (0.42)	2.01 (2.56)**	2.21 (2.33)**
Above average	−110.62 (0.64)	15.70 (0.08)	2.20 (2.81)***	2.59 (2.75)***
Rich	105.34 (0.50)	157.29 (0.83)	−0.37 (0.19)	1.55 (1.57)
Concentric ring dummies and Geographical factors				
60KM ring	361.85 (2.05)**	315.54 (2.09)**	−3.13 (2.08)**	−0.84 (1.01)
80KM ring	20.03 (0.21)	−33.83 (0.21)	−2.42 (1.68)*	0.12 (0.17)
100KM ring	104.41 (0.93)	−10.72 (0.06)	−4.53 (2.94)***	−3.14 (4.13)***
140KM ring	−63.93 (0.56)	−361.81 (2.04)**	−4.74 (3.06)***	−2.52 (3.26)***
Mountain	129.95 (1.32)	395.56 (2.61)***	2.68 (3.45)***	1.75 (2.90)***
Distance to Road	−1.79 (1.03)	−1.15 (0.31)	−0.05 (0.96)	0.04 (0.66)
Socio-economic factors				
Land area	−0.0004 (0.01)	0.088 (1.86)*	0.17 (1.55)	0.18 (9.49)***
Irrigated land area	40.93 (0.28)	38.69 (0.23)	–	–
Migrant_share	−524.49 (4.51)***	−735.01 (3.19)***	−0.25 (0.34)	−1.67 (2.20)**
Self-employed business_share	−0.44 (0.64)	−2.26 (1.92)*	–	–
Observations	400	400	988	988
Adjusted R^2 (Pseudo R^2 for Tobit)	0.1	0.01	0.08	0.03

Note: the numbers in bracket are absolute values.
* Refers to 10% statistically significant level.
** Refers to 5% statistically significant level.
*** Refers to 1% statistically significant level.

(rows 5–7). The *F*-tests on the difference between the interaction terms for the very poor and poor; the very poor and above average; and the very poor and rich show that the differences are statistically significant.

4. SUPERMARKETS AND THE EVOLUTION OF MARKETING SUPPLY CHAINS (OR NOT)

While so far we have shown that the expansion of demand for horticultural crops are, at least in Greater Beijing, supplied by the poor and provide them with higher incomes, there has been no attempt to identify the role of the emergence of new retail institutional forms (such as supermarkets) in these trends. We also do not know if the nature of the contractual relationship is changing between buyer and seller. In this section, we examine the changes in the supply chain (or lack thereof) in two ways. First, we examine the procurement channels at the village and household levels and describe the terms and conditions of the transactions that occur between sellers (the farmers) and the buyers. We do so in both Greater Beijing and Shandong. We also examine the changes in other segments of the supply chain, examining the nature of wholesale markets and the procurement channels of supermarkets.

(a) *Where are the supermarkets?*

Although there has been a lot of discussion about the potential effect of the rise of modern supply chains on welfare in rural areas, according to our data, supermarkets are completely absent (Table 4). Indeed, not one of the 201 village leaders that we interviewed reported the presence of supermarkets for the procurement of any horticultural goods (Panel A, column 1). Likewise, village leaders reported that only 2% of procurement from farmers was by specialized suppliers and only 2% was by processing firms (columns 2 and 3). Hence, in the Greater Beijing area in 2004, only 4% of all horticultural goods were procured by those operating in firms that could be described as part of the modern supply chain. Although not shown, the data from the households that were part of the intensive survey in 50 of the 201 villages in the extensive survey in Greater Beijing show the exact same patterns: households sold almost all of their output to small traders—either in the village or in local wholesale markets. Not one household reported that they sold to a supermarket or a specialized supplier.

A similar picture emerges from the farmers that participated in the focus groups in the 72 Shandong tomato and cucumber villages (Table 5). Fully 99% of farmers in the Shandong tomato producing village in both 2000 (22 + 77) and 2004 (15 + 84) stated that they either sold their tomatoes to small traders that visited their villages or to small traders in the local wholesale markets (columns 1 and 2). While the percentage that was sold to small traders in the wholesale market rose (from 77% to 84%, shifting from direct sales to small traders in the village), there were still less than 1% of sales in all other channels. Cucumber producers showed similar trends; more than 90% of all sales of cucumbers were either to small traders in the village or to small traders in the wholesale market (columns 3 and 4). Interviews with traders from trading firms in the wholesale markets in both Beijing and Shandong (which on average consisted of four employees, almost always family members or close friends) confirm that the procurement channels between the farmer and the wholesale market have changed very little and that the supply of horticultural products in China largely flow through traditional small-trader dominated supply chains (tables not shown, but available in Huang *et al.*, 2006).

Not only was there little evidence of procurement from farmers by the newly emerging players in the retail segment of the supply chain, there was almost no change in the

Table 4. *Supply and marketing channels of horticultural markets in Greater Beijing Area, 2004*

	Modern supply chains			Traditional supply chains		Other supply chains		
	Supermarkets	Specialized suppliers	Processing firms	Small traders	Farmers sell in local periodic markets	Cooperatives	Consumers direct purchase from farmers	Others[a]
Panel A: First-time buyers (%)								
Horticultural crops	0	2	2	79	8	0	7	2
Vegetables	0	3	5	82	5	0	1	3
Fruit	0	1	1	75	11	0	9	3
Nuts	0	6	0	88	3	0	3	0
	Farmer's fields	Village center	Roadside	Periodic markets	Wholesale markets	Urban wet markets	Others[b]	
Panel B: Location of first transaction (%)								
Horticultural crops	65	9	3	6	11	4	2	
Vegetables	64	0	3	6	18	9	0	
Fruit	60	12	3	9	12	3	2	
Nuts	86	11	0	0	0	0	4	
	Modern supply chains			Traditional supply chains		Other supply chains		
	Supermarkets	Specialized suppliers	Processing firms	Small traders	Traders sell to consumers in periodic markets	Cooperatives	Others	
Panel C: Second-time buyers (%)								
Horticultural crops	3	3	10	49	13	0	22	
Vegetables	6	0	6	57	11	0	20	
Fruit	1	2	9	46	16	0	26	
Nuts	3	10	19	50	6	0	12	

[a] "Others" (first time buyers) includes purchases by agents of hotels or restaurants, gifts to other farmers or procurement by organized groups (such as enterprises for distribution to their workers).
[b] "Others" (second time buyers) includes sales to other villages and sales to market sites that supply processing and other food firms.

Table 5. *Procurement channels at the farmgate: the buyer to whom tomato and cucumber producers sold their produce in Shandong sample village, 2000 and 2005*

	Tomato villages		Cucumber villages	
	2000 (%)	2005 (%)	2000 (%)	2005 (%)
Small traders	22	15	14	14
Wholesalers	77	84	77	78
Special suppliers	0	0.004	0.4	0.3
Processing firms	0	0.2	1	3
Supermarkets	0.1	0.3	0	0.1
Associations	0	0	0	2
Exporters	0	0	2	1
Consumers	1	0.4	5	1

Source: Authors' survey.
Note: Data are from question posed to the farmers in the focus group: To whom did you sell your tomatoes (cucumbers)?

contractual terms under which most transactions took place. In the Greater Beijing sample there was nearly zero contracting over either price or quantity, there was no provision of input or credit by the buyer and all transactions took place on a cash, spot market basis. This was true for both 2000 and 2004. In Shandong tomato and cucumber producing villages, the exact same pattern held for both 2000 and 2005. Clearly in our study sites, which cover some of the most productive and commercialized horticultural areas in China, transactions show little penetration by actors in modern supply chains.

(b) *Decomposing the downstream segments of horticultural supply chains*

Using information from our surveys of market officials in Beijing wholesale markets (who could tell us about the total volume of trade of all vegetables, not just tomatoes and cucumbers), it can also be seen that the destination of sales from Beijing's wholesale markets are evolving in response to changing retailing patterns by China's consumers (Table 6). In 2000 by far the largest volume of sales by wholesale traders went to traditional buyers—small retailers (62.3%); wholesalers (12.6%) and small traders (10.8%). Only 3.6 % were sold to supermarkets. During 2000–05, however, Beijing wholesale traders reduced their sales to small retailers, other wholesalers and small traders from 85.7% to 74.8%. In its place, supermarkets (and restaurants) raised their share to 9.3% (10.9%). Clearly the new ways that Beijing residents are buying and consuming their food is changing the channels through which wholesale market traders are selling vegetables.

Importantly, China's markets can be shown to be quite competitive—assuming that large numbers of unregulated traders will result in competitive markets. To see this we document the nature of firms that operate in China's wholesale markets. In Xinfadi (Asia's largest wholesale market), for example, although the daily level of sales from the market is more than 8,000 tons per day, the largest single trader only moves 25 tons per day. When taken in terms of trucks per day, this means that the largest trader in the market only buys and sells about five large trucks of vegetables each day. When one visits the market, however, it is clear that there are more than 1,000 trucks moving in and out of the market each day. On average, according to our survey, each trader does only 1–2 tons of vegetable trading in a day, an amount that fills less than one large truck. This low volume means that there are more than 1,000 traders that operate in this single market for vegetables. Such a scenario is in stark contrast to many vegetable markets in the United States in recent years that have been increasingly dominated by a handful of extremely large enterprises.

A profile of the typical trading company in Beijing's wholesale is consistent with the small volume of sales. In fact, almost all of the traders that we met were small family- or friend-based firms of 2–6 people. In the typical way of doing business for a 6 person firm, two to three team members are located in the marketing slots (or stalls) in the urban wholesale market (e.g., they are the ones that occupy the space in the Xinfadi vegetable market). In some cases, especially for larger and more established firms, their space is permanent. For smaller ones, they may have a space one day, but not for the next several days. For these smaller traders, after they empty their

Table 6. *Wholesale vegetable market channels in selected markets in Beijing. 2000 and 2005*

Buyers	Beijing		Xinfadi		Baliqiao		Dongjiao	
	2000	2005	2000	2005	2000	2005	2000	2005
Small traders	10.8	9.3	12.1	10.5	4.5	3.7	0	0
Small retailers	62.3	55.7	64.7	58.5	61.3	44.4	24.9	29.8
Wholesalers	12.6	9.8	14.2	10.2	5.0	11.5	0	0
Special suppliers	0	0.01	0	0.02	0	0	0	0
Processing firms	0.1	0.1	0	0.08	0.50	0.24	0	0
Supermarkets	3.6	9.3	2.7	8.5	9.6	13.9	8.2	13.7
Consumers	3.8	4.6	0.0	0.8	10.1	14.8	54.6	48.8
Restaurants	6.8	10.9	6.2	11.1	8.9	11.4	12.3	7.8
Group purchasing	0.1	0.3	0.1	0.4	0	0	0	0

Note: Group purchasing includes government units, enterprises, *etc.* (mostly purchasing for special occasions in which employees are given boxes of fruit and vegetables as an in-kind bonus).
Source: Author's survey.

truck or sell their lot of vegetables they leave the market. The rest of the firm's members are out purchasing vegetables from China's farmers in the surrounding villages or from wholesale markets in other parts of the country (e.g., one person from a Xinfadi wholesale firm may be in a Shandong wholesale market). Sometimes the wholesale buyer enters a village and purchases directly from its farmers. Sometimes he/she will purchase a load of vegetables from independent small traders, who are buying from farmers and selling to the wholesaler. When the buyer has purchased sufficient quantities to fill up a truck, the load is transported to Xinfadi from where it is resold to all of the different buyers that come from Beijng (e.g., small retailers; supermarkets; and restaurant owners).

Hence, from our research we see that it is likely that it is the nature of wholesale markets in China that is shielding farmers from experiencing the radical shifts that are occurring in the downstream retail sector. Although wholesale markets themselves are getting bigger; moving to the suburbs and consolidating (Huang *et al.,* 2006), China's wholesale markets are still made up of tens of thousands of individual traders in thousands of trading firms. This picture is consistent with the findings in Tables 4 and 5 in which we find (using village- and household-level data) that China's horticulture economy is dominated by thousands of small traders that come into horticulture-producing villages to procure vegetables from the farmers. Farmers also told us in Beijing that if they went to the local market to sell their vegetables they were also selling to small traders. Since there are really no large traders in a market as large as Xinfadi, the observations from the villages and the observations from the wholesale markets are consistent.c) Supermarket Procurement.

The picture drawn according to the wholesaler interviews differs dramatically from the story that some researchers have been telling: the rise of supermarkets has been leading to a situation in which supermarkets are using contractual arrangements to directly purchase from farmers. In fact, there are a number of pieces of evidence that suggests that this is not the case. First, although it is difficult to verify the share of each day's total vegetable sales that pass through supermarkets, a conservative guess is around 15%. So where does this amount come from? According to our data (Table 6, column 2, row 6) in 2005 Beijing wholesale markets sell about 9.3% of their vegetables to supermarkets. Therefore one plausible story is that supermarkets get about 2/3rd of their vegetables from local wholesale markets and 1/3rd from other sources.

In the rest of this section, we want to try to examine the evidence that can help us answer two questions. First, is it plausible that 2/3rd come from purchases in local wholesale markets (or is it more or less?). Second, (besides local wholesale markets), through what other channels does the supply of fruits and vegetables flow?

Perhaps the most compelling evidence about the dependence on supermarkets on local wholesale markets comes from the supermarkets themselves. In fact, we found that according to one interview with a procurement manager of a Beijing supermarket chain that at first glance the reported sales that move directly from the wholesale market to the supermarket (reported from the supermarket point of view) is remarkably consistent with the results of the wholesaling survey (reported in Table 6). According to the interviewee from the Beijing supermarket, 63% of their vegetables are procured directly from small wholesalers or small product delivery companies (who are just wholesalers that rent an office in or around the wholesale market) in Greater Beijing wholesale markets by supermarket procurement agents (Table 7, rows 1 and 2). Although such information was sometimes only grudgingly given (since buying from wholesale markets is not perceived as being "modern"), we were told that supermarkets had no option except to rely on wholesale markets if they wanted to remain competitive. In other words, during the interview it was discovered that, in fact, supermarkets depend mostly upon wholesale markets to supply their vegetable needs. In some instances, we were told buyers often just buy in the wholesale market itself. Frequently, these purchases are made in the part of the market that has evolved to supply relatively high quality fruits and vegetables. While the new section of the market is evolving towards a specialty of handling high quality produce, it should be noted that the structure of the market in terms of the size and nature of the trading firms is the same. Like traditional wholesale markets, the quality part of the market is dominated by small, private trading firms that procure from farmers and have agents procuring from them. They also do not use contracts. The respondent (traders) also told us that there, in fact, was rarely any problem in procuring sufficient quantities or the quality of the vegetables and fruits that they wanted.

While nearly 2/3rd of procurement of supermarkets is directly from wholesale markets, this is not to say that markets are stagnant. In fact, our data contain evidence of a steady evolution of the downstream segments of China's markets. In particular, as can be see from our data from our supermarket interviews (Table 7, row 3), a large share of vegetables are procured from specialized wholesalers, called Large Farm Product Delivery Companies (22%). These firms differ from traditional wholesalers (and Small Farm Product Delivery Companies) in several fundamental ways. First, they are larger, having around 20–25 employees, on average. Second, they often have a shop-front with a higher profile. Large Farm Product Delivery Companies sometimes also have formal contractual relations with supermarkets, although it was difficult during our interviews to understand the exact nature of the arrangements. Several times it appeared as if these firms were operating under a contract that covered transactions over a fairly long term of the basis of quantities and qualities. However, when queried closer, in fact, most "contracts" were really no more than long run relationships between two parties and neither was legally obligated to the other. In other words, the "contract price" was frequently defined as the "spot market prices." Contracted quantities were defined as the amount the seller was able to supply and the amount that the buyer was willing to purchase. Quality varied over the course of the year. In other words, Large Farm Product Delivery Companies often appeared as if they were acting as an in-the-wholesale-market buying agents for supermarkets. Perhaps the most fundamental difference is that some (not all) of the transactions between the Large Farm Product Delivery Companies and supermarkets were on a credit basis, which gave the supermarkets some degree of leverage (during negotiations) over the delivery companies. Clearly, perhaps more than any other type of institutional shift, the emergence of Large Farm Product Delivery Companies represents at least a small step in the evolution in Beijing's wholesale markets.

Although the emergence of these long term, quasi-contractual relationships between supermarkets and Large Farm Product Delivery Companies appears to be indicative of changes occurring among downstream actors in China's horticultural supply chains, our interviews with supermarkets confirm the hypothesis that the competitive nature of wholesale markets in China shield upstream markets from these changes (at least so far). Most poignantly, when examining the procurement practices of Large Farm Product Delivery

Table 7. *Sources of vegetable procurement of supermarkets in Beijing in 2006*

Sources of vegetable procurement	Share (%)
1. Direct purchases from "Wholesalers" in Xinfadi and other small urban and suburban wholesale markets	**20**
[These firms typically have 2–6 people as employees. Most of them do not have any fixed shop in the market. Instead, they use their trucks as their places of business. All transactions on spot market basis]	
Sources of their supplies	
1.1. Procured by themselves from farmers	8
1.2. Procured by agents from farmers	12
2. Direct purchases from "Small Farm Product Delivery Companies"	**43**
[These firms are similar in size and nature to regular wholesalers (i.e., same as #1). In fact, in the market "Small Farm Product Delivery Companies" are indistinguishable from "Wholesalers." The nature of their dealings with supermarket (they work on a spot market basis, they do not issue receipts; they do not have contracts with either supermarkets or suppliers) and the nature of their supply sources are similar. The only difference is that the firm is renting a shop in or around the wholesale market	
Sources of their supplies	
2.1. Procured by themselves from farmers	10
2.2. Procured by agents from farmers	3
2.3. Procured by themselves from wholesalers in Xinfadi	30
3. Procured from "Large Farm Product Delivery Companies"	**22**
[These firms are, in fact, wholesalers, who in their sources of supply look just like any other wholesaler. In making purchases, they mostly use agents, who are really just small traders that are selling to a single buyer—however, under no contract. The biggest difference is their size. Typically, such a firm has more than 30 people. Because of their size, they are targets of tax collection by local authorities and pay taxes on some of their transactions. Most, but not all, have contracts with supermarkets, although the nature of the contracts appear to be fairly loose and most of the relationship is based on mutual performance. Some of sales is done on a credit basis. With the exception of a small amount (5% from their own production bases), most of their supply channels (and terms of procurement) are indistinguishable from those of "Wholesalers" and "Small Farm Product Delivery Companies"	
Sources of their Supply	
3.1. Procured directly from farmers	6
3.2. Procured by agents from farmers	9
3.3. Procured from Small Farm Product Delivery Companies	1
3.4. Procured from Wholesalers	1
3.5. From their own production bases	5
4. Supermarkets procured by farmers directly without contract	**12**
Sources of Supply	
4.1. Either by agents or employees (which almost universally were formerly small traders themselves)	
5. Supermarkets procured from farmers directly with contracts	**2**
6. Supermarkets' own production base	**1**

Source: Authors' Survey.

Companies, it can be seen that by far most of the purchases are done through conventional channels. Employees of the companies and agents of the companies (who are just freelance small traders) all purchase vegetables directly from farmers in ways that are indistinguishable from those of the employees and agents of traditional (small) wholesalers. In other words, from the farmer's point of view, regardless of whether his/her buyer is from a wholesaler, a Small Farm Product Delivery Company or a Large Farm Product Delivery company, the terms and nature of the procurement transaction is exactly the same. In other words, in most upstream segments of China's vegetable markets there is little evidence that markets are evolving. The same is true for the share of the market (12%) in the case when supermarkets send their own employees of agents directly to buy from farmers (Table 7, row 4).

That is not to say that there is absolutely no experimentation going on. Whether for window dressing or due to the true desire to understand alternative (future) sources of supply, we can find that a small minority of vegetables in China's super market come of novel sources. For example, in 5% of total purchases, Large Farm Product Delivery Companies procure vegetables from their production bases (Table 7). In some cases, the companies actually control production. However, in others (probably most) a production base is really just a village in which there is a long term relationship between the Large Farm Product Delivery Company and the villagers that produce horticultural crops and supply a certain product in return for preferential treatment in terms of reliability of procurement and sometimes a small price premium. In addition, according to our interviews (Table 7, rows 5 and 6), 3% of the vegetables in Beijing's supermarkets are either from farmers with contractual relationships with supermarkets (2%) or from the supermarket's own production base (1%). Although these are interesting developments (and often what is talked about in the press), it must be remembered that as a share of the total volume of vegetables this is very small. According to our estimates, since at most 15% of total vegetables in Beijing are sold through supermarkets, farmers that are producing and supplying under contract account for only 1.2% of Beijing's total supply (or $15\% * [5 + 2 + 1] = 1.2\%$).

5. DISCUSSION AND CONCLUSIONS

In this paper we set out to assess the effect that the rise of the horticultural economy in China has had on the farming sector in China. Although we only have data on two areas inside

China—Greater Beijing and Shandong, our samples were spatially sampled and we are able to produce regionally representative figures on the rise of opportunities for planting horticultural crops and the penetrations of marketing supply chains into rural areas. Questions about who has benefited and who is supplying the horticultural commodities that are increasingly being demanded by China's consumers have concerned some policy officials—both inside and outside of China.

Interestingly, although we showed the rise of horticultural crops was paralleled by a surge in the emergence of supermarkets in urban areas, there has been almost no penetration of modern wholesalers or retailers into rural communities. In Greater Beijing, less than 6% of first-time buyers could be identified as being from modern supply chains—either supermarkets, professional suppliers or processing firms. In Shandong tomato and cucumber producing villages, the share is smaller (around 1%). Instead, China's horticultural economy is dominated by small traders who are themselves poor and small, operating in firms of less than 10 individuals and are themselves earning low wages. Moreover, unlike the evidence found in other countries, it appears as if in China, far from being hurt by the rise of supermarkets and the horticulture boom that has come with it, poor, small farmers in our sample appear to have gained. The richest farmers, in contrast, were playing a smaller role in 2004 than in 2000. Clearly it appears as if this is a special case of "Producing Horticultural Crops with Chinese Characteristics."

So what makes China special? While a full analysis and more definitive conclusions require more research, it is our opinion that there are several characteristics about China's horticultural economy that produces these surprising results. First, China's land holdings are relatively equal. In essence, there are no large farmers in China; indeed in our sample, the average farm size of the largest 20% of the farmer is only 0.36 ha *per capita;* there is not one horticultural farm in our sample that is larger than 1 ha.

Second, there also are almost no farmer cooperatives that can allow farmers to act in concert with one another. In our sample, only 11.4% of the villages reported that they had a horticultural or general farm cooperative. Only 1% of farmers said that they belonged to a cooperative. These numbers, as it turns out, are remarkably similar to figures for all of China reported by Shen (2004) using data from a national representative sample of more than 2,000 villages. Because land size is small and there are few cooperatives, it is easy to see why it could be so difficult for supermarkets and other modern supply firms to deal with farmers, given their atomistic sizes and the absence of organization. The transaction costs of contracting or direct procurement would be high.

The third characteristic that may be relevant to explaining the role of small, poor farmers in the rise of China's horticultural economy is that although land is relatively equally allocated across all communities in China, there are still differences. In the case of horticultural producers (at least in our Beijing sample), farm households in poorer areas and those in more remote areas have relatively more land (0.17 ha *per capita)* than those in areas nearer to the richer, urban center (0.09 ha *per capita).* This would mean that households in these poorer villages are endowed with relatively more land.

In addition, there also are differences in the access that these households have to labor that can be allocated to work on the farm. Although horticultural farmers have the same family size as those not engaged in horticultural farming, the main differences are due to differential access to off farm jobs. Farm households that are nearest to Beijing have a higher percentage of their labor force in off farm employment (42 for those nearest to Beijing; only 31 for those furthest) and they work a larger number of days per year (111 for those nearest; 82 for those furthest).

Importantly, land to labor ratios can also be shown to favor poor households in becoming involved in labor-intensive horticultural farming when dividing the sample between better off households and poorer households. Poorer households have more land and labor available for use in producing horticultural crops. It is partially because of these dynamics that we find that horticultural producer have higher cropping income, but total incomes that are the same as non-horticultural producers. Hence, when considering the nature of China's land and labor together, it is easy to see why poor farmers have increased their share of area in many of the horticultural crops—they are relatively land and labor rich, the two keys factors in the production of horticulture crops.

Two additional characteristics help reinforce the propensity for poorer farmers to be increasing their participation in the horticultural economy, while the supermarkets are almost completely absent from the production areas. Since China's horticultural economy is almost completely unregulated and since China's road and communication networks have improved remarkably over the past 10 years, small traders working with a limited amount of capital and using extremely large amounts of low cost labor (while utilizing the relatively efficient road and communication infrastructure) appear to be out-competing all other types of would-be procurement agents. According to our interviews with the small traders and producers, the competition among small traders is fierce and profit margins on traders are almost always razor thin. There is little above-normal profits available to attract new, more innovative entrants. Interestingly, in this type of small trader-dominated system, there is little or no effort being made to impose or monitor quality or safety standards directly on producers.

Finally, one of the main characteristics of China's economy that produces the status quo is that China is still a relatively poor nation and its consumers, at least so far, appear to be placing a relatively low premium on food safety. Although there is a rising middle class, most urban consumers still live in households making around US$1000 *per capita* annual disposable income (CNSB, 2005). Many of them are becoming increasingly stressed with rising payments in other expenditure categories—housing, automobile ownership, education, and health care. Combined with the absence of an active pro-consumer lobby (which may be limiting the information consumers have on the quality of their food), it is almost certain that the premium willing to be paid by the average urban consumer is still relatively small. When this low premium is combined with the high transaction costs that would have to be born should the supermarket want to maintain tight control over its horticultural supply, along with the thriving, deep, extremely competitive wholesale markets, it may be that, at least now and in the immediate future, China will still be relying mostly on traditional wholesale channels.

If this is true, food safety in China's food system may suffer. While this may be bad news for quality-conscious consumer, it is good news for small, poor farmers. It should be recalled, however, how fast China is changing in so many areas. If any one (or perhaps any several) of these characteristics changed, we might expect to see China's horticultural economy—from both the supply and procurement side—change. The change, like so many other things in China, could be very rapid.

NOTES

1. To choose the household sample, we followed a strict protocol. First, using a roster of all households in the village, we divided the list into two strata—those farmers that produced horticultural crops and those that did not. The total number of households in each category was recorded and later used as weights. We then chose randomly seven horticulture-producing households from the first part of the sample and chose randomly three non horticulture-producing households from the second part of the sample.

2. The total amount of cultivated land in this part of China is constant, so increases in area shares means increases in volume of area devoted to different crops.

3. 15 mu equals 1 ha.

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