Does the U.S. Midwest Have a Cost Advantage Over China in Producing Corn, Soybeans, and Hogs?

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Abstract

China's accession to the World Trade Organization, a significant event for U.S. agricultural trade, has been viewed as benefitting U.S. farmers, especially midwestern farmers. This research compares the productivity and cost of production (COP) of China and the United States in producing corn, soybeans, and hogs. The results show that the U.S. Midwest (defined in this study as the Heartland region as classified by the U.S. Department of Agriculture's Economic Research Service) has a substantial advantage in land and labor productivities in producing corn and soybeans, especially compared to China's South and West producing regions. However, China's Northeast region, a major corn- and soybean-producing area, has a very competitive COP over the U.S. Midwest. In hog production, the U.S. Midwest has a cost advantage over China in feed cost and labor productivity (there is little difference in fine feed usage), but this advantage is more than offset by the lower cost of feeder pigs and low capital replacement cost in China. Land policy in both the United States and China is a key determinant of COP. In addition, labor productivity and related policies in China are driving forces for China's competitive position.

Key words: agricultural trade, competitiveness, corn, cost of production, exchange rate, hogs, land policy, productivity, soybeans, U.S. Midwest versus China.

DOES THE U.S. MIDWEST HAVE A COST ADVANTAGE OVER CHINA IN PRODUCING CORN, SOYBEANS, AND HOGS?

Introduction

China's economy has been growing rapidly since the implementation of economic reforms at the end of the 1970s. This rapid income growth is changing China's food consumption patterns, especially its animal protein consumption. Over the last 15 years, per capita meat consumption (red meat and poultry) in China has increased 166 percent, or an average of 7.2 percent annually. Economic reforms also have led to incentives to develop specialized livestock production systems that are moving the production structure toward larger and more intensive management systems.

Both China and the United States are large producers of pork, corn, and soybeans in international agricultural markets. In 2000, China produced over 47 percent of the world's pork and the United States produced 40 percent of the world's corn and 45 percent of soybeans. China has become a major player in world trade and has strong potential to influence world prices because of the size of its production sector. In 2000, China exported 10.47 million metric tons (mmt) of corn but imported 10.42 mmt of soybeans. Agriculture is one of the few sectors in which the United States has a trade surplus with China. From 1995 to 2000, the agricultural trade surplus averaged about $350 million annually. In 2000, China imported around $1 billion of soybeans and soybean products from the United States, accounting for 58 percent of total U.S. agricultural exports to China.

After 15 years of negotiations, China finally joined the World Trade Organization (WTO) in December 2001. China's inclusion in the WTO, a significant trade issue for U.S. agriculture, is viewed as benefitting U.S. farmers. China promised to cut the currently prevailing average tariff rates from 22 percent to 17.5 percent for agricultural products. For certain agricultural products that are deemed important to the United States, such as animal products, fruits, and dairy products, the average tariff will fall from 31 to

14 percent. For bulk agricultural commodities, such as corn, wheat, and soybean oil, China has agreed to expand market access through tariff rate quotas. In addition, China must curtail export subsidies after WTO accession. The corn export subsidy in 2001 was as high as 418 yuan per metric ton.

Many observers see China as a huge potential market for U.S. products (Hayes and Clemens; Fuller et al.; Qin and Amponsah). However, experts disagree on the extent and composition of U.S. agricultural and food trade with China. The United States's competitiveness in agricultural and value-added products in China depends on many factors, but the difference in cost of production (COP) and productivity are the most important factors.

The objectives of this research are to examine the competitive structures of China and the United States, emphasizing productivity and COP for corn, soybeans, and hogs. This research provides regional comparisons in China and the U.S. Midwest. Three types of hog production systems in China are analyzed. We use COP data from 1996 to 2000 to avoid the variability of productivity and derived COP units. We begin with a description of research methods and data issues.

Research Methods and Data

Production competitiveness has become a popular area of concern as policymakers seek to monitor sectoral economic health, evaluate the consequences of free trade agreements, and assess the impacts of agricultural and tax policies. COP studies have long been familiar tools in the study of inter- or cross-country agricultural commodity competitiveness (Barkema, Drabenstott, and Tweeten; Glaze and Schoney; Le Stum and Camaret; Ortman, Stulp, and Rask; Sharples; Stanton).

There is a no definition of competitiveness in economic theory. However, it is becoming conventional for economists and policymakers to perceive competitiveness as the result of the combined effect of market distortions and comparative advantage (Sharples). Comparative advantage is useful to analyze the optimal welfare and competitiveness under perfect competitive markets. Comparative advantage is a measure of competitiveness in an undistorted world. Comparative advantage is not observable. In order to calculate comparative advantage, all market distortions must be removed. Market

distortions include distortions resulting from policy and distortions resulting from imperfect competition.

Since international agricultural markets are far from being undistorted, the cost and production relationships underlying comparative advantage can provide limited information on a country's competitive position. A country can increase its competitiveness in the international market by changing its agricultural policies or by other factors, such as increasing efficiency, lowering taxes or raising subsidies on crop production and marketing, and depreciating the home currency. An examination of these policy changes can help to explain changes in past and current competitiveness and to analyze the impact of removing the distortions in the future.

This study compares productivity and COP by using the actual observed data. The results provide information on the competitiveness of the two countries in corn, soybeans, and hog production under current policy regimes. We compare competitiveness assuming that two major distorted factors are removed. One factor is U.S. land cost; the other is the exchange rate between the Chinese yuan and the U.S. dollar.

The U.S. Department of Agriculture (USDA) COP estimates do not include effects of government programs, and all are in actual terms. Land cost in the United States is artificially high, with government support capitalized into higher land values (see Schertz and Johnston and Jolly and Lence). A recent study by Beghin, Roland-Holst, and van der Mensbrugghe shows that land rent would be reduced by 43 percent if U.S. government farm policy were removed.

Costs in Chinese renmingbi (RMB) (or yuan) terms are converted into U.S. dollars by China's official exchange rate. The official exchange rate has been distorted in the last several years (Fang and Beghin). In this study, we conduct a scenario analysis on the impact of the exchange rate. We derive the shadow nominal exchange rate based on the real effective exchange rate series from 1995 to 2000 from The World Bank (2000 and 2001). The estimated shadow nominal exchange rates are 8.97 RMB/U.S.$ for 1996, 9.37 RMB/U.S.$ for 1997, 9.38 RMB/U.S.$ for 1998, 8.93 RMB/U.S.$ for 1999, and 8.96 RMB/U.S.$ for 2000.

In addition to the comparisons of total COP, we compare the major components of cost. A comparison of major factors in the COP in the two countries indicates the net

effect on input use and factor payments of the existing forces shaping competitiveness in each country. The comparison provides the sources of the difference in the COP and possible impacts from each factor in the future.

The major data for China's COP are 1996 to 2000 farm household survey data. The survey is conducted by China's Price Bureau in cooperation with the Ministry of Agriculture, Ministry of Forestry, Ministry of Domestic Trade, China Silk Import and Export General Company, China Federation of Supply and Marketing Cooperatives, China's Tobacco Administration Bureau, China's Chinese Medicine Administration Bureau, and China's Light Industry General Committee. The survey, conducted each year, has been carried out for decades. The number of households in the survey varies across agricultural activities, according to the relative importance of each activity. In the 2000 survey, there are 3,843 households for corn, 1,045 households for soybeans, 2,255 households for backyard hog production, 665 households for specialized producers, and 142 households for large-scale practice. Part of the data is available in China's *Rural Statistical Yearbook* (China's National Statistical Bureau). The output data for corn, soybeans, and hogs in China are obtained from *China's Statistical Yearbook*.

The U.S. COP data are obtained from the USDA. The USDA collects data on production technology every four to five years and updates quantities of output and prices of inputs every year. Commodity-specific surveys as part of the annual Agricultural Resource Management Study have been used to collect the data since 1996. The production technology underlying the estimates for 1996 to 2000 reported here are based on the 1996 version of the Farm Costs and Returns Survey for corn, the 1997 version for soybeans, and the 1992 and 1998 versions for hogs. These survey years are normal years in production conditions.

China is disaggregated into six regions, as shown in Figure 1: Northeast (Liaoning, Jilin, and Heilongjiang provinces), North (Beijing, Tianjin, Hebei, Shandong, and Henan provinces), South (Zhejiang, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Guangxi, and Hainan provinces), West (Sichuan, Guizhou, Yunnan, Xizang, and Shaanxi provinces), and Pastoral (Shanxi, Nei Monggol, Gansu, Ningxia, and Xinjiang provinces).

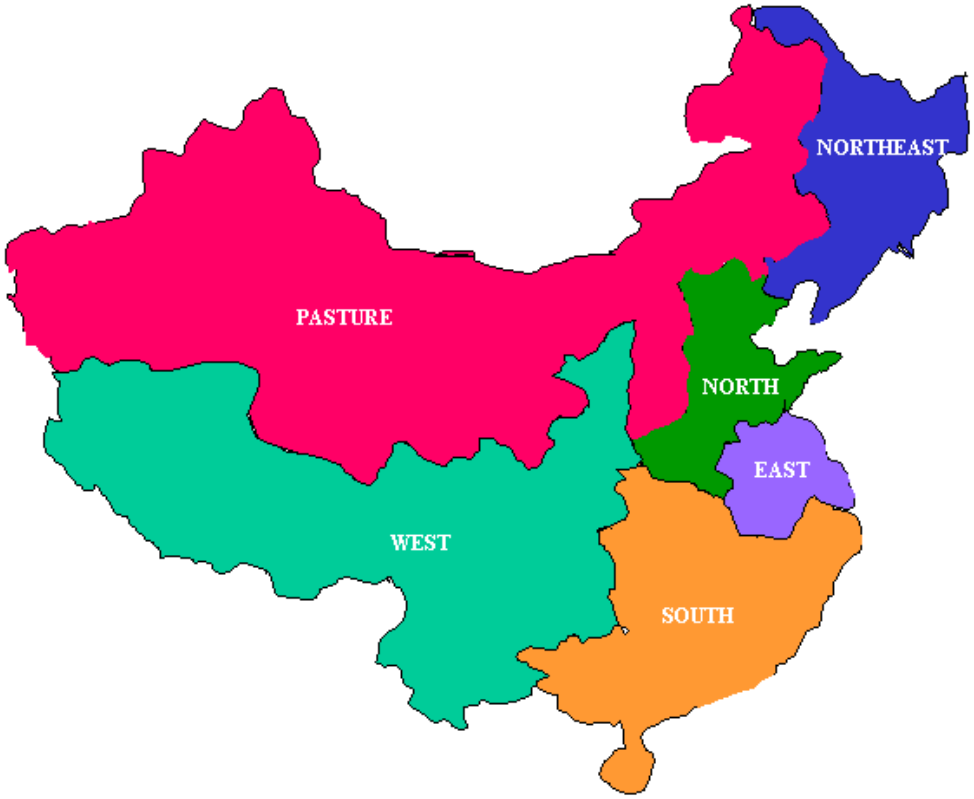

FIGURE 1. China's agricultural regions

The USDA's Economic Research Service (ERS) reports COP by regions. ERS recently constructed regional classifications (see USDA Farm Resource Regions, AIB-760), and the COP data for the U.S. Midwest in this study are for Heartland region data. The Heartland is defined as 518 counties located in eight states: Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, Ohio, and South Dakota.

Corn and Soybean Production

Data on the production and regional shares of corn and soybeans in China are reported in Table 1 and Table 2, respectively. Both corn and soybean productions have exhibited a significant increase in the last two decades. Corn production increased from an average of 64.0 mmt in 1979–1984 to 118.5 mmt in 1995–2000. Over the same period, soybean production in China increased from 8.9 mmt to 14.4 mmt. Both increases are the result of growth in yields as well as in area devoted to production.

TABLE 1. Corn production and regional shares in China

	China	Northeast	North	East	Pastoral	South	West
				Area			
Years	000 ha	%	%	%	%	%	%
1979-84	19,303	24.3	32.8	3.1	10.5	6.2	23.0
1985-89	19,415	25.9	33.1	4.0	9.9	5.7	21.4
1990-94	21,172	26.6	32.4	4.3	10.6	5.7	20.4
1995-00	24,214	26.3	31.5	4.2	13.0	6.1	18.9
				Production			
	000 mt	%	%	%	%	%	%
1979-84	64,003	28.6	33.8	3.3	9.4	4.2	20.6
1985-89	74,040	29.6	34.4	4.6	10.2	3.4	17.8
1990-94	98,590	33.6	32.7	4.1	11.3	3.2	15.0
1995-00	118,470	29.9	30.6	4.3	14.1	4.4	16.7

Source: Calculated by authors based on various issues of *China Statistical Yearbook*.

TABLE 2. Soybean production and regional shares in China

	China	Northeast	North	East	Pastoral	South	West
				Area			
Years	000 ha	%	%	%	%	%	%
1979-84	7,628	36.3	25.3	13.2	5.5	12.4	7.2
1985-89	8,122	39.2	22.0	12.0	7.2	11.8	7.8
1990-94	8,100	40.0	20.1	8.5	10.2	12.6	8.6
1995-00	8,291	36.5	19.2	8.7	13.2	13.9	8.6
				Production			
	000 mt	%	%	%	%	%	%
1979-84	8,868	41.3	24.0	12.4	4.9	10.9	6.5
1985-89	11,236	43.0	20.3	12.7	6.7	10.2	7.1
1990-94	12,464	43.5	21.2	8.3	8.6	11.2	7.2
1995-00	14,382	40.1	20.3	9.5	9.3	13.9	6.9

Source: Calculated by authors based on various issues of *China Statistical Yearbook*.

China's corn and soybean production is concentrated in the Northeast and North regions, the two surplus regions for corn and soybeans. These two regions produce about 60 percent of the corn production and 60 percent of the soybean production in China. The major deficit areas for corn are the South and West. Corn demand is highest in southern China where livestock production is growing. The major soybean deficit areas are the South and East regions. Both regions' soybean crush capacity has developed rapidly with their use of modern technology in recent years. Northeast soybeans compete with imported soybeans in the South and East soybean markets.

Land and labor productivities of corn production and soybean production are presented in Table 3. Corn yield in the United States (averaged 8,272 kg/ha in the five years from 1996 to 2000) are considerably greater compared to those in China (4,878 kg/ha). The yield in the U.S. Midwest (9,509 kg/ha) is virtually double that in China. Land productivity of

TABLE 3. Land (kg/ha) and labor (kg per working day) productivity of corn and soybean production, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
					Corn				
Land	4878	5505	4614	4877	5328	3573	4438	272	9509
Labor	23.04	44.73	25.96	24.71	24.57	14.53	14.23	756	6347
					Ratio to U.S. Midwest				
Land	0.51	0.58	0.48	0.51	0.56	0.38	0.47	0.87	1.00
Labor	275	147	247	248	258	420	448	1.10	1.00
					Soybeans				
Land	1747	1973	1789	2021	1230	1776	1299	564	2993
Labor	13	34	14	16	10	9	7	201	3611
					Ratio of Others to U.S. Midwest (Ratio of U.S. Midwest to Others)				
Land	0.58	0.66	0.60	0.68	0.41	0.59	0.43	0.86	1.00
Labor	(277)	(111)	(257)	(231)	(395)	(435)	(639)	(1.13)	1.00

Source: Calculated by authors based on National Statistical Bureau of China and U.S. Department of Agriculture (USDA) data.

corn production in China varies significantly in different regions. The Northeast, the major corn producing area, has the highest yield (13 percent higher than the national average), while the South region, a corn deficit region, has the lowest yield.

Crop production in China continues to be a very labor intensive, small-scale industry. The typical Chinese farmer has roughly one-half hectare of land for crop production. Mechanization is replacing human labor and draft animals in some regions, but most farmers still use their own labor. Labor productivity in China is very low, at only 1:275 compared with the U.S. Midwest on a five-year average. The Northeast's labor productivity (44.73 kg/day) is 94 percent higher than China's national average.

As is the case for corn, soybean yield and labor productivity in the United States are much higher than in China. The land productivity in the U.S. Midwest is about 152 percent of that in China, and labor productivity is about 277 times that of China. The situation for the Northeast—China's major producing region—is little better compared to the rest of China. In this region, the five-year average soybean yield (1,973 kg/ha) is 13 percent higher than the national average; labor productivity (34 kg per working day) is 177 percent higher.

China's corn COP (per metric ton) and the ratios to those in the U.S. Midwest are summarized in Table 4. Total corn COP in China on average technology (U.S.$120/metric ton [mt]) is much higher than that in the United States (U.S.$99/mt) and the U.S. Midwest (U.S.$95/mt). However, total COP in the two major corn

TABLE 4. Cost of production of corn

Years	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
					U.S.$/Mt				
1996	110	83	90	117	95	220	159	99	95
1997	139	110	119	119	130	190	180	102	99
1998	115	77	99	118	124	201	167	97	93
1999	116	86	125	129	126	165	151	98	96
2000	121	107	92	113	117	150	105	100	95
96-00	120	93	105	119	118	185	152	99	95
					Ratio to COP in U.S. Midwest				
1996	1.15	0.87	0.95	1.23	1.00	2.31	1.67	1.04	1.00
1997	1.41	1.12	1.21	1.20	1.32	1.93	1.82	1.03	1.00
1998	1.23	0.82	1.06	1.26	1.33	2.15	1.79	1.04	1.00
1999	1.21	0.90	1.31	1.35	1.31	1.72	1.57	1.03	1.00
2000	1.28	1.13	0.97	1.19	1.24	1.59	1.11	1.06	1.00
96-00	1.26	0.97	1.10	1.25	1.24	1.94	1.59	1.04	1.00

Source: Calculated by authors based on COP data.

producing regions, the Northeast and North China, are lower or closer to those in the U.S. Midwest. Northeast China COP is 3 percent lower than that in the U.S. Midwest on a five-year average. Although the corn COP is 10 percent higher on a five-year average, the total COP in two of the five years in North China is lower than that of the U.S. Midwest. In contrast, the South and West regions of China have substantial cost disadvantages relative to the U.S. Midwest, and are 94 percent and 59 percent higher, respectively.

The major components of the cost of corn production are reported in Table 5. It is apparent from the data that items putting China corn production at a disadvantage are 137 percent higher fertilizer costs and 77 percent higher power costs. Total fertilizer cost in this table includes chemical fertilizer and manure cost. Power cost covers labor, draft animals, and machinery costs. In the United States, about 80 percent of the power cost is machinery. However, in China, more than 80 percent is labor and draft animal costs. Typically, one or two farmers in a village will own a small tractor and they will cultivate the other farmers' land for a fee.

Table 6 shows that a smaller area is required in the United States to produce a metric ton of corn (0.21 versus 0.11 hectares) because of the higher land productivity. However, total land cost in the United States still turns out to be higher because land cost per hectare is 248 percent higher in the United States than in China. The two countries have different land policies and fees. In the United States, farmers pay rent for land or assume the market rent as land expenditure if the farmer is the owner of the land. In China, the

TABLE 5. Major components in cost of production of corn, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
					U.S.$/Mt				
Land	14	13	16	24	14	19	16	24	25
Power	62	40	49	61	51	106	91	39	35
Total fertilizer	28	25	22	21	30	44	33	12	12
Seeds	7	7	7	7	7	7	6	8	8
					Ratio to COP in U.S. Midwest				
Land	0.56	0.52	0.65	0.94	0.54	0.78	0.63	0.94	1.00
Power	1.77	1.16	1.42	1.74	1.47	3.06	2.61	1.12	1.00
Total fertilizer	2.37	2.13	1.84	1.82	2.53	3.68	2.75	0.99	1.00
Seeds	0.85	0.91	0.88	0.88	0.90	0.93	0.78	1.03	1.00

Source: Calculated by authors based on COP data.

TABLE 6. Land use, price, and cost of corn, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
Cost ($/mt)	14	13	16	24	14	19	16	24	25
Use (ha/mt)	0.21	0.19	0.22	0.21	0.19	0.28	0.23	0.11	0.11
Price ($/ha)	68.45	69.41	73.54	115.38	71.66	69.10	68.36	211.41	238.05
					Ratio to COP in U.S. Midwest				
Cost	0.56	0.52	0.65	0.94	0.54	0.78	0.63	0.94	1.00
Use	1.96	1.77	2.09	1.95	1.79	2.67	2.18	1.06	1.00
Price	0.29	0.29	0.31	0.48	0.30	0.29	0.29	0.89	1.00

Source: Calculated by authors based on COP data.

government owns the land and the land is leased to individual farmers based on family size. The first round of leases was granted in the late 1970s for 20 years and a new round of leases was conducted in the last several years—typically for 30 years. Farmers pay the tax to the government with a proportion of their production. The land tax cost is very low compared to rent in the United States. However, farmers also need to pay the fee to different levels of local government (central government, village, and township). These fees are relatively high and there has been an upward trend in recent years. In our cost calculation, both the central government tax and local taxes are included in the land cost. On a five-year average, the land cost of producing corn in China is only 56 percent of that in the U.S. Midwest.

China's labor cost on a metric ton basis has averaged about six times the labor cost in the U.S. Midwest, as shown in Table 7. China has cheaper labor and the wage rate is only 1/462 that of the United States. But the cheap labor advantage is offset by lower

TABLE 7. Labor use, wage, and cost of corn, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
Labor requirement (days/mt)	44.06	22.91	39.31	41.23	40.95	73.07	74.19	0.17	0.16
Wage ($/day)	1.13	1.10	1.05	1.32	0.91	1.22	1.11	53.38	53.33
Labor cost ($/mt)	49.69	25.20	41.15	53.90	37.22	88.72	81.77	9.27	8.41
Power cost ($/mt)	61.52	40.44	49.30	60.55	51.29	105.93	90.58	38.75	34.55
	Ratio to COP in U.S. Midwest								
Labor requirement	279.17	145.18	249.07	261.21	259.47	462.91	470.02	1.10	1.00
Wage	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Labor cost	5.91	3.00	4.90	6.41	4.43	10.55	9.73	1.10	1.00
Power	1.78	1.17	1.43	1.75	1.49	3.08	2.63	1.12	1.00

Source: Calculated by authors based on COP data.

labor productivity. Labor requirements for producing one metric ton of corn is 44 working days in China, versus 0.17 working days in the United States. As a net effect, China has a substantial labor cost disadvantage.

Table 8 indicates that China's fertilizer usage in corn production is more intensive than in the United States, at a rate 22 percent higher than in the U.S. Midwest on a per hectare basis and 143 percent higher on a per metric ton basis. In terms of fertilizer cost per unit of output, China has twice the U.S. Midwest's chemical fertilizer cost and 137 percent higher fertilizer use. In China, the South region has the highest fertilizer cost while the North has the lowest fertilizer cost in corn production.

Table 9 provides a summary of COP in soybean production. Similar to its position with corn, China has a cost disadvantage in soybean production. The total COP is 106 percent of that in the U.S. Midwest. However, there are three regions with lower total COP in terms of metric tons than that of the U.S. Midwest. The total COP in the Northeast, North, and East is 82 percent, 90 percent, and 92 percent of levels in the U.S. Midwest, respectively. These three regions are the major soybean-producing areas in China.

The major components of the COP for soybeans are summarized in Table 10. As in the case of corn, fertilizer and power are two major contributors to the cost disadvantage of China's soybean production. The average fertilizer cost is 264 percent higher compared to that in the U.S. Midwest, much higher than in the case of corn (137 percent). Total power cost is another large item contributing to higher cost in China (66 percent). In fact, power is

TABLE 8. Fertilizer use and cost of corn, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S. Midwest
Chemical fertilizer use/area (kg per hectare)	286.6	280.84	237.21	225.4	329.06	318.3	281.1	235.37
Chemical fertilizer use/output (kg per mt output)	59.81	52.98	53.49	46.36	63.79	86.75	62.91	24.63
Chemical fertilizer cost ($/mt)	24	22	20	18	25	33	26	12
Total fertilizer cost ($/mt)	28	25	22	21	30	44	33	12
	Ratio to COP in U.S. Midwest							
Chemical fertilizer use/area	1.22	1.19	1.01	0.96	1.40	1.35	1.19	1.00
Chemical fertilizer use/output	2.43	2.15	2.17	1.88	2.59	3.52	2.55	1.00
Chemical fertilizer cost	2.00	1.86	1.70	1.53	2.15	2.77	2.15	1.00
Total fertilizer cost	2.37	2.13	1.84	1.82	2.53	3.68	2.75	1.00

Source: Calculated by authors based on COP data.

TABLE 9. Cost of production of soybeans

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
	U.S.$/Mt								
1997	246	164	235	199	350	384	544	210	205
1998	225	172	180	169	384	253	262	212	202
1999	205	154	173	170	293	296	297	229	221
2000	207	196	160	230	236	245	246	228	211
97-00	221	172	187	192	316	294	337	219	209
	Ratio to COP in U.S. Midwest								
1997	1.20	0.80	1.15	0.97	1.71	1.88	2.66	1.03	1.00
1998	1.12	0.85	0.89	0.84	1.90	1.25	1.30	1.05	1.00
1999	0.93	0.70	0.79	0.77	1.33	1.34	1.35	1.04	1.00
2000	0.98	0.93	0.76	1.09	1.12	1.16	1.17	1.08	1.00
97-00	1.06	0.82	0.90	0.92	1.52	1.41	1.62	1.05	1.00

Source: Calculated by authors based on COP data.

TABLE 10. Major components in cost of production of soybeans, 1997 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
	U.S.$/Mt								
Land	42.80	35.50	39.19	49.83	49.52	35.40	28.91	69.25	73.09
Power	113.42	70.85	90.72	95.63	156.78	199.47	206.06	77.92	68.76
Total fertilizer	24.52	28.74	16.28	11.50	44.63	33.33	36.95	7.73	6.75
Seeds	22.53	16.30	19.31	23.15	33.65	24.70	39.78	17.30	15.71
	Ratio to COP in U.S. Midwest								
Land	0.59	0.48	0.54	0.68	0.68	0.48	0.39	0.95	1.00
Power	1.66	1.03	1.33	1.40	2.30	2.94	3.04	1.13	1.00
Total fertilizer	3.64	4.27	2.42	1.71	6.63	4.95	5.48	1.15	1.00
Seeds	1.44	1.04	1.23	1.48	2.13	1.58	2.53	1.10	1.00

Source: Calculated by authors based on COP data.

the largest factor affecting China's soybean COP in dollar terms ($44/mt higher). However, the power cost in the Northeast region is very close to that in the U.S. Midwest. Interestingly, China's seed cost to produce soybeans is much higher (44 percent), although the seed price in China is much lower. United States producers primarily use Roundup Ready seed, paying a high price for the seed and agreeing not to save it for additional planting. China, on the other hand, still uses non-genetically modified seed varieties that are inexpensive. The higher unit seed cost may result from the fact that quantity used per acre is higher and the yield is lower in China's soybean production.

Similar to the case of corn, the United States has a land productivity advantage that is offset by higher land rent. As a result, the United States has a substantial land cost disadvantage. Table 11 shows that the area required to produce a metric ton of soybeans is much lower in the United States (0.57 hectares in China compared to 0.36 hectares in the United States). However, total land cost in the United States turns out to be much higher ($42.8/mt in China and $69.25/mt in the United States). Land cost will continue to be a significant determinant of the relative competitiveness of the United States and China in corn and soybeans in the future. Some analysts predict that the gap in area required to produce corn and soybeans in the two countries may be closed in the future if China catches up with the level of productivity in the United States. However, considering the high proportion of farmers already using modern varieties and the already high level of fertilizer use in China, the potential magnitude and speed at which China can catch up in crop productivity may be overstated. Moreover, the countries' land costs are driven largely by their respective policy regimes. The low land cost in China is

TABLE 11. Land use, price, and cost of soybeans, 1997 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
Cost ($/mt)	42.80	35.50	39.19	49.83	49.52	35.40	28.91	69.25	73.09
Use (ha/mt)	0.57	0.51	0.57	0.50	0.81	0.56	0.78	0.36	0.33
Price ($/ha)	74.71	69.12	69.15	99.50	60.84	62.85	37.22	194.23	218.48
	Ratio to COP in U.S. Midwest								
Cost	0.59	0.48	0.54	0.68	0.68	0.48	0.39	0.95	1.00
Use	1.71	1.54	1.69	1.50	2.43	1.68	2.32	1.07	1.00
Price	0.34	0.32	0.32	0.46	0.28	0.29	0.17	0.89	1.00

Source: Calculated by authors based on COP data.

artificial and reflects the administrative control in land use and the lack of a free land market. On the other hand, in the United States, land cost is artificially high, with government support capitalized into higher land values. As land use policy is liberalized in China, and as government support in the United States is reduced, land costs in both countries are expected to move toward convergence. That is, land cost is expected to increase in China and decrease in the United States.

Soybean production labor requires 76 days per mt in China compared to 0.32 days in the United States. However, even with a 462 percent higher wage rate in the United States than in China, labor cost in China is 378 percent higher for soybean production (Table 12) as that in the United States.

In contrast to corn production, soybean production fertilizer use per hectare in China on average is 32 percent lower than that in the U.S. Midwest, as summarized in Table 13. The difference in fertilizer utilization on a per metric ton basis is much smaller in soybean production than in corn production. The major factor contributing to higher fertilizer costs is the price. The major soybean producing region in China, the Northeast region, has almost the same amount of fertilizer use per hectare as the U.S. Midwest.

TABLE 12. Labor use, wage, and cost of soybeans, 1997 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
Labor requirement (days/mt)	76.60	30.50	71.10	63.66	108.97	120.01	176.12	0.32	0.28
Wage ($/day)	1.12	1.11	1.05	1.29	0.96	1.42	1.02	56.96	57.31
Labor cost ($/mt)	85.98	33.82	75.14	81.65	104.60	171.47	179.79	17.99	15.95
Power cost ($/mt)	113.42	70.85	90.72	95.63	156.78	199.47	206.06	77.79	68.90
	Ratio to COP in U.S. Midwest								
Labor requirement	274.40	109.26	254.70	228.05	390.34	429.90	630.88	1.13	1.00
Wage	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.99	1.00
Labor cost	5.39	2.12	4.71	5.12	6.56	10.75	11.28	1.13	1.00
Power	1.66	1.03	1.33	1.39	2.29	2.93	3.04	1.13	1.00

Source: Calculated by authors based on COP data.

TABLE 13. Fertilizer use and cost of soybeans, 1997 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S. Midwest
Chemical fertilizer use/area (kg per hectare)	80.23	115.43	67.76	45.15	117.81	45.81	113.27	117.69
Chemical fertilizer use/output (kg per mt output)	45.96	59.78	37.54	22.89	95.55	25.75	87.75	39.37
Chemical fertilizer cost ($/mt)	18.64	26.59	13.82	9.09	38.75	17.63	19.56	6.75
Total fertilizer cost ($/mt)	24.52	28.74	16.28	11.50	44.63	33.33	36.95	6.75
	Ratio							
Chemical fertilizer use/area	0.68	0.98	0.58	0.38	1.00	0.39	0.96	1.00
Chemical fertilizer use/ output	1.17	1.52	0.95	0.58	2.43	0.65	2.23	1.00
Chemical fertilizer cost	2.77	3.95	2.05	1.36	5.76	2.62	2.90	1.00
Total fertilizer cost	3.64	4.27	2.42	1.71	6.63	4.95	5.48	1.00

Source: Calculated by authors based on COP data.

Hog Production

Pork is the most popular meat in Chinese diets, accounting for more than 80 percent of total red meat consumption. Hog production is the dominant component of total livestock output in China, with an annual output of 42.81 mmt from 1995 to1999. The South region produces about 40 percent of China's hogs, and about 20 percent are produced in the West region (Table 14).

Pork production systems in China include backyard production, specialized household production, and large-scale commercial production. Each farm household in the backyard production system may feed one to several pigs in the backyard. On average, backyard producers raised 5.2 pigs per household. Feed and feeding methods vary, but roughage is an important feed source in backyard production (Fang et al.; Wailes et al.). Roughage in pork production is green plant leaves and wild vegetables. Farmers in backyard production use their own family's labor to collect these feeds in lieu of using feed grains. The animals are slaughtered by local butchers and sold in the nearby village wet market.

Specialized livestock households allocate most of their farm labor and time to producing one or two kinds of livestock products. On average, specialized producers raise

TABLE 14. Hog production and regional shares in China

	China (mmt)	Northeast (%)	North (%)	East (%)	Pastoral (%)	South (%)	West (%)
1995	35.89	8.33	19.55	9.93	3.10	37.45	21.63
1996	39.74	8.88	20.68	9.66	3.33	36.93	20.52
1997	59.54	4.83	12.29	5.87	8.85	55.05	13.11
1998	38.84	8.07	21.25	10.29	4.72	34.42	21.24
1999	40.06	8.30	21.37	10.35	4.87	33.85	21.26
1995-00	42.81	7.68	19.03	9.22	4.97	39.54	19.55

Source: Calculated by authors based on various issues of *China Statistical Yearbook*.

220 head per household. Feed and feeding methods used are different from that of the backyard feeding households.

Large-scale commercial producers in the South cater to the export market in Hong Kong and to population centers in coastal cities. These production facilities are comparable to those in the West in terms of size of operation, feeding practices, machinery and equipment used, and productivity levels. The average size of an operation is 6,032 head per farm based on the 54 farms surveyed. The shares of Chinese pork production are about 80 percent for backyard, 15 percent for specialized household, and 5 percent large-scale operations, respectively.

Three indices are used to compare the productivity of hog production in China and the United States: days on feed (DOF), fine feed conversion ratio (FFCR), and labor productivity. The comparisons are reported in Table 15.

It should be noted that the initial and final weights of animals, which vary among production systems as well as by country, greatly influence the DOF comparison and are not standardized in this analysis. The DOF for backyard production is much longer than that of specialized and large-scale hog production. There is a downward trend for DOF for both production practices in China. DOF dropped from 217 days in 1996 to 181 days in 2000 for small-scale production and from 170 days to 152 days for large-scale production for China's average technology. DOF for large-scale production in 2000 was 138 days on average. In the U.S. Midwest, the average DOF is about 176 days. Compared to the U.S. Midwest, DOF for average small-scale production in China is longer. In contrast, DOF for average specialized household and large-scale production in China is shorter. There are significant regional differences in China, and average DOF in the East and South regions of China is much shorter.

TABLE 15. Productivity of finishing feeder pig production, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S. Midwest
	Days on Feed (DOF), Days							
Backyard	195	171	193	164	246	164	256	
Specialized	160	160	149	123	201	137	187	
Large scale	138	160	134	119	147	121	173	
	Ratio to DOF in U.S. Midwest (197 days)							
Backyard	1.11	0.97	1.10	0.93	1.40	0.93	1.45	
Specialized	0.89	0.93	0.83	0.69	1.11	0.77	1.07	
Large scale	0.70	0.81	0.68	0.60	0.74	0.62	0.88	
	Fine Feed Conversion Ratio (FFCR)							
Backyard	2.83	3.31	3.03	3.25	2.93	2.61	2.46	3.39
Specialized	3.28	3.33	3.44	3.49	3.36	3.17	2.81	3.39
Large scale	3.51	3.49	3.43	3.61	3.33	3.80	3.21	3.38
	Ratio to FFCR in U.S. Midwest							
Backyard	0.83	0.98	0.90	0.96	0.86	0.77	0.73	1.00
Specialized	0.97	0.98	1.01	1.03	0.99	0.94	0.83	1.00
Large scale	1.04	1.03	1.02	1.07	0.98	1.12	0.95	1.00
	Labor Productivity (Kg per Working Day)							
Backyard	7.15	14.98	8.10	8.10	6.59	9.36	5.23	
Specialized	17.32	23.04	37.78	17.91	22.27	42.96	14.59	
Large scale	33.00	43.60	43.44	90.40	45.45	62.22	19.10	
	Ratio of Labor Productivity in U.S. Midwest (90 Kg per Working Day) to Others							
Backyard	12.59	6.01	11.11	11.11	13.66	9.62	17.21	
Specialized	5.20	3.91	2.38	5.03	4.04	2.10	6.17	
Large scale	2.73	2.06	2.07	1.00	1.98	1.45	4.71	

Source: Calculated by authors based on COP data.
Note: 2000 data for large-scale production in China.

It is important to note that comparison of feed conversion between different production systems might be subject to problems because of differences in the feed ration used. For example, there is also a significant difference in the FFCR for production practices in China. FFCR for backyard production in China is much lower compared to specialized household production and to the more commercial production in China and in the U.S. Midwest. This is because of the different compositions in feed used by each particular production system. Production systems in the United States are more intensive in their use of feed grains, while backyard producers in China (and to a large extent, even specialized household producers) use green roughage in their feed, which is not accounted for in the FFCR. FFCR for specialized production in China is very close to that in the U.S. Midwest. FFCR for a large-scale production in China is 4 percent higher than that in the U.S. Midwest.

Hog production also is labor intensive in China compared to that in the United States. One working day in the U.S. Midwest produces about 90 kg pork, while backyard hog production in China produces only 7.15 kg. Labor productivity in the U.S. Midwest is 12.59 times greater than that of backyard production in China, 4.72 times greater than specialized household hog production in China, but only 2.73 times greater than the large-scale production in the South region of China.

The average COP for hogs from 1996 to 2000 is summarized in Table 16. At first glance, total COP in China is lower compared to the U.S. Midwest: 33 percent lower for backyard production, 32 percent lower for specialized production, and 41 percent lower for large-scale production. After adjusting for the feeder pig cost, the difference is reduced to 18 percent for backyard producers, 22 percent for specialized household producers, and 32 percent for large-scale production. Including the feeder pig cost adjustment, the South region, the largest hog-producing region in China, has the highest COP, with a ratio of 92 percent, 87 percent, and 100 percent for backyard production, specialized household production, and large-scale production compared to the U.S.

TABLE 16. Cost of production of finishing feeder pigs, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
	Backyard (U.S.$/100 Kg)								
Total	97.73	82.34	89.17	104.60	81.95	116.73	93.25	39.36	147.80
No feeder pig	75.73	64.98	68.20	76.95	70.55	85.13	75.52	89.91	95.22
	Ratio to COP in U.S. Midwest								
Total	0.67	0.57	0.62	0.72	0.57	0.8	0.64	0.94	1.00
No feeder pig	0.82	0.71	0.75	0.84	0.77	0.92	0.82	0.95	1.00
	Specialized Household Production (U.S.$/100 Kg)								
Total	98.24	80.49	95.95	147.10	79.13	117.42	95.62	139.36	147.80
No feeder pig	71.97	62.16	68.55	93.90	65.39	80.39	72.73	89.91	95.22
	Ratio to COP in U.S. Midwest								
Total	0.68	0.55	0.66	1.04	0.54	0.81	0.68	0.94	1.00
No feeder pig	0.78	0.67	0.74	1.06	0.71	0.87	0.80	0.95	1.00
	Large Scale (U.S.$/100 Kg)								
Total	87.46	70.00	83.41	88.50	75.54	105.62	95.00	138.96	146.59
No feeder pig	64.05	54.57	59.70	61.36	58.08	75.02	69.97	72.31	75.27
	Ratio to COP in U.S. Midwest								
Total	0.60	0.48	0.57	0.60	0.52	0.72	0.65	0.95	1.00
No feeder pig	0.85	0.72	0.79	0.82	0.77	1.00	0.93	0.96	1.00

Source: Calculated by authors based on COP data.
Note: 2000 data for large-scale production in China.

Midwest. Compared to the specialized household production in the East China region, the U.S. Midwest has a 6 percent cost advantage.

Because of wide differences in production practices, it is more meaningful to evaluate specific, comparable cost items. The U.S. Midwest has a cost advantage in feed cost amounting to $5.41/100 kg compared to specialized hog producers in China, or a 15 percent lower feed cost (see Table 17). However, backyard production in China has almost the same unit feed cost as in the U.S. Midwest because of wide use of green roughage in its feed ration. The South, East, and West regions in China have higher feed

TABLE 17. Major components in cost of production of finishing feeder pigs, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
	Backyard (U.S.$/100 Kg)								
Feed	49.94	49.03	47.97	51.00	48.94	55.96	43.90	49.32	51.60
Feeder pig	22.00	17.37	20.96	27.65	11.39	31.59	17.73	49.47	52.60
Labor	20.10	10.26	16.27	20.70	16.14	23.20	24.97	9.00	11.00
Other	5.69	5.69	3.97	5.26	5.47	5.98	6.66	32.05	32.70
	Ratio to COP in U.S. Midwest								
Feed	1.00	0.99	0.97	1.01	0.99	1.12	0.87	0.96	1.00
Feeder pig	0.44	0.35	0.41	0.55	0.23	0.64	0.36	0.94	1.00
Labor	1.91	0.94	1.54	2.02	1.51	2.18	2.36	0.82	1.00
Other	0.18	0.18	0.13	0.17	0.17	0.19	0.21	0.97	1.00
	Specialized Household (U.S.$/100 Kg)								
Feed	57.01	50.05	57.01	72.65	49.58	67.33	58.13	49.16	51.60
Feeder pig	26.27	18.33	27.39	53.20	13.74	37.02	22.89	49.45	52.60
Labor	8.84	6.63	6.31	15.51	8.36	8.17	10.56	9.03	11.00
Other	6.12	5.48	5.23	5.74	7.45	4.89	4.03	31.72	32.70
	Ratio to COP in U.S. Midwest								
Feed	1.15	1.00	1.15	1.52	1.02	1.35	1.20	0.96	1.00
Feeder pig	0.53	0.37	0.54	1.09	0.27	0.74	0.47	0.94	1.00
Labor	0.80	0.63	0.57	1.50	0.72	0.74	0.98	0.82	1.00
Other	0.19	0.17	0.16	0.19	0.23	0.16	0.13	0.97	1.00
	Large Scale (U.S.$/100 Kg)								
Feed	52.16	42.02	47.99	55.47	48.80	66.68	55.84	38.85	39.53
Feeder pig	23.41	15.43	23.71	27.14	17.47	30.60	25.02	66.65	71.32
Labor	5.01	3.77	4.38	2.83	4.49	3.99	8.60	6.92	8.49
Other	6.88	8.77	7.33	3.06	4.78	4.35	5.53	26.54	27.25
	Ratio to COP in U.S. Midwest								
Feed	1.32	1.06	1.21	1.40	1.23	1.69	1.41	0.98	1.00
Feeder pig	0.33	0.22	0.33	0.38	0.24	0.43	0.35	0.93	1.00
Labor	0.59	0.44	0.52	0.33	0.53	0.47	1.01	0.82	1.00
Other	0.68	0.51	0.64	0.72	0.59	0.85	0.75	0.94	1.00

Source: Calculated by authors based on COP data.
Note: 2000 data for large-scale production in China.

costs, reflecting the high COP of corn and soybeans and higher transportation costs of feed. China has a labor disadvantage in backyard production due to low labor productivity but it has a labor advantage in specialized household production and large-scale production. China has a strong feeder pig cost advantage across all three types of practices. Our data do not explain this cost differential, but the most likely major source of the difference is the labor intensity in feeder pig production, where China has a significant advantage over the United States due to the availability of cheap labor.

The U.S. Midwest has a substantial cost disadvantage in other cost terms ($27.01 for backyard production, $26.58 for specialized household, and $25.82 for large-scale production). The major difference in other cost terms is attributable to the higher capital replacement costs (or depreciation) in the United States. It is difficult to ascertain whether the computation of capital replacement cost is similar enough in both countries to warrant a valid comparison in this category.

Impacts of U.S. Land Rent Distortion and Exchange Rates

When the distortion of land values in the United States is removed, the average land cost per metric ton of output from 1996 to 2000 in the U.S. Midwest is virtually the same as that of the average level in China (99 percent) for corn production and is 3 percent higher for soybean production (see Table 18). The unit land cost in the U.S. Midwest becomes much smaller than that in either China's East or South regions in corn production; in soybean production, it is smaller than that of East China. While land cost for the U.S. Midwest is still higher than that of the Northeast region of China, the difference is reduced from 48 percent to 10 percent in corn production and from 52 percent to 15 percent in soybean production.

Tables 19 and 20 give the results of three scenarios for corn and for soybean production, respectively, compared to the baseline. The first scenario removes the U.S. land cost distortion only, the second makes the exchange rate adjustment only, and the third uses a combination of the previous two scenarios. When land cost distortion was corrected, the competitiveness of corn and soybean production in the U.S. Midwest was significantly increased. The COP in the U.S. Midwest increased from 26 percent higher in the baseline to 42 percent higher for corn production and from 6 percent higher in the

TABLE 18. Land cost after adjusting U.S. land cost in corn and soybean production, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
					U.S.$/Mt				
Corn	14.10	12.93	16.20	23.68	13.53	19.44	15.71	13.40	14.28
Soybeans	42.80	35.50	39.19	49.83	49.52	35.40	28.91	39.47	41.66
					Ratio to COP in U.S. Midwest				
Corn	0.99	0.90	1.13	1.66	0.95	1.36	1.10	0.94	1.00
Soybeans	1.03	0.85	0.94	1.19	1.20	0.85	0.69	0.95	1.00

Source: Calculated by authors based on COP data.

TABLE 19. Scenario analysis on the cost of production of corn, 1996 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
					U.S.$/Mt				
Base	120	93	105	119	118	185	152	99	95
U.S. land cost	120	93	105	119	118	185	152	89	85
Exchange rate	109	84	95	108	107	168	138	99	95
Both	109	84	95	108	107	168	138	89	85
					Ratio to COP in U.S. Midwest				
Base	1.26	0.97	1.10	1.25	1.24	1.94	1.59	1.04	1.00
U.S. land cost	1.42	1.09	1.24	1.41	1.40	2.19	1.80	1.05	1.00
Exchange rate	1.14	0.88	1.00	1.13	1.12	1.76	1.45	1.04	1.00
Both	1.29	0.99	1.13	1.28	1.27	1.98	1.63	1.05	1.00

Source: Calculated by authors based on COP data.

TABLE 20. Scenario analysis on the cost of production of soybeans, 1997 to 2000 average

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
					U.S.$/Mt				
Base	221	172	187	192	316	294	337	219	209
U.S. land cost only	221	172	187	192	316	294	337	190	178
Exchange rate only	204	158	173	177	292	272	311	219	209
Both	204	158	173	177	292	272	311	190	178
					Ratio to COP in U.S. Midwest				
Base	1.06	0.82	0.90	0.92	1.52	1.41	1.62	1.05	1.00
U.S. land cost only	1.24	0.97	1.05	1.08	1.78	1.66	1.90	1.07	1.00
Exchange rate only	0.95	0.74	0.81	0.83	1.36	1.27	1.46	1.05	1.00
Both	1.12	0.87	0.95	0.98	1.60	1.49	1.71	1.07	1.00

Source: Calculated by authors based on COP data.

baseline to 24 percent higher in soybean production. Corn production in the U.S. Midwest becomes competitive overall compared to all regions in China. Northeast China switched from cost advantage to cost disadvantage in corn production. In soybean production, the U.S. Midwest switched from cost disadvantage to cost advantage relative to the North and East regions of China. Northeast China still has a cost advantage compared to the U.S. Midwest.

As expected in the second scenario with the exchange rate adjustment, the depreciating Chinese yuan increases China's competitiveness in corn and soybean production. China's COP decreased from 26 percent higher to 14 percent higher. The Northeast region becomes more competitive and the North region changes from a cost disadvantage to an equal advantage in unit COP. On average, in soybean production, China changed from cost disadvantage to advantage. Three regions in China (Northeast, North, and East) become more competitive. The other three regions remain at a cost disadvantage.

As a net effect of both U.S. land cost and the exchange rate, the U.S. Midwest gains more in competitiveness. The U.S. Midwest has a cost advantage in corn production over all the regions in China except in the Northeast. The Northeast region has almost the same competitiveness as the U.S. Midwest in corn production in terms of COP. In soybean production, the Northeast and North regions in China are still competitive. The COP in the East China region comes close to that of the U.S. Midwest.

The scenario of the exchange rate on COP in feeder pigs was conducted and the results are summarized in Table 21. As expected, depreciating the Chinese RMB significantly increases the cost advantage for China's hog production. All ratios of China's COP over the U.S. Midwest are reduced by 6 to 7 percent.

Conclusions and Discussion

This research compares the productivity and COP (cost of production) between China and the United States for corn, soybeans, and hogs and provides regional comparisons in China and the U.S. Midwest. Three kinds of hog production systems in China are examined.

TABLE 21. Exchange rate on cost of production of finishing feeder pigs, 1996 to 2000 average (ratio to COP in U.S. Midwest)

	China	Northeast	North	East	Pastoral	South	West	U.S.	U.S. Midwest
					Backyard (Baseline)				
Total	0.67	0.57	0.62	0.72	0.57	0.8	0.64	0.94	1.00
No feeder pig	0.82	0.71	0.75	0.84	0.77	0.92	0.82	0.95	1.00
					(Scenario)				
Total	0.61	0.52	0.56	0.65	0.51	0.73	0.58	0.94	1.00
No feeder pig	0.75	0.64	0.68	0.77	0.70	0.84	0.74	0.95	1.00
					Specialized Household Production (Baseline)				
Total	0.68	0.55	0.66	1.04	0.54	0.81	0.68	0.94	1.00
No feeder pig	0.78	0.67	0.74	1.06	0.71	0.87	0.80	0.95	1.00
					(Scenario)				
	0.61	0.50	0.60	0.95	0.49	0.73	0.62	0.94	1.00
No feeder pig	0.71	0.61	0.68	0.97	0.65	0.79	0.73	0.95	1.00
					Large Scale (Baseline)				
Total	0.60	0.48	0.57	0.60	0.52	0.72	0.65	0.95	1.00
No feeder pig	0.85	0.72	0.79	0.82	0.77	1.00	0.93	0.96	1.00
					(Scenario)				
Total	0.55	0.44	0.52	0.56	0.47	0.66	0.60	0.94	1.00
No feeder pig	0.79	0.67	0.74	0.76	0.72	0.92	0.86	0.95	1.00

Source: Calculated by authors.
Note: 2000 data for large-scale production in China.

The results show that the United States has a substantial advantage in land and labor productivity in corn and soybean production. The United States also has labor productivity in hog production, but there is not a big difference in DOF (days on feed) and fine feed requirements of the two countries. Based on China's average technology, the United States has a cost advantage in corn and soybean production but a disadvantage in hog production.

Although the United States has a strong advantage in land productivity, it has a substantial cost disadvantage in land because of inflated land rent resulting from government programs. It is unlikely that China can make up the difference in land productivity because of current intensive fertilizer usage. It is expected that land costs in both countries will move toward convergence. The land policies in both countries will play a significant role in determining their relative competitive positions.

China has very cheap labor. However, labor costs in producing corn and soybeans are more expensive than in the United States because of lower labor productivity. There

has been an upward trend in labor productivity in China and this trend is expected to continue as more job opportunities in the nonagricultural sectors occur.

The United States has a significant cost disadvantage in producing hogs regardless of the production practice. The disadvantage stems mainly from feeder pig costs and capital costs included in the "other" cost category.

Our results show that producing corn in China's South and West regions is extremely costly. To produce the same amount of corn, the South and West regions costs are 94 percent and 59 percent higher, respectively, compared to costs in the U.S. Midwest. These differences in COP provide a good opportunity for U.S. farmers because these two regions are major corn consumption and importing regions in China. The two regions together produced 21.66 mmt of pork annually in the last five years, or 2.58 times the total pork production of the United States.

The United States has a significant cost advantage over the South, West, and Pastoral regions of China. Total COP including land cost to produce a unit of soybeans in these three regions is 41 percent, 62 percent, and 52 percent higher, respectively, relative to that of the U.S. Midwest. These three regions are big importing regions of soybeans in China as there is a growing demand for soybean meal for livestock, and this will have important implications for U.S. soybean exporters. The South region has been emerging as a large soybean demand market, as modern soybean crushing capacity has developed in the last several years. In addition to the COP advantage, crushers prefer imported seed because U.S. soybeans have a higher oil content than do domestic seeds, and delivery is more reliable.

However, U.S. corn and soybeans are facing strong competition from the Northeast and North regions of China. The results of this study show that the unit costs of producing corn and soybeans in these two regions are nearly equal to those in the U.S. Midwest. Interestingly, the results indicate that the situation for Chinese farmers in major producing regions as a result of WTO accession is not as bad as many had thought.

With China's good productive potential, mostly found in the Northeast region but with the bulk of consumption occurring in the Southeast region, investment in and development of transportation infrastructure will be a major determinant in how regional competitiveness will translate into trade patterns in the future. Industry experts report that

the cost of transporting corn and soybeans from the Northeast to the South in China is comparable to transporting them from the United States.

In hog production, the U.S. Midwest has a cost advantage over China in terms of feed cost based on average technology, but this advantage is more than offset by the lower cost of feeder pigs and low capital replacement cost in China. In addition, producers in the U.S. Midwest are competitive in terms of COP compared to the producers of specialized households and large-scale farms in the major hog-producing regions of South and East China.

Removing the U.S. land value distortion would increase the overall competitiveness of U.S. corn, soybean, and hog producers. However, the benefits from removing U.S. land value distortion would be offset by the depreciating Chinese yuan. The net effects from these two policy scenarios will not change the major conclusions discussed above. The recently passed U.S. agricultural law removes any expectations for a reduction of land value distortions in the near future.

China is conducting an experiment in land tax and fee reforms in an attempt to reduce land costs and increase farm income. The experiment started at Anhui province in 2000 and Jiangsu province joined the experiment in 2001. The Chinese government allowed several more provinces to join the reform in 2002. The reform has reduced farmers' costs but it has run into many obstacles. A major difficulty for the reform is local governments' lack of funds to pay for the huge loans and education funds. We cannot quantify the impact of this policy, as it remains unclear at this time.

The results of this study provide important information on China's competitiveness in the international corn, soybean, and pork markets, and these results have important implications for China's inclusion in the WTO. However, COP analysis provides only one of the determinants of a country's competitive position. Domestic agricultural and nonagricultural policies have a major impact on competitiveness. Currently, the United States provides much better support to farmers, which makes U. S. products more competitive in China's markets.

Export potential for Chinese pork is also constrained by sanitary and phytosanitary (SPS) considerations. In particular, China is not free of foot-and-mouth disease and classical swine fever. China intends to develop disease-free regions to avoid SPS

restrictions, but its success in doing so remains to be seen. China can also circumvent SPS restrictions by exporting processed pork products (Fabiosa et al.).

sThe results of this study should be taken with all the caveats that have been raised. Foremost is the inherent limitation in this type of study where some concepts (such as capital depreciation for hog production) are not standardized. In addition, this study did not analyze the quality difference between the two countries. For example, the U.S. soybean is considered superior to local varieties, having 2 percent to 2.5 percent more oil content, more standardized seed size, and less foreign material. The comparability of pork quality in the different production systems is also uncertain.

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