Market Liberalization and Crop Planting Decision: A Case of China

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Abstract

The effects of market liberalization on Chinese farmers' crop planting decisions are investigated. The results show that the effects of market liberalization on planting decisions are more significant in the case of crops with minimum support price (rice, wheat, and corn) than in the case of crops where planting decision is determined by market prices (cotton and soybean). The effects appear to be different across regions and time zones and more significant in 1993 than in 2005. In most cases, both own and cross price supply elasticites increased from 1993 to 2005.

Key words: Market Liberalization, Chinese Crop planting, Supply Response

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Introduction

WTO accession has supported economic growth in China by expanding market forces, lowering tariffs on imported goods, and improving access to foreign markets. Under these reforms, household farm production has become far more commercialized, producing more horticultural and other cash crops rather than staple grains (Lohmar, Gale, and Zhang, 2004). Recently, much attention has been paid to the effects of Chinese WTO admission on world trade (Anderson 1997; Wang 1997; Huang and Chen 1999; Addonizio and Bhattasali 2000; Fang and Babcock 2003; Huang and Rozelle 2003; Yu and Frandsen 2005; Huang et al. 2005). These efforts provide empirical support to free trade theories explaining the remarkable success of China's WTO admission. During the last five years, Chinese GDP has almost doubled and increasing portions of the rural labor force have migrated to urban or metropolitan areas for employment. Today, roughly one-half of rural household income comes from non-farm sources (Lohmar, Gale, and Zhang, 2004).

Another variable related to China's WTO accession but not much discussed in the literature is the effect of market liberalization on Chinese farmers' crop planting decision. China's crop structure has experienced great spatial and temporal variation during the past decade. At national level, the share of area planted with grain has decreased from 75 percent in 1993 to 67 percent in 2005. At the same time, in 1993 the share of cash crop area ranged from 43 percent in *Xinjiang* to 11 percent in *Tibet* while in 2005, it varied from 60 percent in *Xinjiang* to 13% in *Jilin* (Table 1, Chinese Agricultural Yearbook, 1993 and 2005). A recent study of technical efficiency in Chinese agriculture also showed that technical inefficiencies are quite significant with remarkable differences

across provinces and time zones (Yao, Liu, and Zhang, 2001; Chen and Huffman, 2006; Chen, Huffman and Rozelle, 2006).

In the mid-1990s, especially after Deng's trip to southern China in 1992 and China's central government efforts to join the WTO, a widespread liberalization of crop planting decisions and grain marketing channels took place, even in areas with a strong collective heritage such as the *Jiangsu* province. The grain market has been liberalized to a very large extent and participation of private traders have already grown to a significant level, representing more than one-third of the wheat and rice markets and more than half of the maize market. Counting all grain types, the state was controlling only about one-third of the marketed surplus (Cheng, 1996). Those efforts further expanded farmers' freedom on crop planting decision making.

This spatial and temporal variation provides fertile ground for the increasing understanding of choice under the process of institutional change. This paper uses data from a national village-level survey conducted in 1993 and 2005 to test empirically competing theories explaining the crop choices of China's farmers. We are particularly interested in explaining the importance of market liberalization on crop changes. Since 1993 was the first year of grain marketing reforms by the Chinese government and 2005 was the last year with available information, by examining data from both years this study is the first to quantify and analyze the impact of rapid market liberalization on farmers' crop decision during the late-1990s, which has received little attention until now.

The paper is organized as follows. Section 2 reviews basic policy changes in China, theories of crop planting choice in China, and the methodology used. Section 3 describes the village and secondary data used in the paper. Section 4 presents the

estimation results and describes the extent to which different factors are responsible for spatial and temporal variation in cropping structure changes. Section 5 discusses the conclusions.

Basic Policy Review and Conceptual Framework

Basic Policy Review

Transition to a market economy and market liberalization are the driving forces of economic expansion in China. Rural domestic policy reforms applied during the past two and half decades can be divided into three stages: 1978-1992; 1993-1997; and1998 until present. The household responsibility system reform was initiated in the late 1970s when farmland was reallocated to individual households by contracts. The duration of contracts was 15 years at the beginning of the 1980s. In 1993, the government allowed the contracts to be extended for another 30 years after the expiration of existing contracts. The current policy allows land to be subleased to other households. The households can also hire temporary farm workers. But under the new system land is still collectively owned (Lin and Zhang 2003).

At the same time, the marketing system was also under reform. In 1985, the mandatory quota procurement system was changed into a contract procurement system. The government abolished compulsory sales and replaced them with contract purchase. This policy changes were followed by a dramatic decline in grain production. In early 1993, a new reform was implemented. Its main aspects included the reliability of urban residents on market forces for staple grain supply. All grain transactions between provinces were completed on a voluntary basis and mandatory quota deliveries were

reduced and in some areas eliminated. In April 1998, China implemented a new grain marketing and stock-holding policy. Direct grain purchasing from farmers was prohibited for individuals and private companies. Commercial agencies of grain bureaus and the grain reserve system were to be the only entities purchasing grain from farmers. Prices of grain sold by grain bureaus were to be set at a level higher than procurement prices in order to avoid marketing losses (Findlay and Chunlai, 1999). Since 2004, the Government of China began guaranteeing farmers a minimum price for grain crops such as rice, corn and wheat. If market prices were to drop below the set floor price, the government would instruct *Sinograin*, a state enterprise responsible for holding grain reserves or its provincial counterparts, to purchase the grain at the floor price. However, for cotton, soybeans and other cash crops the situation was different: the government effects on farmer's planting decision are limited because farmers "plant their pocketbook" and they pay little heed to government's pronouncements and policy objectives unless they are compensated (FAS, 2006).

Conceptual Framework

To analyze the market liberalization policy effects on farmers' crop planting decisions, we adopted a trait-based adoption model of agricultural innovations within the farm household framework (Feder and Umali, 1993; Singh, Squire, and Strauss, 1986; Owuor, Smale, and Groote, 2004).

Because most Chinese farmers only sell part of their production, following Owuor, Smale, and Groote, farmers' land allocation decisions with respect to specific crops can be explained in the context of household decision-making rather than in a profit maximization one. In this framework, the household maximizes utility over a set of

consumption items (C_f) generated on the farm, a set of purchased consumption goods (C_{nf}) and leisure (l). The preferences are also represented by the characteristics of the household Q_{hh}.

(1) $$\max_{C_{fi}, C_{nf}} U(C_f, C_{nf}, l; Q_{hh})$$

Such that

(2) $$\sum_i a_i \le A;$$

(3) $$\sum_i x_i \le X;$$

(4) $$\sum_i h_i + l \le L;$$

(5) $$Q_i = f(a_i, x_i, h_i); C_{fi} + C_{si} \le Q_i$$

(6) $$\sum P_{fi} C_{fi} \le \sum_i [E(P_i) C_{si} - P_{xi} x_i - w_i l_i] + \sum_i w_i h_i$$

Where

(7) $$E(P_i) = \begin{cases} \max(P_{gi}, P_{mi}) & crops \quad with \quad guaranteed \quad price \\ P_{mi} & price \quad decided \quad by \quad market \end{cases}$$

Expression (1) represents households consuming part of their own production (C_{fi}) as well as some goods purchased in open markets (C_{nfi}). Expressions (2)-(4) represent land constraint (A), input constraint (X) and labor constraint (L). Expression (5) represents the production function for the i crop and the portion of the crop sold in the market (C_{si}). Expression (6) represents the budget constraint in one period for farmer i. Expression (7) represents farmers' expected price formation: for crops like rice, wheat or corn, there is a guaranteed price (minimum price or procurement price) and farmers make their decision based on the comparison between guaranteed price, previous year price and other information; otherwise, crops like cotton and soybeans are more likely determined by the lagged market price.

To solve the maximization problem, we can get the reduced form equations for a specific crop area as

(8) $$a_i^* = a^*(E(P), A, Q_{hh}, L)$$

Methodology

It is evident that if a particular region's farmers do not plant a specific crop is not only because that specific crop is not adapted to that region, but maybe because they decide not to plant due to economic reasons. To estimate the effects of market liberalization on crop structure and account for the censored issue, we follow the consistent two-step estimation procedure for a system of censored equations suggested by Shonkwiler and Yen (SY 1999). However, this procedure is not efficient (Chen and Chen, 2002; Tauchmann, 2005; Yen and Lin, 2006). The degree of the inefficiency depends on the degree of correlation among the error terms. To account for this issue, we adopted a multi probit model to estimate whether a household consumes specific products using latent variables with a selection mechanism. The estimated parameters were then used to calculate the cumulative density functions (CDF) $\Phi_i(.)$ and the probability density functions (PDF) $\phi_i(.)$, which are used to estimate the second step, the crop share equations based on Shonkwiler and Yen.

Following their approach, we model a village planting corn, soybean, wheat, cotton, and rice using latent variables with the selection mechanism

(9) $$\begin{aligned} y_{it} &= X_{it}^{'}\beta_i + \varepsilon_{it} \text{ if } d_{it} = Z_{it}^{'}\alpha_i + \nu_{it} > 0 \\ &= 0 \qquad\qquad \text{otherwise} \end{aligned}$$

where y_{it}^{*} and d_{it} are crop area share and a dummy variable if a specific crop is planted at time *t*, respectively; x_{ik} are the market liberalization and other socio-demographic variables and regional indexes. In the second step, y_{it}^{*} can be modeled as follows:

$$y_{it} = \Phi(Z_{it}'\hat{\alpha}_i) f(X_{it}, \beta_i) + \eta_{ii}\phi(Z_{it}'\hat{\alpha}_i) + \xi_{it} \tag{10}$$

Data and Empirical Specification

Data

The data used in this paper primarily come from national village surveys conducted in 1993 and 2005. The surveys cover 297 villages in 28 provinces in 1993 and 327 villages in 2005. Most of the villages (261) were surveyed in both years. The price information consisted of provincial data compiled from the Chinese Agricultural Yearbook (1993 and 2005) because it was not provided by the surveys.

There are remarkable differences in crop planting structures across space and time in both samples. Table 2 presents crop structure comparison for the sample averages in 1993 and 2005. For villages with complete data in both years (261 villages), the average number of planted area units per village in the whole sample increases from 3,571 *mu* in 1993 to 4,074 *mu* in 2004 as result of decreasing area in regions corresponding to"cities", north central, and south coast and increasing areas in the northeast, central south, central coast, northwest and south west regions. The total share of wheat, rice, and soybeans area falls sharply from 62 percent to 44 percent while the shares of corn and vegetables increase significantly. These changes appear to reflect the impacts of policy changes during the last decade.

Worth noting, too, is the great variation across regions with respect to the planting crop shares. In both 1993 and 2005, wheat has the highest share in the northwest and north central provinces; rice shows the largest share in central-south and south-coast regions; soybean is high in northeast and north central; while corn has the highest share in the "city", northeast and north central regions.

Empirical Specification

In the Chinese traditional economic system, given the central role played by village leaders in the village's economic life, the leader makes the final decision on the desired crop planting areas for the village. However, this is probably not a good assumption for the current situation, since most farmers plant their crops based on their own interest. Neither the village leaders nor the farmers can guarantee that any crop structure will remain profitable, so that there is an important distinction between desired and actual planted areas.

Because these different processes are not separable, it is appropriate to think of the crop structure as being a function of a common set of village characteristics. Next, we review briefly the rationale for including each variable and the theoretical predictions for the sign of the coefficients.

Market Development Variables

A set of variables is provided to test the effects of the development of input and output markets on crop planting choices. The main hypothesis is that market development should be associated with planting choices because with well- functioning markets, farmers are more willing to plant cash crops than grain crops.

We include variables for each of the key input markets: land and labor. Land market development (LNDMKT) is measured as the share of households renting in or renting out land. Labor market development (LABMKT) is captured by the number of laborers migrating into or out of the village as a share of total laborers.

We include several variables that measure output market development and general market development. TRADE, the provincial rural retail sales divided by rural social output value, captures the development of the market for goods, both inputs and outputs. Finally, we include a number of location variables that are likely to correlate with the level of market development: whether or not the village is in a suburb (SUBURB), whether or not the township is located in the village (TOWN), whether or not the village is in hilly terrain (HILL), and whether or not the village is in mountain terrain (MTN). However, TOWN, HILL and MTN are not significant in any of the equations at the earlier stages of the estimation. Those variables are eliminated to save degrees of freedom.

Regional Controls

We divide China into seven regions. One of the provincial-level "unobservables" captured by the dummies is the specific crops not adapted to that region or not planted because of cultural or other socioeconomic reasons.

Estimation Results

The estimated multi crop probit equations and share equations for five major crops based on a single year are presented in Table 3 and Table 4, and elasticity estimates with respect to prices of different crops are calculated in Table 5.

Table 3 shows that the effects of market liberalization on crop choices are more significant in 1993 than in 2005. In 1993, the TRADE variable is significant in the rice (+), corn (-), soybean (+) and cotton (+) equations while it is only significant in the rice (+) and cotton (+) equations for 2005. One explanation for these results could be that the market differences among regions are declining as the market becomes more liberalized. Farmers can sell their crops among regions much easier than before. LAND is significant in the corn equation with negative sign, LABOR is significant in the wheat equation with negative sign and in the soybean equation with positive sign for 2005. These results implied that land and labor migrations are two of the main variables affecting crop choices in 2005: the share of crops not requiring large amounts of labor increase while the share of crops requiring considerable amounts of labor and/or land decrease. Most of the region index variables are significant in the crop choice equations and the estimated parameters have the same sign in both years as expected. However, some of the regional index parameters resulted more significant in 2005 than in 1993.

The endogeneity of crop planting choices is supported by a significant error correlation coefficient at the 10% level of significance: wheat is positively correlated with corn, soybeans, and cotton; rice is negatively related to corn in 1993, negatively related to cotton and positively related to soybeans in 2005; corn is positively correlated with soybeans and cotton in 1993 and positively correlated only with soybeans in 2005; soybeans is positively related to cotton in both years.

TRADE is positively related to rice and negatively related to wheat in 1993 while it is negatively related to wheat and positively related to soybeans in 2005. The results indicated that soybean planting share increased with market liberalization while wheat

planting area share decreased. The corn price parameter is significant (and positive) in the wheat and rice equations for 1993 and in corn and soybean equations for 2005; wheat is negatively related to cotton in 1993 and positively related to wheat in 2005; rice price is positively related with cotton in 1993 and only significant in rice equation in 2005; Soybean price is significant in the wheat equation (positive) and the rice equation (negative) in 1993, and also significant in rice (positive) and soybean (positive) equations for 2005; cotton price is significant in wheat (negative), rice (positive) and soybean (negative) equations for1993, and also significant in the wheat (negative) and cotton (positive) equations for 2005.

Table 7 presents the area supply elasticities based on 1993, 2005 and pooled data estimations. For most crops, 2005 elasticities are higher than in 1993. The only elasticities larger than one are the 2005 rice own price elasticity and the rice/soybean cross price elasticity for the same year. All own price elasticities are significant and positive based on 2005 data while none of them were significant in 1993. The main explanation to those results might be the fact that the grain, soybean and cotton markets were open in 2005 but not in 1993. Soybeans and rice show large cross price elasticties probably due to the planting rotation between those crops in China, especially in Southern China.

Conclusion and Discussion

This paper investigates the crop planting structure in China based on around 300 village survey data for 1993 and 2005. A censored crop share system is used to estimate the planting decisions of Chinese farmers based on single year and pooled years data.

Censoring was addressed using the two-step estimation procedure of Shonkwiler and Yen (1999). For the five crops investigated in the study, the differential effects of market liberalization on planting decisions across regions were less significant in 2005 than in 1993. This result might be explained by the fact that in 1993 farmer's participation on liberalized markets significantly varied across regions while in 2005 the participation rates were more homogeneous at national level. Values of all estimated supply price elasticities increased in 2005 with respect to1993. These results may reflect the increased choices faced by farmers when market liberalization took place.

The overall results point to several potential policy implications. First, the significant difference between the area price elasticities of 1993 and 2005 suggests that market liberalization along the past ten years achieved significant effects in Chinese farmers planting decision. This outcome should be taken into consideration when evaluating and implementing future Chinese agricultural policy income-based interventions as a means to meet domestic food security goals and increase farmers' income level. A differential approach based on location to implement income support interventions seems to be more appropriate in this case. This is especially important to effectively implementing income-based policies for improving the well-being of those Chinese farmers exclusively working in the agricultural sector. On the other hand, the results also suggested that exporters of US agricultural goods such as cotton and soybeans may have to be affected by Chinese domestic policy changes and should reconsider the effects of elasticity changes in Chinese crop planting decisions.

Second, the elasticity differences estimated from this article can be used in various analytical procedures (i.e. simulation models) to evaluate the welfare effects of

domestic food policies as well as international trade policies. Quantification of the welfare impacts of domestic food policies would be more meaningful if more recent and accurate elasticity estimates are used in simulation models. Updating elasticities are also important in analyzing effects of trade policies. For example, the domestic own-price elasticities of crop planting can be combined with import share data to calculate Chinese import demand elasticities. Reliable estimates of cotton, soybeans and other crops import demand elasticities can then be utilized to simulate for example the impact of WTO trade liberalization policies on specific commodities. Since China imports most of agriculturual commodities (e.g. cotton, soybean, and rice) to compensate shortfalls in domestic supply, the updated elasticity information gleaned from our analysis may be of value in the redesign and implementation of its trade policies.

References

Anderson, K. "On the Complexities of China's WTO Accession." *The World Economy*, 1997 (20): 749-72.

Addonizio, Elizabeth and Deepak Bhattasali. "The Impact of WTO Entry on China's Agricultural Sector." Mimeographed (June 2000). World Bank Resident Mission in Beijing, World Bank, Beijing.

Chen, K., & Chen, C. "Cross Product Censoring in a Demand System with Limited Dependent Variables: A Multivariate Probit Model Approach." 2002. Edmonton, Canada: University of Alberta.

Chen, Zhuo, Wallace Huffman, Scott Rozelle, "Farm Technology and Technical Efficiency: Evidence from Four Regions in China," ISU Economics Working Paper #06022, May 1, 2006.

Chen, Zhuo, Wallace Huffman, "Measuring county-level technical efficiency of Chinese agriculture: a spatial analysis," Book Chapter, included in *China's Agricultural Development,* Edited by X-Y. Dong, S. Song, & X. Zhang, Ashgate Publishing Limited, UK, 2006.

Fang, Cheng and Bruce A. Babcock, "China's Cotton Policy and the Impact of China's WTO Accession and Bt Cotton Adoption on the Chinese and U.S. Cotton Sectors, "*Working Paper 03-WP-322*, Iowa State University, January 2003.

Cheng, Yuk-shing, "China's grain marketing system reform in 1993–1994: empirical evidence from a rural household survey," *China Economic Review* 1996(7): 135-153.

FAS, "China, Peoples Republic of Grain and Feed Annual 2006," Available at http://www.fas.usda.gov/scriptsw/attacherep/default.asp.

____,"China, Peoples Republic of Cotton and Products Annual 2006," Available at http://www.fas.usda.gov/scriptsw/attacherep/default.asp.

Feder, G., and D. Umali, " The Adoption of agricultural Innovations," A review. *Technological Forecasting and Social Change* 43(1993): 215-239.

Findlay, Christopher and Chen Chunlai, "A Review of China's Grain Marketing System Reform," ACIAR China Grain Market Policy Project Paper No. 6. 1999. Available at http://www.adelaide.edu.au/cies/papers/gmp6.pdf.

Huang, Jikun and Chunlai Chen. "Effects of Trade Liberalization on Agriculture in China: Commodity Aspects." CGPRT Centre Working Paper No. 43, Bogor, 1999.

Huang, Jikun and Scott Rozell, " The Impact of Trade Liberalization on China's Agriculture and Rural Economy." SAIS Review vol. XXIII no. 1 (Winter–Spring 2003). Available at http://muse.jhu.edu/journals/sais_review/v023/23.1huang.pdf.

Huang, Jikun, Zhigang Xu, Scott Rozelle and Ninghui Li, " Impacts of Trade Liberalization on Agriculture and Poverty in China." FED Working Papers Series No. FE20050018. Available at http://fed.ccer.edu.cn/pub/workingpaper/200522421522213248.pdf.

Lin, Justin Yifu and Fan Zhang, "The Effects of China's Rural Policies on the Sustainability of Agriculture in China," *memo*, 2003. Available at http://203.116.43.77/publications/specialp2/ACF348.html.

Lohmar, Bryan, Fred Gale, and Linxiu Zhang, "New Opportunities for Economic Assessment with Rural Household Data in China," Paper prepared for presentation at the MEXSAI Third Annual Conference on Agricultural Statistics, Cancun, November 2-4, 2004.

Owuor, George, Melinda Smale, and Hugo De Groote. "Crop Biotechnology for Africa: Who will Gain from Adopting Bt Maize in Kenya?" Selected paper presented at the American Agricultural Economics Association Annual Meeting, Denver, Colorado, August 1-4, 2004.

Pan, Suwen and Albert Park. "Collective Ownership and Privatization of China's Village Enterprises," Working paper, University of Michigan, 1998. Available at http://www.bus.umich.edu/KresgeLibrary/Collections/Workingpapers/wdi/wp141.pdf.

Shonkwiler, J. S., and S. T. Yen. "Two-Step Estimation of a Censored System of Equations." *American Journal of Agricultural Economics* 81 (1999): 972-82.

Singh, I., L. Squire, and J. Stauss (eds). *Agricultural Household Models: Extensions, Applications, and Policy,* John Hopkins University Press, 1986.

Tauchmann, H. "Efficiency of Two-Step Estimators for Censored Systems of Equations: Shonkwiler and Yen Reconsidered." *Applied Economics*, 37(4,2005): 367-374.

Wang, Zhi. "The Impact of China and Taiwan Joining the World Trade Organization on US and World Agricultural Trade: A Computable General Equilibrium Analysis." *Technical Bulletin,* No. 1858 (May 1997). Commercial Agriculture Division, Economic Research Service, US Department of Agriculture, Washington, D.C..

Yao, Shujie, Zinan liu, and Zongyi Zhang, "Spatial Differences of Grain Production Efficiency in China, 1987-1992," *Economics of planning*, 2001(34): 139-157.

Yen, S., & Lin, B.-H. "A Sample Selection Approach to Censored Demand Systems." *American Journal of Agricultural Economics*, 88(3, 2006): 742-749.

Yu, Wusheng and Søren E. Frandsen, "China's WTO Commitments in Agriculture and Impacts of Potential OECD Agricultural Trade Liberalizations," *Asian Economic Journal* 2005 (19), –. doi:10.1111/j.1467-8381.2005.00202.x.

Table 1. Chinese Grain (Corn, Wheat, and Rice) Planting Percentage Comparison 1993 and 2005 (%)

Province	1993	2005
Anhui	73.06	70.36
Beijing	80.58	60.44
Fujian	71.97	58.09
Gansu	78.21	69.44
Guangdong	64.80	57.87
Guangxi	65.71	53.88
Guizhou	67.90	63.98
Hainan	68.10	54.47
Hebei	81.14	71.03
Heilongjiang	87.40	85.79
Henan	74.32	65.74
Hubei	67.53	53.94
Hunan	65.99	60.65
Inner Mongolia	81.90	70.36
Jiangsu	75.07	64.25
Jiangxi	58.73	65.74
Jilin	87.06	86.69
Liaoning	84.00	80.39
Ningxia	80.76	70.58
Qinghai	71.11	51.52
Shaanxi	84.53	77.68
Shandong	76.45	62.52
Shanghai	65.06	41.15
Shanxi	82.03	65.74
Sichuan	78.16	69.25
Tianjin	79.81	57.61
Tibet	89.44	75.62
Xinjiang	57.04	40.01
Yunnan	73.94	70.27
Zhejiang	72.45	53.24
National	74.80	67.07

Source: Chinese Agricultural Statistics, 1993 and 2005.

Table 2. Sample Crop Structure, 1993 and 2005 (*Mu*, Weighted Average)

Regions	1993							2005						
	Total Sown Area	Wheat (%)	Rice (%)	Soybean (%)	Corn (%)	Cotton (%)	others (%)	Total Sown Area	Wheat (%)	Rice (%)	Soybean (%)	Corn (%)	Cotton (%)	others (%)
Cities (BT)	2441	26	22	9	24	1	12	2284	16	22	4	35	0	24
Northeast (NE)	5562	6	18	26	34	1	11	8425	0	18	20	44	0	8
North Central (NC)	2886	37	3	19	28	3	8	2670	28	3	6	35	3	10
South Central (SC)	3295	13	43	9	3	5	18	3648	8	47	4	4	5	23
Central Coast (CC)	2779	19	33	14	8	2	17	3007	20	25	3	11	2	26
South Coast (SA)	4172	0	60	5	0	0	25	2858	0	30	2	1	0	25
Northwest (NW)	4491	42	11	11	16	4	12	4740	35	2	3	17	8	31
Southwest (SW)	4450	12	37	14	11	0	18	4779	9	30	3	12	0	25
Total	3571	21	26	15	16	2	15	4074	16	22	6	21	2	19

Note: Cities include Beijing, Tainjin, and Shanghai; Northeast includes Liaoning, Jilin, and Heilongjiang; North Central includes Henan, Hebei, Shanxi, Shaaxi, and Inner Mongolia; South Central includes Anhui, Jiangxi, hubei, and Hunan; Central coast includes Jiangsu, Zhejiang, Fujian, and Shangdong; South Coast includes Guangdong and Hainan; Northwest includes Gansu, Qinghai, Ningxia, and Xinjiang; Southwest includes Guangxi, Sichuan, Guizhou, and Yunnan.

Table 3. Participation Equations Results

	1993					2005				
	Wheat	Rice	Corn	Soybean	cotton	wheat	Rice	Corn	Soybean	cotton
Intercept	5.68	3.59	-0.39	-0.89	-4.56	0.68	-0.89	0.51	-3.41*	-17.13
	(6.94)	(10.77)	(1.28)	(1.06)	(12.74)	(1.52)	(0.94)	(1.17)	(1.09)	(12.17)
Income per capita	-0.0006	0.00001	-0.0005	-0.0002	-0.0003	0.0001	-0.0003	-0.003	-0.0008	0.005
(excluding Ag)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.003)	(0.00)	(0.003)
Land/labor	2.04*	0.00	0.00	0.00	-0.03*	-0.67	0.01	0.03	0.02*	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
LADMKT	2.04	3.39	0.48	-3.51	0.83	-0.67	0.24	-0.17*	-0.18	-0.09
	(3.74)	(4.66)	(2.30)	(2.25)	(2.94)	(0.60)	(0.16)	(0.12)	(0.12)	(0.17)
LABMKT	-0.22	-0.05	-0.30	0.30	-0.77	-0.45*	-0.06	-0.13	0.27*	-0.07
	(0.42)	(0.47)	(0.42)	(0.41)	(0.52)	(0.22)	(0.19)	(0.16)	(0.22)	(0.24)
TRADE	-0.01	0.02*	-0.02*	0.02*	0.03*	0.00	0.02*	0.00	0.01	0.04*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Suburb	0.09	0.07	0.01	-0.22*	-0.04	-0.19	-0.38*	0.21	0.38*	0.31*
	(0.14)	(0.12)	(0.14)	(0.11)	(0.12)	(0.20)	(0.22)	(0.20)	(0.21)	(0.24)
BT	-1.33	0.95*	-0.02	0.72*	0.46	-0.48	1.00*	0.00	0.48	-1.03*
	(0.65)	(0.47)	(0.01)	(0.48)	(0.58)	(0.43)	(0.39)	(0.01)	(0.40)	(0.49)
NC	-0.76*	0.93*	-0.26	-0.17	-0.53*	-1.04*	1.02*	-1.30*	0.02	-1.31*
	(0.31)	(0.24)	(0.30)	(0.24)	(0.28)	(0.23)	(0.23)	(0.43)	(0.23)	(0.30)
SA	5.07	-4.22	1.44*	1.00*	3.76	4.29*	-0.36	0.99*	1.26*	3.60
	(8.71)	(10.74)	(0.42)	(0.39)	(13.06)	(1.81)	(0.41)	(0.38)	(0.40)	(5.32)
CC	0.30	-1.42	1.51*	-0.34	-1.05*	-0.46*	-1.05*	0.62*	-0.31	-1.54*
	(0.27)	(0.32)	(0.28)	(0.24)	(0.29)	(0.22)	(0.29)	(0.25)	(0.26)	(0.26)
NW	-7.32	0.74*	0.97*	0.09	0.25	-2.21*	1.41*	-0.25	1.31*	-0.62
	(14.04)	(0.33)	(0.37)	(0.30)	(0.40)	(0.55)	(0.31)	(0.34)	(0.32)	(0.33)
SW	0.35	-1.55*	-0.78	-0.50	0.57*	-0.66*	-1.04*	0.23	-0.05	13.98
	(0.30)	(0.39)	(0.54)	(0.31)	(0.34)	(0.24)	(0.27)	(0.43)	(0.24)	(12.32)

Table 3. (Continued)

Error Correlation	1993					2005				
	Wheat	Rice	Corn	Soybean	cotton	wheat	Rice	Corn	Soybean	cotton
Wheat	1.00	-0.02	0.56*	0.32*	0.38*	1.00	-0.06	0.36*	0.17*	0.42*
Rice		1.00	-0.23*	-0.11	-0.05		1.00	0.09	0.36*	-0.35*
Corn			1.00	0.32*	0.29*			1.00	0.58*	0.13
Soybean				1.00	0.28*				1.00	0.27*
Cotton					1.00					1.00

Table 4. **Share Equations Results**

	1993					2005				
	Wheat	Rice	Corn	Soybean	cotton	Wheat	Rice	Corn	Soybean	cotton
$\Phi_i(.)$ *intercept	2.05*	-1.79*	0.17	0.89*	0.47	-1.41*	1.52*	0.64	-0.31	3.07*
	(0.27)	(0.46)	(0.27)	(0.36)	(0.37)	(0.58)	(0.59)	(0.54)	(0.33)	(0.86)
$\Phi_i(.)$ *LADMKT	-0.14	0.46	-0.49	0.89	0.19	-0.20	0.01	-0.14*	-0.31	-0.02
	(0.38)	(0.44)	(0.57)	(0.36)	(0.21)	(0.17)	(0.02)	(0.09)	(0.33)	(0.10)
$\Phi_i(.)$ *LABMKT	-0.08	0.10	0.14	0.05	-0.04	-0.08	0.04	-0.04	0.003	0.05
	(0.10)	(0.09)	(0.11)	(0.09)	(0.09)	(0.06)	(0.05)	(0.04)	(0.02)	(0.07)
$\Phi_i(.)$ *TRADE	-0.01*	0.01*	0.0004	-0.002	-0.003	-0.01*	0.004	0.002	0.004*	-0.01
	(0.002)	(0.003)	(0.0003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.01)
$\Phi_i(.)$ *BT	0.05	-0.02	-0.03	0.0004	0.02	-0.07	0.06	0.29*	0.0005	-0.10
	(0.10)	(0.22)	(0.14)	(0.16)	(0.12)	(0.09)	(0.22)	(0.10)	(0.08)	(0.18)
$\Phi_i(.)$ *SW	-0.28*	0.02	0.08	0.27*	0.14	-0.43*	0.03	0.51*	0.13*	-0.01
	(0.10)	(0.17)	(0.10)	(0.13)	(0.11)	(0.09)	(0.08)	(0.06)	(0.04)	(0.14)
$\Phi_i(.)$ *NC	-0.09*	-0.11	0.03	0.06	-0.07	0.22*	-0.27	0.28*	0.04	-0.40*
	(0.05)	(0.18)	(0.06)	(0.07)	(0.07)	(0.06)	(0.19)	(0.05)	(0.03)	(0.23)
$\Phi_i(.)$ *SC	-0.21*	0.26*	0.40*	-0.12*	-0.13	-0.13*	0.25*	-0.11	-0.02	-0.33
	(0.05)	(0.07)	(0.21)	(0.06)	(0.08)	(0.06)	(0.06)	(0.08)	(0.03)	(0.25)
$\Phi_i(.)$ *CC	-8843.48	-0.28*	0.64*	0.28	-1033.24	-268.71	0.004	-0.29*	0.08	-100.65
	(47860.50)	(0.16)	(0.35)	(0.24)	(6574.50)	(14307.70)	(0.10)	(0.17)	(0.12)	(1908.00)
$\Phi_i(.)$ *NW	-0.14*	0.37*	0.26*	-0.05	0.28*	0.44*	-0.31	0.02	0.08	-0.04
	(0.08)	(0.21)	(0.14)	(0.12)	(0.10)	(0.11)	(0.29)	(0.06)	(0.11)	(0.15)
$\Phi_i(.)$ * wheat price	0.0007	-0.01	-0.002	0.0004	-0.01*	0.15*	0.05	-0.08	0.04	0.02
	(0.002)	(0.01)	(0.003)	(0.0004)	(0.004)	(0.08)	(0.52)	(0.08)	(0.07)	(0.10)
$\Phi_i(.)$ *rice price	0.0002	0.0008	-0.00002	-0.002	0.00007*	-0.05	0.44*	0.14	-0.03	-0.78
	(0.0002)	(0.0007)	(0.0003)	(0.004)	(0.00004)	(0.80)	(0.18)	(0.47)	(0.29)	(1.54)
$\Phi_i(.)$ *corn price	0.004*	0.003*	-0.0002	-0.00006	0.0007	0.001	0.004	0.02*	0.02*	-0.01
	(0.001)	(0.002)	(0.0001)	(0.001)	(0.001)	(0.02)	(0.02)	(0.01)	(0.01)	(0.04)

Table 4. Continued

	1993					2005				
	Wheat	Rice	Corn	Soybean	cotton	Wheat	Rice	Corn	Soybean	cotton
$\Phi_i(.)$ *soybean price	0.002*	-0.003*	0.0006	0.00006	-0.0001	0.0005	0.22*	-0.04	0.0005*	0.43
	(0.001)	(0.001)	(0.0009)	(0.001)	(0.001)	(0.45)	(0.03)	(0.27)	(0.0001)	(0.87)
$\Phi_i(.)$ *cotton price	-0.006*	0.01*	0.0007	-0.01*	-0.002	-0.01*	-0.001	0.002	-0.002	0.003*
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.0005)	(0.004)	(0.003)	(0.002)	(0.001)
$\Phi_i(.)$ *income	0.00003	0.00004*	0.0002*	0.00002	0.00001	0.0001	0.0001	0.0002	0.00001	0.002*
	(0.00003)	(0.00002)	(0.00006)	(0.00003)	(0.00003)	(0.0003)	(0.0001)	(0.0006)	(0.00001)	(0.001)
$\phi_i(.)$	-0.03	0.17	-0.61*	-0.19	-0.16*	0.38*	0.11	0.21	-0.01	-0.31
	(0.09)	(0.11)	(0.27)	(0.15)	(0.08)	(0.16)	(0.12)	(0.15)	(0.09)	(0.22)

Table 5. Supply Price Elasticties 1993 and 2005

	wheat	rice	corn	soybean	Cotton
			1993		
wheat	0.0057	-0.119	-0.015	0.028	-0.006*
rice	0.0019	0.010	-0.0001	-0.0019	0.0006*
corn	-0.019*	0.020*	0.0008	-0.0003	0.0003
Soybean	0.036*	-0.090*	0.010	0.012	-0.0002
Cotton	-0.001*	0.0028*	0.006	0.0008*	0.00004
			2005		
wheat	0.504*	0.230	-0.281	0.059	0.006
Rice	-0.161	1.942*	0.522	-0.049	-0.273
Corn	0.0025	-0.02	0.052*	0.017	-0.003
soybean	-0.003	1.839*	-0.276	0.001*	0.267
cotton	0.003	0.004	-0.004	0.0001	0.004*