



THE UNIVERSITY OF GEORGIA  
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# **Competitiveness of Peanuts: United States versus China**

Changping Chen, Stanley M. Fletcher,  
Ping Zhang, and Dale H. Carley





## **Abstract**

The primary objective of this study was to evaluate the competitive position of peanuts for the U.S. in comparison with China at both the national and regional levels in a free trade market for the 1988–93 period. A nonparametric statistical method was used to determine the similarities and differences in economic costs, yield, and net returns to farm management and risks between the two countries. Total economic costs were decomposed further into seed, fertilizer, chemicals, labor, and other expenses. Results indicate that economic costs in peanut production were significantly larger in the U.S. than in China. Peanut production was, however, more profitable in the U.S. than in China if land value and quota rent were not included in U.S. economic costs. There was no statistical evidence for the difference of net returns based on world peanut prices in Rotterdam if land value and quota rent were excluded in economic costs. This study concludes that American peanuts were less competitive than Chinese peanuts in the world market in terms of costs and net returns. The U.S. peanut industry has a competitive advantage in high-quality products and good infrastructure of production, processing, and transportation, while China's peanut industry has a competitive advantage in "free land" and cheap labor.

# Competitiveness of Peanuts: United States versus China

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## Introduction

Peanuts are one of the most important oilseed crops in international trade for southern U.S. agriculture. The U.S. on average produced about 1,906 thousand metric tons (mt) of peanuts and exported about 20 percent of its production to foreign markets during the period 1991–93 (U.S. Department of Agriculture 1991–1994). The U.S. has also been a leading exporter in the world peanut market for decades, with a share in the world market averaging 32.88 percent in the 1970s, 28.05 percent in the 1980s (Fletcher et al. 1992), and about 27.09 percent for the 1991–94 period (U.S. Department of Agriculture 1991–1994).

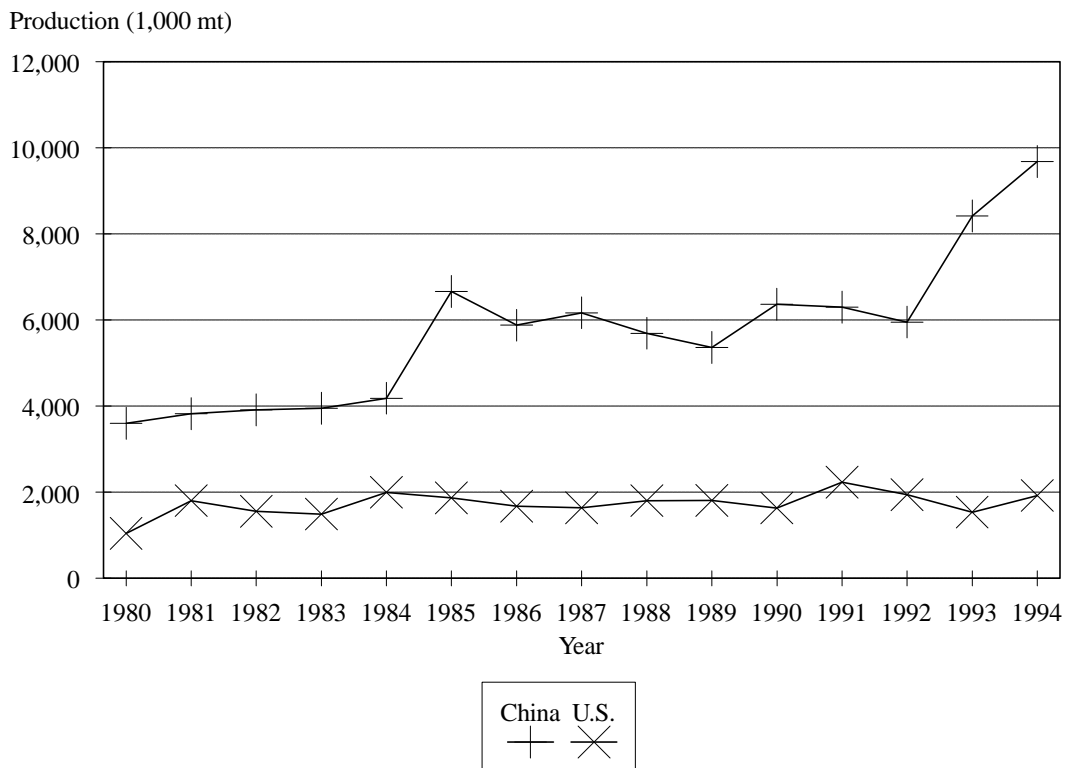
The predominant role of peanut exports for the U.S. in the international market has been decreasing, with China emerging as a new peanut exporter since the early 1980s. This change is reflected both in domestic production and in market shares in the world market for the two countries. While the U.S. supply management program with quotas has kept U.S. peanut production at a relatively constant level, rural economic reform in China boosted that country's peanut industry after 1978. Since 1984 the difference in total peanut production has become wider between the U.S. and China (figure 1). A comparison of market shares among the top three peanut-exporting countries (i.e., the U.S., China, and Argentina) depicts dynamic changes in the world peanut market (figure 2). While the Argentinean share appears to be relatively constant, the U.S. share in the world peanut market consistently varied with the fluctuations of China's market share during the 1980–94 period. The market share for China has surpassed that for the U.S. since 1993.

Movement toward a global marketplace in the world economy continues, as characterized by the implementation of the North American Free Trade Agreement (NAFTA)

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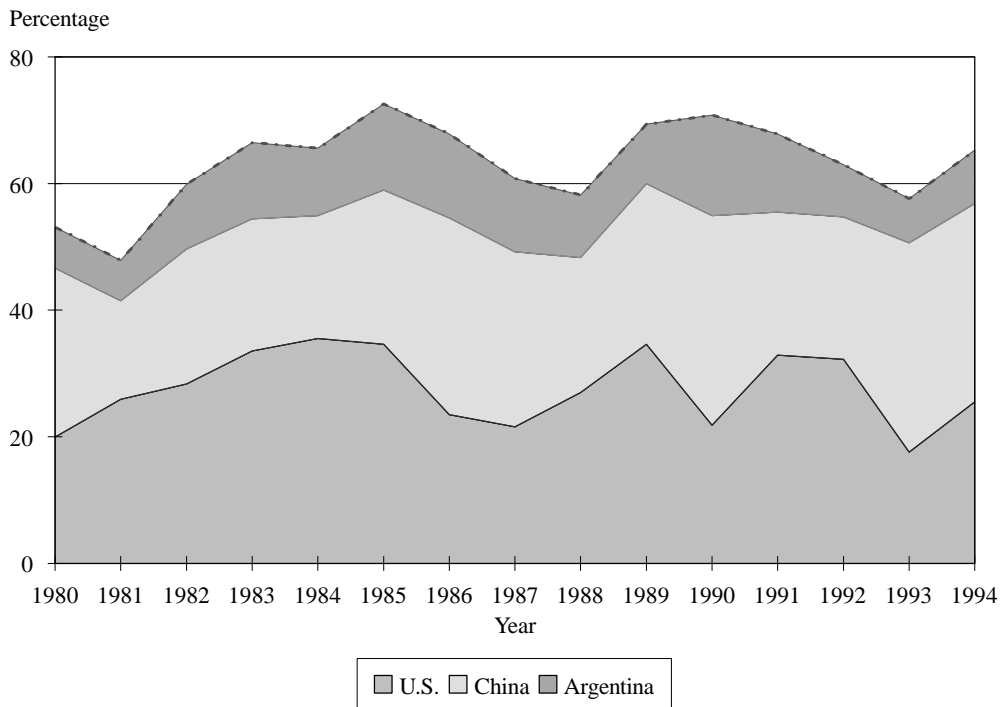
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and the Uruguay Round negotiations for the General Agreement on Tariffs and Trade (GATT). Increasing free trade presents the U.S. peanut industry with new opportunities and challenges. The American peanut industry can access foreign markets more easily than before because trade barriers and tariffs are being partially or totally removed among the NAFTA and GATT member countries. The U.S. domestic peanut industry has to meet the competition from the rest of the world, however. Although not presently a member of the World Trade Organization (WTO, a successor to GATT), China does have Most Favorite Nations (MFN) status. This allows Chinese peanuts to enter into the U.S. market at GATT tariff levels rather than the higher tariff levels.



**Figure 1. Peanut production for the U.S. and China.**

In such a dynamic world economy, there is a concern about the competitiveness of U.S. peanuts in the world market. Many wonder if China's peanut industry will have even more strength to compete with the U.S. peanut industry after it takes nearly one-third of the world market share. An understanding of these issues is important. The U.S. peanut industry needs the information to evaluate its current production and marketing practices and adjust its strategies in international trade. Policymakers also need this information to reform the peanut program and enhance the competitiveness of the U.S. peanut industry in the world market. A comprehension of the endogenous factors in the domestic market and exogenous factors at work in the international market can assist the industry in increasing its competitiveness and in regaining the lost market share.



**Figure 2. Market shares of peanut exports in the world market for the U.S., China, and Argentina.**

### Objectives of the Analysis

To address the concerns and issues raised in the U.S. peanut industry, this study analyzed the competitiveness of peanuts for the U.S. relative to China, in terms of economic costs, yield, and net returns both in the domestic and in international markets. Specific objectives of this study were to

- (1) estimate economic costs, yield, and net returns in peanut production for the U.S. and its major peanut-producing region: Southeast;
- (2) estimate economic costs, yield, and net returns of peanut production for China and its major peanut-producing province: Shandong;
- (3) compare and contrast economic costs, yield, and net returns between the U.S. and China;
- (4) compare and contrast economic costs, yield, and returns between the Southeast and Shandong; and
- (5) determine the competitive position of peanuts for the U.S., compared with China in the international market.

## Overview of the Study

A significant amount of literature has been developed in the analysis of competitiveness of major agricultural commodities across countries, but little is known about the competitive position of U.S. peanuts in the world market because of the difficulty of obtaining information from foreign countries. In the economic literature the term “competitiveness” often is defined as an ability to maintain or increase market share through a sustained period of time (Larson and Rask 1992). Competitiveness is also viewed as a matter of long-term survival (Thurow 1992). If a firm can survive by selling at the ongoing price, the firm is, in Thurow’s words, “competitive.” If a firm can survive from gaining more market share by selling at the ongoing price, the firm is more competitive. A competitive firm must be profitable while gaining or maintaining its market share (Duren et al. 1991). An increase in competitiveness does not, however, necessarily increase the welfare for a nation (Gupta and Gladwin 1992). Competitiveness across countries is complex because of the exchange rate, trade barriers, domestic policies, the social and political system, etc. Sharples (1990) indicated that international competitiveness is the result of the combined effect of market distortions and comparative advantage.

Economists use rather broad economic indicators to measure the competitiveness of agricultural commodities across countries. Sumner (1986), for example, investigated the competitive positions of several agricultural commodities using production indices such as the growth of labor and land productivity. Polopolus (1986) indicated that productivity growth is a primary consideration in maintaining a favorable competitive position. Sharples and Milham (1990) used export supply to investigate the long-run competitiveness of Australian agriculture. Andrew and Ethridge (1987) and Le Stum and Camaret (1990) used cost of production to evaluate the competitive advantage of cotton and wheat across countries. Cost of production is a leading indicator of competitiveness, although it is not a direct measure (Ahearn et al. 1990). Low costs and survival profits are essential for a firm to stay in business in a competitive market. Andrew and Ethridge (1987) further emphasized that the exchange rate should be considered in comparing production costs across countries because the purchasing power of one country’s currency for another country’s goods was affected by the exchange rate.

The intent of this study was not to determine the competitive position of American peanuts from all aspects comprehensively because marketing costs were not included in this analysis. Rather, using the most recent information, this study investigated the competitiveness of U.S. peanuts in terms of economic costs of production and net returns to management and risks both for the U.S. and for China.

The remainder of this study consists of five sections. The “Methods and Data Sources” section discusses the statistical tool, the procedures of compiling and processing data, and information sources. The “Costs and Returns in the Country” section discusses costs, returns, and historical changes in their original physical and monetary measures for each country and region, so that readers who have the background for China could examine the firsthand information. “Comparisons Between the Countries” focuses on the comparison and contrast of economic costs, land productivity, and returns using U.S. measurements. The section, “Competitive Position of Peanuts for the U.S.,” evaluates the competitiveness for U.S. peanuts, compared with China’s, in the international market. The last section summarizes the entire study and discusses the implications of the findings.

## Methods and Data Sources

A statistical test is appropriate for comparing and contrasting the economic costs and returns in peanut production between the U.S. and China. The statistical test provides more reliable evidence for the similarities and differences in peanut production. Conventionally, the comparison of means between two populations can be accomplished by a Student's  $t$  test, if the samples investigated are large and meet the normality assumption. A nonparametric statistical method was more appropriate to achieve the objective since there were only six years of information available. The Mann-Whitney test was chosen to conduct the comparisons. The hypothesis of comparing the means between two populations could be written formally:

$$H_0: E(X_{U.S.}) = E(X_{China})$$

$$H_1: E(X_{U.S.}) \neq E(X_{China})$$

where  $X$  represents either the total economic costs, a specific cost component, yield, or net returns. The null hypothesis says that there is no significant difference on average for  $X$  between the U.S. and China during the study period. If there are no identical observations (i.e., no ties) or a few identical observations (i.e., a few ties) in both samples, the Mann-Whitney test statistic equals the sum of the ranks assigned to the sample from the first population (i.e., the U.S.) as the following:

$$T = \sum R(X_{i,u.s.}),$$

where  $R$  represents rank and  $i$  denotes the  $i$ th observation in the U.S. for  $X$  (Conover 1980). A comparison of the calculated  $T$  with the corresponding quantile of the Mann-Whitney test statistic tabulated concludes the hypothesis test. If there are many ties, the formulation is modified by subtracting the mean from  $T$  and dividing by the standard deviation to obtain

$$T_1 = \frac{T - n \frac{N+1}{2}}{\sqrt{\frac{nm}{N(N-1)} \sum_{i=1}^n R_i^2 - \frac{nm(N+1)^2}{4(N-1)}}$$

where  $n$  is the sample size for the U.S.,  $m$  is the sample size for China,  $N = n + m$ , and  $\sum R_i^2$  is the sum of the squares of all  $N$  of the ranks or average ranks actually used in both samples. A comparison of  $T_1$  with the corresponding value in a normal distribution table determines the level of significance (Conover 1980).

Budgets were the means used to compile economic costs, yield, and returns of peanut production for the two countries. Total economic costs were separated into comparable cost components such as seed, fertilizer, chemicals, and labor. The items that were not comparable were combined into a special category: other expenses. Seed expenses reflect the costs of peanut seed used per acre. Fertilizer expenses measure the costs of fertilizers used for peanut production. Lime and gypsum expenses are included in fertilizer costs. Chemicals



consist of herbicides, insecticides, fungicides, and nematocides. Labor includes the labor paid and unpaid related to peanut production. The item of other expenses is a mixed category, which includes general farm overhead, custom operations, fuel, lube, electricity, drying, taxes, insurance, interest, etc. Yield measures how many pounds of peanuts are produced on per acre of land. Net returns to management and risks equal the difference of total production value minus total economic costs. All these items were estimated and tabulated in each country's own monetary measures. The items for China were then converted to U.S. values so that comparisons could be made.

Quota rent and land value were treated as separate cost components for the U.S. because there was no basis for the comparison across the countries. Cotton land rent was also used as a substitute to peanut land rent so that the impact of peanut land values associated with the government peanut program on the costs and returns could be examined for the U.S.<sup>1</sup> Quota rent does not exist for peanut production in China since China uses a "contract" system (semi-mandatory means) to control staple crop production, such as grain, cotton, and oilseeds. There is no farm land market available in China because land is not a private but a public property in the central planned economy. In the current system, farm land belongs to local communities called Zhu (i.e. group). A Zhu is the lowest farm production unit consisting of 30–40 households in the rural area. Any growers in the group are eligible to farm a certain number of acres of land. Farmers who use the land are obligated, however, to pay agricultural tax in kind and sell a certain amount of their products to the state government at regulated prices. Meanwhile, the government uses input subsidies, such as commercial fertilizers and improved seeds, as incentives to encourage more farmers to participate in government plans. Farmers can use their land, but they do not have the right to sell the land or rent it to anyone else. All the transactions among growers, group, and government are guaranteed by contracts.

Costs and returns of peanut production were examined both at the national and at regional levels between the two countries, respectively. The Southeast, including Georgia, Alabama, and Florida, was chosen as a special region for study because it is the major peanut-producing region for the U.S. peanut industry. The southeastern region produced 60.21 percent of U.S. peanuts during the 1992–94 period (U.S. Department of Agriculture 1995). The Shandong province was chosen in this analysis as a special region for China because it plays the same important role for China's peanut industry as the Southeast does for the U.S. Peanuts grown in Shandong accounted for 31 percent of Chinese peanuts during the 1991–93 period (China State Statistical Bureau 1992–1993). Furthermore, export peanuts were mainly produced in the southeastern region for the U.S. and in Shandong for China.

The data used in this study were collected from several sources. Economic costs and returns for the U.S. were collected from annual "Economic Indicators of the Farm Sector: Costs of Production" (U.S. Department of Agriculture 1988–1994). The data on Chinese peanut production costs and returns were collected from *China Agricultural Yearbook* (1988–1991) and *China Rural Statistics Yearbook* (1992–1993). Economic costs and returns for the Shandong province were primary survey data collected from the Shandong Agricultural Bureau. Six years of information (1988–93) were used in this study, since 1993 was most current and 1988 was the earliest for the primary data in the Shandong province. Exchange rates used to convert monetary values between the countries were based on the *International Financial Statistics Yearbook* published by International Monetary Fund

(1994). The conversion between acre and mou was based on the conversion factors published in *A New English-Chinese Dictionary* (1985). Peanut price reported in Rotterdam was considered as the reference peanut price in the world market. The conversion from the world shelled peanut price (i.e., Rotterdam price) to farmer stock price (i.e., in-shell peanut price) was based on the procedure established by the U.S. International Trade Commission.<sup>2</sup>

## Costs and Returns in the Country

### United States

Economic costs per acre for U.S. peanuts during the period 1988–93 averaged \$682.03 (table 1). Variable cash expenses represented 47.54 percent of the total economic costs. Quota rent was the largest single cost item and accounted for 16.77 percent of the economic costs. The composition of variable cash expenses shows the predominance of chemical costs, which accounted for 26 percent of variable cash expenses. While total costs per acre trended upward during the period 1988–91, due to large increases in seed and fertilizer expenses, costs per acre have declined since 1991. Quota rent remained relatively constant because there was no substantial change in government policy during the study period.

While yield per acre for U.S. peanuts averaged about 2,300 lbs. (table 1), it dropped substantially in 1990 and 1993, respectively, because of major weather fluctuations. The variation in yield per acre resulted in large swings in per pound costs for U.S. peanuts. Costs per pound reached as high as \$0.36 in 1993 and \$0.34 in 1990, due to the poor yield in those two years. While net returns to management and risk in peanut production were \$3.32/acre on the average during the study period, there were losses to peanut growers in 1991 and 1993.

Economic costs of southeastern peanuts averaged \$675.30 per acre (table 2), which was slightly lower than the costs at the national average during the period 1988–93. Variable cash expenses accounted for 48 percent of the total economic costs. Chemical costs ranked first (about 28.3 percent) in the variable cash expenses. While peanut quota rent remained relatively stable, peanut land value doubled between 1988 and 1993. The large increase in land rent during the study period was probably attributed partially to the statistical adjustment in the 1991 USDA peanut cost of production survey.

On average, yield was 2,338 lbs. per acre and economic costs were 29.60 cents per pound for southeastern peanuts. While costs per pound went up in the southeastern region from 1988 to 1991, the costs declined slightly from 1991 to 1993. Net returns to management and risks in the Southeast averaged \$12.07/acre during the study period, but southeastern peanut growers experienced losses in three out of six years if quota value and land rent were included in the economic costs.

### China

Economic costs of peanut production averaged 159.64 yuans/mou (i.e., Renmibi yuans per mou) (table 3) for China during the period 1988–93. Labor expenses on average amounted to 51.91 percent of the total economic costs. The large percentage of labor expenses in the economic costs suggests that China's peanut production was highly labor

intensive. Seed expenses represented 22.40 percent and fertilizer 12.58 percent of the total economic costs for Chinese peanut production.

**Table 1. Economic Costs and Returns of Peanut Production for the U.S., 1988–93**

Item	1988	1989	1990	1991	1992	1993	Average <sup>a</sup>
	\$/acre						
Variable cash expenses							
Seed	73.44	70.54	71.98	110.47	70.32	71.18	77.99
Fertilizer, lime, & gypsum	30.59	31.15	28.77	43.86	43.27	42.40	36.67
Chemicals	72.91	76.21	80.14	87.56	89.70	92.57	83.18
Custom operations	9.47	9.99	10.30	8.01	7.90	7.92	8.93
Fuel, lube, & electricity	33.72	36.56	38.64	38.02	35.06	26.78	34.80
Repairs	19.82	20.77	21.17	26.95	29.01	27.60	24.22
Hired labor	32.62	31.88	32.96	44.35	46.47	44.93	38.87
Drying	24.85	25.44	21.37	15.32	16.36	12.71	19.34
Other variable cash expenses	0.00	0.00	0.00	0.49	0.49	0.56	0.26
Subtotal	297.42	302.54	305.33	375.03	338.58	326.65	324.26
General farm overhead	33.71	32.51	37.63	23.98	24.30	19.92	28.68
Taxes & insurance	13.37	13.72	13.48	19.44	19.12	17.57	16.12
Capital replacement	51.51	53.82	54.91	44.74	49.16	46.41	50.09
Operating capital	8.23	9.64	9.23	10.20	6.04	5.10	8.07
Other non-land capital	11.91	15.20	16.82	22.12	25.40	23.97	19.24
Land value	63.79	64.90	68.90	88.57	92.58	97.77	79.42
Peanut quota rent	113.79	113.90	116.79	113.10	113.38	115.40	114.39
Unpaid labor	39.50	42.07	43.93	41.18	42.67	41.24	41.77
<b>Total</b>	<b>633.23</b>	<b>648.30</b>	<b>667.02</b>	<b>738.36</b>	<b>711.23</b>	<b>694.03</b>	<b>682.03</b>
Average yield (lbs/acre)	2427.30	2432.40	1954.70	2466.64	2575.74	1940.24	2299.51
Economic costs (¢/lb)	26.09	26.65	34.12	29.93	27.61	35.77	30.03
Production value (\$/acre)	695.66	679.53	695.41	697.23	753.66	570.58	682.02
Net returns (\$/acre)	62.43	31.23	28.39	-41.13	42.43	-123.45	3.32
Net returns (¢/acre)	2.57	1.28	1.45	-1.67	1.65	-6.36	-0.04

Source: U.S. Department of Agriculture. "Economic Indicators of the Farm Sector." Economic Research Service, 1988–93.

a. Due to rounding, the total in this column may not equal the summation of the column.

**Table 2. Economic Costs and Returns of Peanut Production for the Southeast, 1988–93**

Item	1988	1989	1990	1991	1992	1993	Average <sup>a</sup>
	\$/acre						
Variable cash expenses							
Seed	74.97	74.25	76.23	116.56	73.86	73.75	81.60
Fertilizer, lime, & gypsum	34.39	34.48	31.90	45.27	43.22	42.31	38.60
Chemicals	79.50	83.23	87.57	97.63	101.82	104.26	92.34
Custom operations	9.96	10.45	10.78	6.88	6.50	6.63	8.53
Fuel, lube, & electricity	32.16	35.70	35.94	31.98	29.84	22.49	31.35
Repairs	18.93	19.85	19.97	24.43	25.71	24.95	22.31
Hired labor	31.25	29.53	31.05	38.07	38.64	37.72	34.38
Drying	24.32	24.62	16.94	13.83	15.01	11.29	17.67
Other variable cash expenses	0.00	0.00	0.00	0.04	0.04	0.05	0.02
Subtotal	305.48	312.11	310.38	374.69	334.64	323.45	326.79
General farm overhead	36.17	34.88	40.37	19.58	19.36	15.95	27.72
Taxes & insurance	13.01	13.52	13.15	19.62	19.20	17.80	16.05
Capital replacement	50.70	52.83	53.35	34.59	36.39	35.32	43.86
Operating capital	8.84	10.41	10.02	10.19	5.97	5.05	8.41
Other non-land capital	11.41	14.52	15.87	17.77	19.62	19.00	16.37
Land value	52.98	49.96	44.14	94.74	96.36	110.43	74.77

**Table 2 (continued)**

Item	1988	1989	1990	1991	1992	1993	Average <sup>a</sup>
	\$/acre						
Peanut quota rent	122.46	122.58	125.69	118.89	119.45	124.24	122.22
Unpaid labor	36.07	38.24	40.67	39.67	40.75	39.29	39.12
Total	637.12	649.05	653.64	729.74	691.74	690.53	675.30
Average yield (lbs/acre)	2556.30	2561.00	1717.20	2485.58	2688.33	2019.92	2338.06
Economic costs (¢/lb)	24.92	25.34	38.06	29.36	25.73	34.19	29.60
Production value (\$/acre)	731.52	694.30	594.83	677.20	812.89	613.50	687.37
Net returns (\$/acre)	94.40	45.25	-58.81	-52.54	121.15	-77.03	12.07
Net returns (¢/acre)	3.69	1.77	-3.42	-2.11	4.51	-3.81	0.10

Source: U.S. Department of Agriculture. "Economic Indicators of the Farm Sector." Economic Research Service, 1988-93.

a. Due to rounding, the total in this column may not equal the summation of the column.

**Table 3. Economic Costs and Returns of Peanut Production for China, 1988-93**

Item	1988	1989	1990	1991	1992 <sup>a</sup>	1993 <sup>a</sup>	Average <sup>b</sup>
	Yuans/mou						
Seed	25.46	27.95	39.06	43.54	41.60	36.94	35.76
Fertilizer	15.37	17.32	22.29	21.26	23.47	20.84	20.09
Chemicals	1.59	2.38	3.69	3.42	3.27	2.90	2.88
Machinery	0.58	0.69	1.23	1.69	1.28	1.14	1.10
Animal forces	5.73	6.25	6.92	8.41	7.47	6.63	6.90
Irrigation	0.57	0.94	1.26	1.25	2.20	1.96	1.36
Labor	71.76	69.79	85.71	89.43	95.63	84.92	82.87
Other direct expenses	6.32	2.43	3.15	3.72	4.87	4.32	4.14
Share of farm expenses	1.50	2.00	2.17	3.34	2.84	2.52	2.40
Share of manage, expenses	1.05	1.86	2.04	3.03	2.56	2.28	2.14
Total	129.96	131.60	167.51	179.09	185.20	164.45	159.64
Average yield (kgs./mou)	168.88	144.72	134.08	164.17	170.46	144.46	154.46
Economic costs (fens/kg.)	76.95	90.93	124.93	109.09	108.65	113.84	103.35
Production value (yuans/mou)	210.51	241.62	253.90	301.61	293.63	266.31	261.26
Net returns (yuans/mou)	80.55	110.02	86.39	122.52	108.43	101.86	101.63
Net returns (fens/kg.)	47.70	76.02	64.43	74.63	63.61	70.51	65.80

Sources: *Agricultural Statistical Yearbook*, 1988-91, and China State Statistical Bureau, 1992-93.

a. Because of the statistical format change, there were only total, labor, and other costs available in 1992 and 1993. The rest of the cost items for the two years were derived from the previous five-year average.

b. Due to rounding, the total in this column may not equal the summation of the column.

Total economic costs per mou show an upward trend, with an increase of 26.54 percent from 1988 to 1993. The large increase in production costs was probably attributable to the increasing input prices caused by the high inflation rate in the recent years. Yield per acre for peanuts was 154.46 kgs. per mou and varied considerably with time during the study period. Costs per kilogram for Chinese peanuts trended upward, with an average of 1.03 yuans.

Economic costs of Shandong peanuts were 182.80 yuans/mou on the average (table 4), about 23 yuans higher than the national average. While labor costs were still the major cost component for Shandong peanuts, that category accounted for only 38.87 percent of the total economic costs. Shandong peanut growers appear to use more fertilizer and less labor than other growers nationwide.

**Table 4. Economic Costs and Returns of Peanut Production for Shandong, 1988–93**

Item	1988	1989	1990	1991	1992	1993	Average <sup>a</sup>
	Yuans/mou						
Seed	25.10	29.63	42.25	28.15	28.92	49.68	33.96
Fertilizer	18.24	22.57	26.28	45.65	49.12	71.60	38.91
Chemicals	8.14	6.20	10.27	7.30	6.68	10.96	8.26
Machinery	2.70	3.69	2.25	6.86	6.51	14.59	6.10
Animal forces	0.47	2.61	4.85	5.05	8.06	6.75	4.63
Irrigation	3.56	1.55	0.64	0.10	4.62	0.15	1.77
Labor	72.90	76.84	89.69	55.00	58.80	73.12	71.06
Other direct expenses	2.40	3.34	6.34	7.20	11.56	10.74	6.93
Share of farm expenses	1.97	1.86	2.87	2.43	2.60	11.03	3.79
Share of manage, expenses	1.80	1.49	1.97	6.27	10.26	22.54	7.39
<b>Total</b>	<b>137.28</b>	<b>149.78</b>	<b>187.41</b>	<b>164.01</b>	<b>187.13</b>	<b>271.16</b>	<b>182.80</b>
Average yield (kgs./mou)	175.00	190.26	228.04	223.00	169.00	263.00	208.05
Economic costs (fens/kg.)	78.45	78.72	82.18	73.55	110.73	103.10	87.86
Production value (yuans/mou)	228.40	287.66	323.29	309.66	241.79	606.04	332.81
Net returns (yuans/mou)	91.12	137.88	135.88	145.65	54.66	334.88	150.01
Net returns (fens/kg.)	52.07	72.47	59.59	65.31	32.34	127.33	72.10

Source: Unpublished survey data from Shandong Agricultural Bureau.

a. Due to rounding, the total in this column may not equal the summation of the column.

The costs per mou display an upward trend, with an increase of 97.52 percent between 1988 and 1993. Economic costs increased about 45 percent between 1992 and 1993 due to substantial increases in seed, fertilizer, machinery, and labor expenses. Other cost components were fairly stable during the study period, however.

Yield per acre was 208.05 kgs. per mou on the average, 54 kgs. higher than the national average during the study period. Higher yield resulted in low per kg. costs for Shandong peanuts. Net returns to management and risks for peanut growers were 150.01 yuans per mou, or about 48 yuans per mou higher than net returns at the national average (table 4).

## Comparisons Between the Countries

### U.S. vs. China

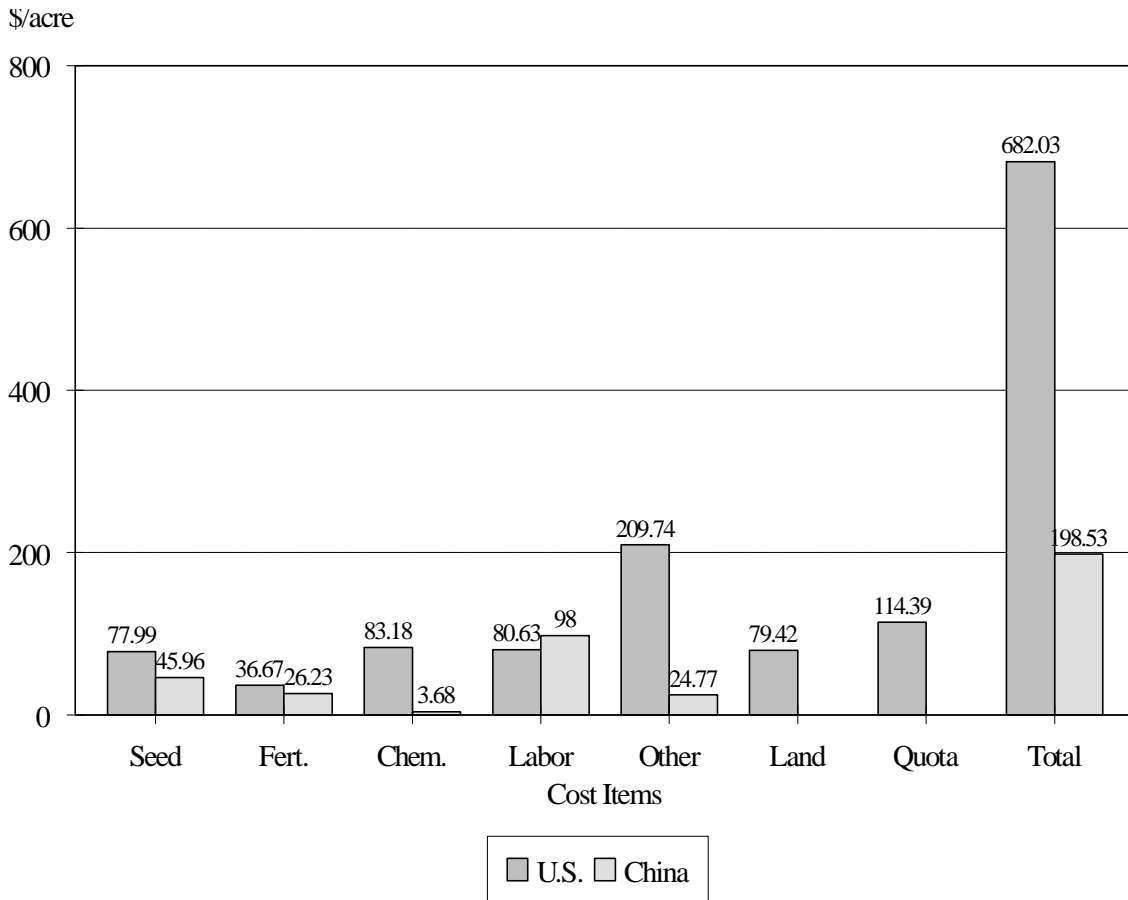
Economic costs per acre in peanut production were higher for the U.S. than for China during the 1988–93 period, and the difference of costs between the two countries was statistically significant at the one percent level of probability (table 5). Per acre peanut costs averaged \$682.03 for the U.S., while the costs were \$198.53 for China. The larger economic costs per acre for American peanuts were chiefly attributed to quota rent, land value, and other expenses. As discussed previously, quota rent and land value do not exist in China because of the central planned economic system. All cost components (i.e., seed, fertilizer, chemicals, and other expenses), except labor, in peanut production were significantly higher for the U.S. than for China on per acre basis (table 5 and figure 3). Percentage distribution of each cost component (excluding land value and quota rent) further illustrated the similarities and divergences of cost composition between the two countries



**Table 5. Comparison of Economic Costs and Returns in Peanut Production Between the U.S. and China, 1988-93**

Item	1988		1989		1990		1991		1992		1993		Average <sup>a</sup>		Test for Differences <sup>b</sup>	
	U.S.	China	U.S.	China	U.S.	China	U.S.	China	U.S.	China	U.S.	China	U.S.	China	Statistic	Difference
	\$/acre															
Seed	73.44	41.57	70.54	45.03	71.98	49.63	110.47	49.71	70.32	43.83	71.18	45.96	77.99	45.96	57	32.03*
Fertilizer	30.59	25.10	31.15	27.90	28.77	28.32	43.86	24.27	43.27	25.03	42.40	26.13	36.37	26.13	57	10.55*
Chemicals	72.91	2.60	76.21	3.83	80.14	4.69	87.56	3.90	89.70	3.40	92.57	3.68	83.18	3.68	57	79.50*
Labor	72.12	117.17	73.95	112.44	76.89	108.91	85.53	102.10	89.14	71.51	86.17	75.86	80.63	98.00	39	-17.37
Other expenses	206.59	25.77	217.65	22.81	223.55	21.30	209.27	24.48	212.84	41.43	188.54	12.82	209.74	24.77	57	184.97*
Subtotal	455.65	212.20	469.50	212.03	481.33	212.86	536.69	204.47	505.27	185.20	480.86	164.45	488.22	198.53	57	289.68*
Land value	63.79		64.90		68.90		88.57		92.58		97.77		79.42			
Quota rent	113.79		113.90		116.79		113.10		113.38		115.40		114.39			
Total	633.23	212.20	648.30	212.03	667.02	212.86	738.36	204.47	711.23	185.20	694.03	164.45	682.03	198.53	57	483.49*
Revenue	695.66	343.72	679.53	389.28	695.41	322.63	697.23	344.36	753.66	323.69	570.58	280.83	682.02	334.09	57	397.92*
Yield (lb/acre)	2427	2496	2432	2139	1955	1982	2467	2427	2576	2520	1940	2135	2300	2283	39	16.20

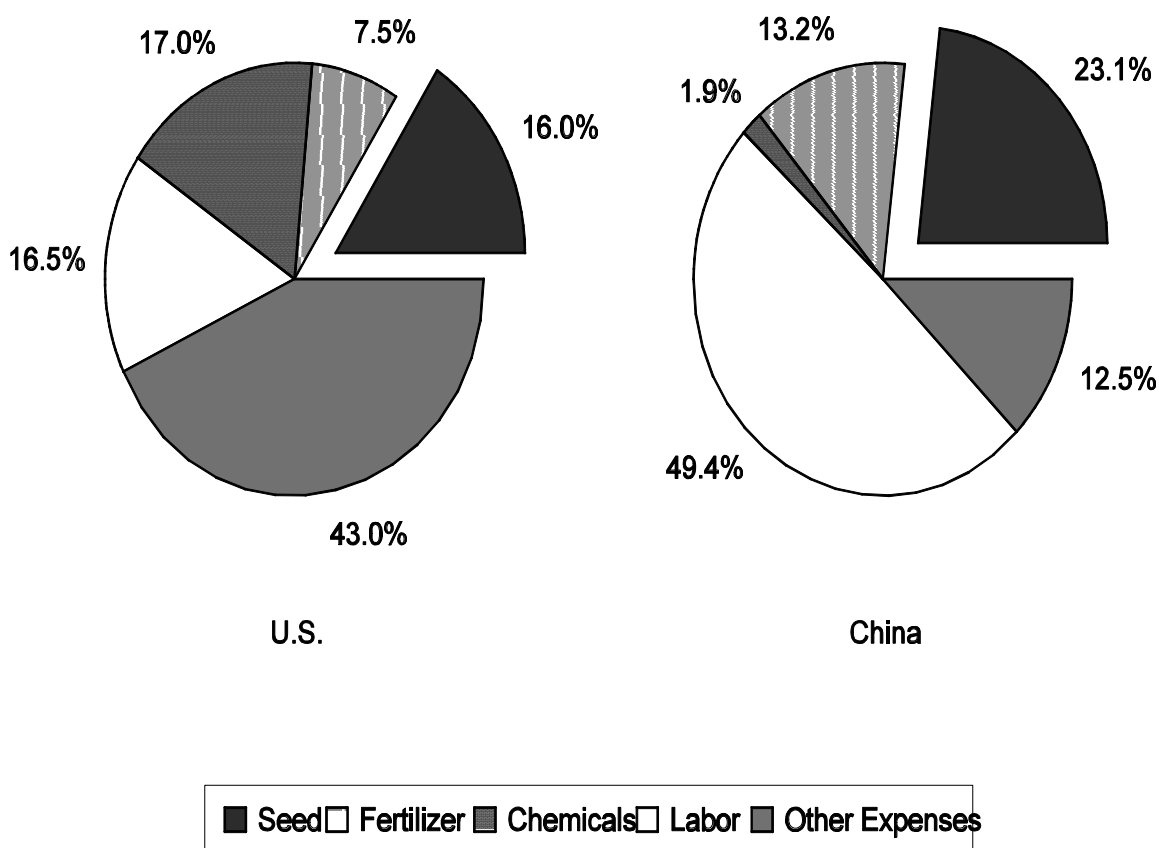
a. Due to rounding, the total in this column may not equal the summation of the column.  
 b. The Mann-Whitney test for the mean difference between the U.S. and China; "\*" indicates significance at the 1% level.



**Figure 3. Comparison of economic costs in peanut production between the U.S. and China (1988–93 average).**

(figure 4). Large other expenses for American peanuts resulted from the costs of using and maintaining peanut-farming equipment, such as the costs of fuel, lube, electricity, repairs, and capital replacement. Since modern farming equipment, such as combines and drying facilities, were not available, Chinese peanut growers used animals (e.g., cows and horses) to cultivate land. High labor-intensive farming practices and cheap labor sources resulted in low expenses in peanut production. The low expenses of seed, fertilizer, and chemicals for Chinese peanuts were also probably due to the abundant cheap labor sources. This is so because all production processes, including peanut planting, pest and disease control, fertilizer uses, and harvest, were performed manually.

Although there was a significant difference in per acre economic costs for peanut production between the U.S. and China, little difference was found for peanut yield. While yield per acre averaged 2,300 lbs. for the U.S., it was 2,283 lbs. per acre for China during the study period (table 5). It was not *a priori* expected that per acre yield for Chinese peanuts was nearly the same as that for American peanuts, given the low costs in Chinese peanut production. High per acre yield for Chinese peanuts might be due to Chinese traditional intensive farming practices. The fact that cultivated land is less than 0.3 acre per capita and less than 0.60 acre per rural labor for China (Colby, Crook, and Webb 1992) suggests that limited land forces farmers to use land in an extraordinarily intensive way.



**Figure 4. Comparison of percentage distribution for the cost components of peanut production between the U.S. and China (1988–93 average).**

High costs and similar yield for the U.S. resulted in high costs per pound for peanut production. Even without quota rent and land value, per pound economic costs were significantly higher for the U.S. than for China (table 6). While per pound cost was 21.48 cents for American peanuts, the cost was 8.77 cents/lb. for Chinese peanuts. If quota rent and land value were considered, per pound cost was 30.03 cents/lb. for American peanuts.

Returns (including peanut hay values) to farm management and risks in peanut production were greatly affected by land value and quota rent. If quota rent and land value were included in U.S. economic costs, there was no profit on average in peanut production for the U.S. over the study period. Net returns per acre in peanut production averaged \$135.57 less for the U.S. than for China (table 6). If quota rent was not included in U.S. economic costs, there was no significant statistical difference in net returns per acre between the two countries. A substitution of cotton land rent for peanut land rent in U.S. economic costs increased net returns by about \$23 per acre at the national average in the U.S. That is, there was about one cent/lb. difference in net returns due to land value difference between peanuts and cotton. Net returns were significantly higher, however, for American than for Chinese peanuts during the study period if both quota rent and land value were excluded in U.S. economic costs. Returns to management and risks on a per pound basis followed the same pattern as those on per acre basis.



**Table 6. Comparison of Economic Costs and Returns in Peanut Production Under Different Assumptions Between the U.S. and China, 1988–93**

Item	Average (1988–93)		Test for Difference <sup>a</sup>	
	U.S.	China	Statistical	Difference
<i>Production value</i>				
Production value (\$/acre)	682.02	334.09	57	347.92*
Production value (¢/lb)	29.85	14.74	57	15.11*
<i>Economic costs (¢/lb)</i>				
All <sup>b</sup>	30.03	8.77	57	21.30*
No quota (with peanut land) <sup>c</sup>	24.98	8.77	57	16.21*
No quota (with cotton land) <sup>d</sup>	23.99	8.77	57	15.22*
No quota & land <sup>e</sup>	21.48	8.77	57	12.70*
<i>Net returns (¢/lb)</i>				
All <sup>b</sup>	-0.18	5.97	21	-6.15*
No quota (with peanut land) <sup>c</sup>	4.87	5.97	41	-1.10
No quota (with cotton land) <sup>d</sup>	5.86	5.97	41	0.11
No quota & land <sup>e</sup>	8.37	5.97	50	2.40**
<i>Net returns (\$/acre)</i>				
All <sup>b</sup>	-0.02	135.55	21	-135.57*
No quota (with peanut land) <sup>c</sup>	114.38	135.55	41	-21.17
No quota (with cotton land) <sup>d</sup>	137.23	135.55	42	1.68
No quota & land <sup>e</sup>	193.80	135.55	50	58.25***

a. The Mann-Whitney test for the mean difference between the U.S. and China. "\*" indicates significance at 1% level; "\*\*\*" indicates significance at 5% level; and "\*\*\*\*" indicates significance at 10% level.

b. Both quota rent and peanut land value were included.

c. Quota rent and peanut land value were included

d. Quota rent was excluded, but cotton (instead of peanut) land value was included.

e. Both quota rent and peanut land value were excluded.

### Southeastern U.S. vs. Shandong

Economic costs, yield per acre, and net returns in peanut production were summarized in [table 7](#) for the major peanut-producing regions: Southeast in the U.S. and Shandong in China for the 1988–93 period. Per acre economic costs in peanut production were significantly higher for the Southeast than for Shandong. While other expenses, seed, and chemical costs were significantly higher for the Southeast than for Shandong, respectively, there was little difference in fertilizer and labor expenses in peanut production between the two regions in terms of monetary values ([table 7](#) and [figure 5](#)). The similarity and divergence for each cost component were further revealed by percentage distribution of each cost component (excluding land value and quota rent) during the study period ([figure 6](#)).

Yield per acre in peanut production was significantly different between the Southeast and Shandong at the five percent level of probability ([table 7](#)). While per acre yield averaged 2,338 lbs. for the Southeast, it was 3,075 lbs. for Shandong during the period 1988–93. The difference in per acre yield between the Southeast and Shandong is probably attributed to the drought in 1990 and 1993 in the Southeast. It may also be due to the high fertilizer

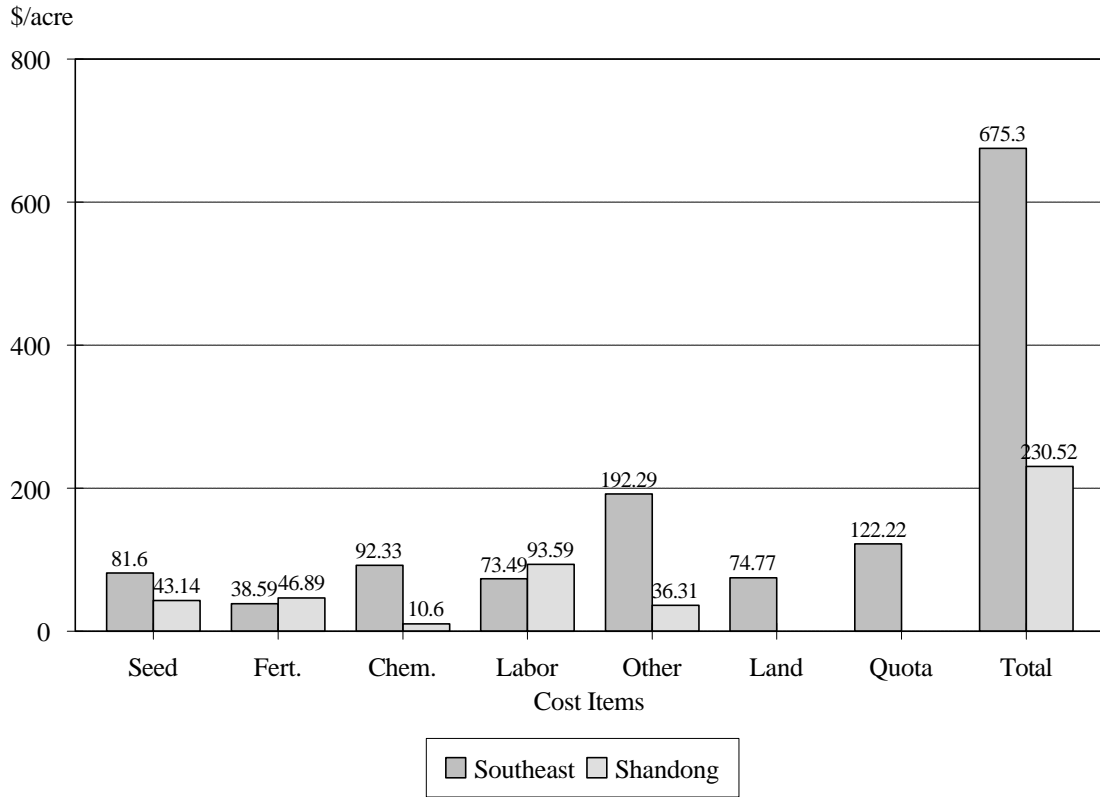


**Table 7. Comparison of Economic Costs and Returns in Peanut Production Between the Southeast and Shandong, 1988–93**

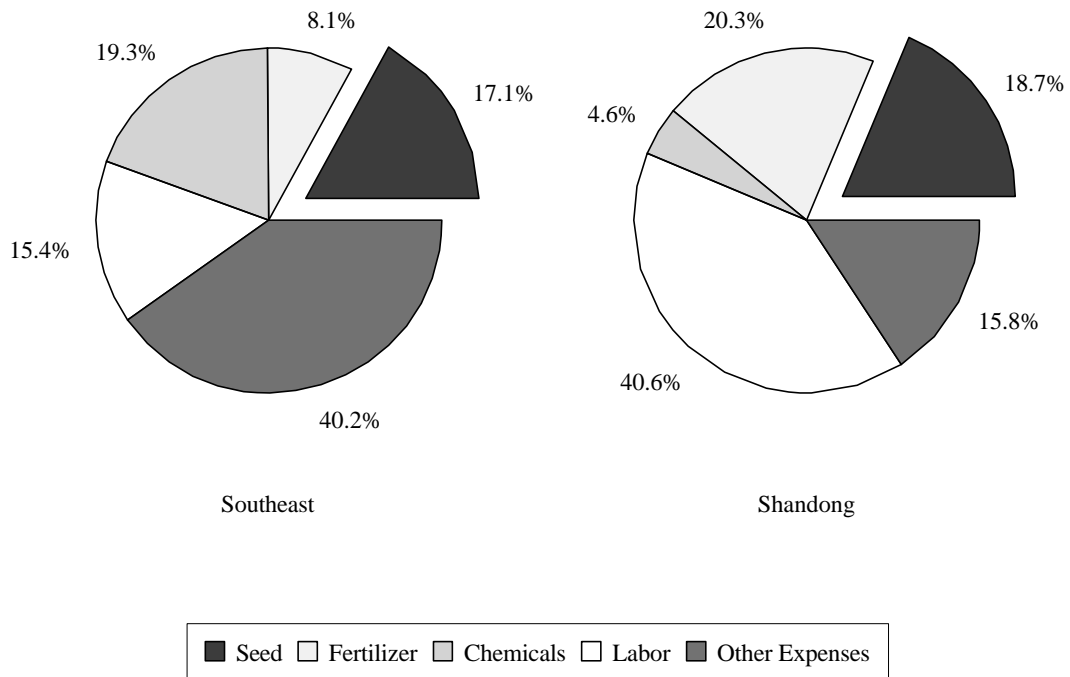
Item	1988		1989		1990		1991		1992		1993		Average <sup>a</sup>		Test for Differences <sup>b</sup>	
	Southeast	Shandong	Southeast	Shandong	Southeast	Shandong	Southeast	Shandong	Southeast	Shandong	Southeast	Shandong	Southeast	Shandong	Statistic	Difference
	\$/acre															
Seed	74.97	40.98	74.25	47.74	76.23	53.69	116.56	32.14	73.86	31.88	73.75	52.39	81.60	43.14	57	38.47*
Fertilizer	34.39	29.78	34.48	36.36	31.90	33.39	45.27	52.12	43.22	54.15	42.31	75.50	38.60	46.89	35	-8.29
Chemicals	79.50	13.29	83.23	9.99	87.57	13.05	97.63	8.33	101.82	7.36	104.26	11.56	92.34	10.60	57	81.74*
Labor	67.32	119.03	67.77	123.80	71.72	113.97	77.74	62.80	79.39	64.82	77.01	77.11	73.49	93.59	35	-20.10
Other expenses	205.50	21.06	216.78	23.43	216.39	24.04	178.91	31.87	177.64	48.07	158.53	69.39	192.29	36.31	57	155.98*
Subtotal	461.68	224.15	476.51	241.32	483.81	238.14	516.11	187.26	475.93	206.28	455.86	285.94	478.32	230.52	57	247.80*
Land value	52.98		49.96		44.14		94.74		96.36		110.43		74.77			
Quota rent	122.46		122.58		125.69		118.89		119.45		124.24		122.22			
Total	637.12	224.15	649.05	241.32	653.54	238.14	729.74	187.26	691.74	206.28	690.53	285.94	675.30	230.52	57	444.79*
Revenue	731.52	372.52	694.30	463.46	594.83	410.81	677.20	353.55	812.89	266.54	613.50	636.97	687.37	417.39	57	270.00*
Yield (lb/acre)	2556	2587	2561	2812	1717	3371	2486	3296	2688	2498	2020	3888	2338	3075	25	-737.41**

a. Due to rounding, the total in this column may not equal the summation of the column.

b. The Mann-Whitney test for the mean difference between the U.S. and China; \*\* indicates significance at the 1% level, and \*\*\* indicates significance at the 5% level.



**Figure 5. Comparison of economic costs in peanut production between the Southeast and Shandong (1988-93 average).**



**Figure 6. Comparison of percentage distribution for the cost components of peanut production between the Southeast and Shandong (1988-93 average).**

input and traditional labor-intensive farming practices in the Shandong province. Per pound economic cost of peanuts was significantly higher for the Southeast than for Shandong, even if quota rent and land value were excluded in the U.S. economic costs (table 8).

**Table 8. Comparison of Economic Costs and Returns in Peanut Production Under Different Assumptions Between the Southeast and Shandong, 1988–93**

Item	Average (1988–93)		Test for Difference <sup>a</sup>	
	Southeast	Shandong	Statistical	Difference
<i>Production value</i>				
Production value (\$/acre)	687.37	413.38	57	273.99*
Production value (¢/lb)	29.70	13.48	57	16.22*
<i>Economic costs (¢/lb)</i>				
All <sup>b</sup>	29.60	7.60	57	22.00*
No quota (with peanut land) <sup>c</sup>	24.22	7.60	57	16.62*
No quota (with cotton land) <sup>d</sup>	22.62	7.60	57	15.02*
No quota & land <sup>e</sup>	20.98	7.60	57	13.38*
<i>Net returns (¢/lb)</i>				
All <sup>b</sup>	0.10	5.88	23	-5.77*
No quota (with peanut land) <sup>c</sup>	5.48	5.88	37	-0.39
No quota (with cotton land) <sup>d</sup>	7.08	5.88	44	1.20
No quota & land <sup>e</sup>	8.72	5.88	50	2.84***
<i>Net returns (\$/acre)</i>				
All <sup>b</sup>	12.07	186.86	16	-174.79*
No quota (with peanut land) <sup>c</sup>	134.29	186.86	36	-52.57
No quota (with cotton land) <sup>d</sup>	172.00	186.86	37	-14.86
No quota & land <sup>e</sup>	209.06	186.86	40	22.20*

a. The Mann-Whitney test for the mean difference between the U.S. and China. "\*" indicates significance at 1% level; "\*\*\*" indicates significance at 5% level; and "\*\*\*\*" indicates significance at 10% level.

b. Both quota rent and peanut land value were included.

c. Quota rent and peanut land value were included

d. Quota rent was excluded, but cotton (instead of peanut) land value was included.

e. Both quota rent and peanut land value were excluded.

Net returns to management and risks in peanut production for the two specific regions show similar patterns, compared with those at the national level for the two countries. If quota rent and the value of peanut land were included in the economic costs, southeastern peanut growers made significantly lower net returns than Shandong growers. A substitution of cotton land rent for peanut land rent increased about \$38 in net returns per acre (i.e., about two cents/lb.). In the Southeast, peanut land on average had higher value than cotton land. If both quota rent and land value were excluded from the economic costs, southeastern peanut growers, however, made significantly higher net returns than the growers in Shandong.

### Competitive Position of Peanuts for the U.S.

The economic costs and returns in the domestic market to some extent reflected the competitive position of peanuts for the U.S. at the domestic level, compared with China. More information was needed, however, to conclude the competitive position for American peanuts in the international market because production value in peanut production was affected by government intervention. A comparison of economic costs and returns in the world market could reveal an unbiased position for the competitiveness of American peanuts, since the price at the international market is the one received by the peanut industry for exports.

In the international market American peanuts had significantly higher market value than Chinese peanuts in terms of shelled peanut price in Rotterdam. The prices published by *Public Ledger* show that shelled peanuts (40/50 runner for the U.S. and Hsu-ji 40/50 for China) averaged \$1,113.63/mt in the world market for the U.S. and \$901.00/mt for China during the period 1988–93 (table 9). Farmer stock prices (in-shell peanuts), however, converted from the world peanut prices (shelled peanuts) show little difference between the two countries during the study period. The divergence of statistical significance between the world prices and converted farm stock prices for the two countries was partially attributable to shelling and culling cost and the rate of culling.<sup>2</sup> Since both shelling and culling were performed manually in China, cost of shelling and culling would be lower and rate of culling would be higher in China than in the U.S. Consequently, there was no statistical evidence for the difference of converted farmer stock prices, even though world peanut prices were significantly different between the two countries.

**Table 9. Comparison of Net Returns Converted from Shelled Peanut Price in Rotterdam Under Different Assumptions Between the U.S. and China, 1988–93**

Item	Average (1988–93)		Test for Difference <sup>a</sup>	
	U.S.	China	Statistic	Difference
<i>World peanut prices</i>				
In Rotterdam (shelled/, \$/mt)	1113.63	901.08	57	212.55*
At farmgate (¢/lb)	24.83	23.91	32	0.92
<i>Economic costs (¢/lb)</i>				
All <sup>b</sup>	30.03	8.77	57	21.30*
No quota (with peanut land) <sup>c</sup>	24.98	8.77	57	16.21*
No quota (with cotton land) <sup>d</sup>	23.99	8.77	57	15.22*
No quota & land <sup>e</sup>	21.48	8.77	57	12.70*
<i>Net returns converted from Rotterdam price (¢/lb)</i>				
All <sup>b</sup>	-5.20	15.14	24	-20.34**
No quota (with peanut land) <sup>c</sup>	-0.15	15.14	24	-15.29**
No quota (with cotton land) <sup>d</sup>	0.84	15.14	27	-14.30**
No quota & land <sup>e</sup>	3.36	15.14	29	-11.38

a. The Mann-Whitney test for the mean difference between the U.S. and China. "\*" indicates significance at 1% level; "\*\*" indicates significance at 5% level.

b. Both quota rent and peanut land value were included.

c. Quota rent and peanut land value were included

d. Quota rent was excluded, but cotton (instead of peanut) land value was included.

e. Both quota rent and peanut land value were excluded.

Without quota value and land rent, net returns to management and risks at the national average were 3.36 cents/lb. for the U.S. and 15.4 cents/lb. for China, respectively (table 9). No statistical evidence was found, however, for the difference in net returns between the two countries.<sup>3</sup> If land value (no matter whether peanut or cotton land) was included in the U.S. economic costs, the difference of net returns to management and risks became significant between the two countries at the five percent probability level. Net returns in peanut production were lower for the U.S. than for China. Considering the two major peanut-production regions, no statistical evidence was found for the difference in net returns between the Southeast and Shandong if land value and quota rent were excluded in the economic costs of the U.S. (table 10). A significant difference in net returns to management and risks was found, however, in peanut production between the two regions if land value was included in the U.S. economic costs.

**Table 10. Comparison of Net Returns Converted from Shelled Peanut Price in Rotterdam Under Different Assumptions Between the Southeast and Shandong, 1988–93**

Item	Average (1988–93)		Test for Difference <sup>a</sup>	
	Southeast	Shandong	Statistic	Difference
<i>World peanut prices</i>				
In Rotterdam (shelled/, \$/mt)	1113.63	901.08	57	212.55**
At farmgate (¢/lb)	24.83	23.91	32	0.92
<i>Economic costs (¢/lb)</i>				
All <sup>b</sup>	29.60	7.60	57	22.00*
No quota (with peanut land) <sup>c</sup>	24.22	7.60	57	16.62*
No quota (with cotton land) <sup>d</sup>	22.62	7.60	57	15.02*
No quota & land <sup>e</sup>	20.98	7.60	57	13.38*
<i>Net returns converted from Rotterdam price (¢/lb)</i>				
All <sup>b</sup>	-4.77	16.31	21	-21.08*
No quota (with peanut land) <sup>c</sup>	0.61	16.31	25	-15.70**
No quota (with cotton land) <sup>d</sup>	2.22	16.31	28	-14.09***
No quota & land <sup>e</sup>	3.85	16.31	29	-12.46

- The Mann-Whitney test for the mean difference between the Southeast and Shandong. “\*\*” indicates significance at 1% level; “\*\*\*” indicates significance at 5% level; and “\*\*\*\*” indicates significance at the 10% level.
- Both quota rent and peanut land value were included.
- Quota rent and peanut land value were included
- Quota rent was excluded, but cotton (instead of peanut) land value was included.
- Both quota rent and peanut land value were excluded.

There was a divergence in net returns between the domestic and the international markets for these two countries. At the domestic level, peanut production was more profitable (2.40 cents/lb) in the U.S. than in China (table 6) if quota rent and land value were excluded in the U.S. economic costs, but it was more profitable (11.38 cents/lb) in China than in the U.S. in the international market (table 9). The divergence of net returns between the domestic and international market for the U.S. was due to the U.S. program and the differences of shelling and culling losses. The peanut program affected the net returns in U.S. peanut production because quota peanuts were historically priced higher in the domestic market than in the international market. The economic costs and returns

of American peanut production reported by U.S. Department of Agriculture were the mixtures of costs and returns for quota and additional peanuts. The U.S. peanuts in the international market were only additional peanuts. Since peanut production associated with quota generates larger profits than does additional peanuts for the U.S., the price difference between quota and additional peanuts resulted in the divergence of net returns between the domestic and international markets for the U.S. In addition, higher costs of shelling and culling and lower culling rate relative to mechanical processing for U.S. peanuts were also responsible for the difference in U.S. net returns between domestic and international markets in relation to China.

### **Summary and Conclusions**

The U.S. and China were not only major peanut producers but also major export competitors in the world. Losing shares in the world market and rapid trade liberalization for the U.S. in the recent years have raised concerns about the competitive position of U.S. peanuts in the world market. This study analyzed the economic costs, yield, and net returns in peanut production for the U.S. as compared with China in both the domestic and international markets in a free trade environment. Results revealed that cost structures of peanut production were different between the U.S. and China. U.S. peanut production was capital-intensive because of using and maintaining modern farming equipment, while Chinese peanut production was labor-intensive due to abundant and cheap labor sources. U.S. peanut growers tended to use more seed and chemicals, while Chinese peanut growers tended to use more labor and fertilizers. While yield per acre of peanut production was nearly the same at the national level between the two countries, it was significantly higher for Shandong than for the southeastern region.

Economic costs per acre in peanut production were significantly higher at both the national levels and specific regions for the U.S. than for China during the 1988–93 period. Even if quota rent and land value were excluded from U.S. costs, economic costs of peanut production were still significantly higher for the U.S. than for China because of the large expenses of using modern farming equipment in the U.S. The net returns to management and risks in peanut production was significantly higher for the U.S., however, than for China if quota rent and land value were not included in the U.S. economic costs. If land value was included and quota rent was excluded, little difference was found for the net returns between the two countries. If both quota rent and land value were included in the U.S. economic costs, net returns were significantly less for the U.S. than for China.

Although world shelled peanut price in Rotterdam was significantly higher for the U.S. than for China during 1988–93, there was little difference in farmer stock prices, converted from the world shelled peanut price, due to the differences in shelling and culling costs and culling losses. If land value and quota rent were not included in the economic costs for the U.S. peanut production, there was no statistical evidence for a difference in net returns between the two countries and between the two regions, respectively. If land value was included in the economic costs for the U.S., peanut production was more profitable in China than in the U.S.

All this taken together suggests that American peanuts were less competitive than Chinese peanuts in the international market in terms of costs and net returns to peanut

growers, given that Chinese peanut growers do not pay land and quota rents. The U.S. peanut industry, however, has competitive advantages over China's industry in the infrastructures of production, processing, and transportation. Most importantly, abundant land is the unique natural endowment for the U.S. peanut industry. China's industry has competitive advantages in "free land" (due to the social system) and cheap labor, but the increasing land conflict among grain crops, oilseed crops, and industrial uses is a major obstacle for China's agriculture, including the peanut industry. Furthermore, the lack of market force in China's land system may induce inefficiency in land utilization that will deteriorate the land issue for China's agriculture. It should be emphasized, however, that the economic costs were low for Chinese peanut production. As the world moves toward more free trade, improving production economic efficiency and reducing economic costs will be study topics for U.S. peanut growers and processors. The competitiveness of U.S. peanuts not only depends on high quality but also on low costs in peanuts and peanut products in the international market.

Precautions must be taken when accepting these results. The economic costs analyzed do not include marketing costs for peanuts because the information was not available for both countries. The infrastructure of peanut exporting, such as transportation facilities, marketing creditability, the stability of exchange rate, and trade barrier for China, would need to be considered. Also, the industrialization of China has significantly increased wage rates in the last couple of years, which will probably alter the peanut production cost. Further study is needed to evaluate comprehensively the competitive position of U.S. peanuts in the world market by including other peanut competitors such as Argentina.



### Endnotes

1. The U.S. peanut program, in a conventional belief, has increased peanut land value in recent years relative to other commodities' land value. The purpose of using cotton land rent as a substitute for peanut land rent in this analysis is to examine the impact of land rent associated to the peanut program on the costs and net returns in peanut production. Furthermore, cotton is the major alternative crop to peanuts.
2. The formula used to convert world shelled peanut price to farmer stock in-shell peanut price is as follows:

$$FSP = [P_R/2205 - (C_{sc} + C_s)](R_c)(R_h)$$

where FSP = Farm Stock Price (\$/lb),  $P_R$  = price in Rotterdam (\$/mt),  $C_{sc}$  = cost of shelling and culling (\$/lb),  $C_s$  = cost of shipping (\$/lb),  $R_c$  = rate of culling (%), and  $R_h$  = rate of hulling (%). For the U.S.  $C_{sc} = 0.0998$ ,  $C_s = 0.029$ ,  $R_c = 88\%$ , and  $R_h = 75\%$  based on the criteria established by the International Trade Commission. Since shelling and culling were performed manually in China, adjustments were made for the cost of shelling and culling and the rate of culling. Considering the manual harvest and cheap labor in China, it is reasonable to set  $C_{sc} = 0.051$  and  $R_c = 97\%$  and the other conversion factors equal between the two countries.

3. The Mann-Whitney test for the difference of means between two populations is relatively robust because ranks of the observations from two samples are used to compute the test statistic. If the observations in one sample are not consistently larger than the observations of the other sample, the difference of two means is usually not statistically significant, even though the mean of one sample is larger than the mean of the other sample.

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