Will Market Prices Enhance Chinese Agriculture?: A Test of Regional Comparative Advantage

Colin A. Carter and Fu-Ning Zhong

China is the world's largest producer and consumer of food. In the past, China's governmental policy advocated regional self-sufficiency in agricultural production, and it is generally believed that regional self-sufficiency was enforced at high economic cost. However, this changed with the 1979 economic reforms which encouraged some regional specialization. It is expected that there may be further shifts in regional production patterns and interregional trade flows. This article uses data on land productivity to test for regional comparative advantage, and it provides some empirical evidence on provincial comparative advantage in cotton versus grain production in China.

Key words: Chinese agriculture, comparative advantage.

In his book entitled *Getting Prices Right: The Scope and Limits of Agricultural Price Policy,* Peter Timmer stresses the fact that there are high payoffs associated with allowing markets to work in developing countries. His logic is indisputable, and in fact many developing countries are moving in the direction of market deregulation. The People's Republic of China is one prominent example. It accounts for about one-fourth of the world's poor and over the past decade has experimented with an open-market philosophy in the agricultural sector. In this article we hypothesize that "getting prices right" will lead to increased regional specialization in Chinese agriculture, and we provide some empirical evidence on how China's peasant farmers have responded to greater economic freedom.

China is the third largest country in the world, with a land area of approximately 9.6 million square kilometers. It has primarily a temperate climate, but since China encom-passes such a large area, climatic conditions vary across a wide spectrum. Given the variation in climate, topography, and soils, one would expect Chinese agriculture to be extremely diverse from region to region and from province to province. However, this is not the case. There has been very little regional specialization because past Chinese government policy advocated local self-sufficiency in almost every aspect of agricultural production.

China has a long history of self-sufficiency in nonagricultural as well as agricultural goods and as a country has never been trade oriented. This was true as far back as the feudal period. In modern China the Marxist ideology has been used by the country's leaders to emphasize the importance of self-reliance. International trade was viewed by the Chinese government as a method whereby rich countries could exploit poor ones. In many of his writings, Chairman Mao Tse-tung[1] stressed the point that a country's political independence is inseparable from its economic independence. As Shu-yun Ma succinctly stated:

Self-reliance was the guiding principle of China's foreign trade during Mao's era, upon which there had been no serious discussion among Chinese economists on inter-

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[1] Also spelled Mao Zedong.

national trade prior to the adoption of the open door policy. (p. 292)

The situation changed in 1979 and according to Ma, Chinese economists have come to accept the validity of the theory of comparative advantage. They recognize that the original Ricardian concept of comparative advantage was partially based on the labor theory of value and is thus not incompatible with Marxist ideology. Of course, this applies to regional trade within the country as well as to international trade.

It is generally believed that regional self-sufficiency in Chinese agriculture has been enforced at a very high economic cost. However, the 1979 economic reforms have moved Chinese agriculture in the direction of encouraging specialization through providing for market-determined resource allocation. If these reforms continue, industrial crops will be substituted for grain in those areas where grain yields have been relatively poor. It is expected that there may be significant shifts in regional production patterns and interprovincial trade flows. Increased specialization and trade in agriculture present enormous opportunities for economic gain in China (Anderson; World Bank 1985a). Some knowledge of the comparative advantage of each province or region would be useful for forecasting overall production and trade adjustments and for analyzing policy alternatives. We use data on land productivity to test for regional comparative advantage in Chinese agriculture and provide some empirical evidence on provincial comparative advantage in cotton versus grain production. The specific hypothesis tested here is that for a selected number of provinces in China, the ratio of sown areas of cotton to grain is determined by the expected ratio of yields and/or returns.

Theories of Comparative Advantage

Trade models are normally built to determine which goods a country (or region) will trade and why (Deardorff). The formation of trade flows is explained according to the law of comparative advantage, which states that a country (or region) will tend to export those goods which have the lowest relative costs (prices) in a closed economy. Trade models such as the Ricardian and Heckscher-Ohlin (H-O) then provide an

explanation for differences in "closed economy" prices.

The classical (Ricardian) theory of comparative advantage assumes one factor of production and predicts that relative productivity differentials will determine a country's (region's) specialization in production and its direction of trade. It asserts that the composition of trade is determined by international productivity differentials and this leads to differences in relative autarkic prices between countries. According to the theory, a country will specialize in the production of those goods which can be produced at a lower opportunity cost relative to other countries. A country or region will export (import) products for which the international price is higher (lower) than the domestic opportunity cost of producing an additional unit. This concept has been generalized under the modern H-O trade model, which suggests that resource endowments determine comparative advantage. Although these models have many restrictive assumptions, their basic tenet regarding the direction of trade remains sound. These theories can be applied to interregional trade, and in fact they may have more validity for trade between regions within a country since many of the assumptions may be more realistic in that context than for trade between two countries.

Specialization in Agriculture

There are relatively few studies available on comparative advantage in agricultural trade. Pearson and Meyer used the domestic resource cost approach and estimated the relative comparative advantage of African coffee growers. They argued that a country has a comparative advantage in exporting a commodity if the social opportunity cost of production is less than the border price. Pearson and Meyer computed country ratios of the opportunity costs of domestic factors used in each unit of production to the net foreign exchange generated per unit. They found Uganda, Ethiopia, and Tanzania to have a strong comparative advantage in coffee. The Ivory Coast was found to have a much weaker competitive position in coffee production.

A World Bank (1985b) report on China addressed the issue of provincial comparative advantage in industrial crops. This report measured the ratio of industrial crop yields to ce-

real grain yields in each province. The ratio was normalized by dividing it through by the same ratio of yields for the entire country. The resulting comparative advantage index (CAI) was calculated using one year's data and it was computed for seven different crops: groundnuts, sesame, rapeseed, cotton, jute, sugar cane, and tobacco. A cross-sectional correlation coefficient was then run between the CAIs and the actual sown-area percentages in each province. The correlation coefficients were compared to similar statistics for India. These results are shown in table 1, where it is clear the correlation coefficients tend to be higher for China than for India, except for jute and tobacco. The World Bank, therefore, concluded that provincial specialization in industrial crops according to comparative advantage was more characteristic of 1981 China than India in 1977/78. This was a surprising result because there are relatively few restrictions placed on Indian farmers in terms of which crops they are able to grow. However, the World Bank used only one year's data and the linear correlation coefficient estimates may not be accurate given that for some crops there were as few as nine observations.

In agriculture, if we are considering only crop production, the land productivity differential in terms of yield ratios among crops can be taken as the appropriate measure of comparative advantage. This is consistent with the H-O theory. As a matter of fact, unlike capital, land is a nonneutral input in crop growing. Differences in climate, topography, and soils result in deviations in the relative productivity of land in growing different crops. These differences may be viewed as different resource endowments in crop production. When the yield differential is taken as the empirical measure of the relative productivity of land, the existing skills of farmers are implicitly incorporated into the measure of comparative advantage (human resources). However, only yield-increasing human resources are included, and this approach does not capture other aspects of human resources.

The composition of trade flows has often been used in past studies as a measure of specialization. The composition of total output is parallel to that of trade flows in this respect. However, in agriculture the actual output or the composition of trade may not be the appropriate measure of specialization. Due to fluctuations in weather and other uncertain

Table 1. World Bank Measures of Comparative Advantage in China (1981) and India (1977/78)

	Correlation Coefficient	
	India	China
Groundnuts	.16	.23
Sesame	−.17	.33
Rapeseed	.22	.43
Cotton	.19	.42
Jute	.46	.45
Sugar cane	−.02	.54
Tobacco	.48	.15

Source: World Bank 1985b, p. 134.

factors, actual output differs from that expected or anticipated, and the latter is what is actually reflective of the observed comparative advantage. The expected output is proportional to actual sown area; in fact, the expected output is the product of the actual sown area and the expected yield. Therefore, the sown-area ratio, rather than output or trade composition, may best indicate the intended degree of specialization and trade. According to the theory, the sown-area ratio of different crops can be explained by the expected yield ratio. If output prices change over time or vary among regions, the sown-area ratio will be determined by the return ratio, which is the product of the yield ratio and the price ratio.

A major difficulty in testing the theory of comparative advantage in Chinese agriculture is the existence of the government's quantitative control over both the sown areas and the deliveries of major farm products to the state. If this government control is complete and does not take into consideration comparative advantage, the sown-area ratio may not have any relationship with the yield or return ratio. However, if we can identify a period in which peasants in some provinces had relative freedom in making decisions in this regard, it is possible to conduct empirical tests of the peasants' behavior.

China's Grain and Cotton Production

Grain and cotton are two major crops in China.[2] The sown areas of the two crops together

[2] In China's official statistics, "grain" includes rice, wheat, corn, soybeans, sorghum, millet, potatoes, and other coarse grains. Cot-

account for about 85% of the total national acreage. Both grain and cotton have been subject to delivery quotas since the early 1950s. Before 1979, compulsory sown-area plans were imposed to ensure that delivery quotas were met because the quota prices were not high enough to stimulate the desired output. As a result, peasants had no choice in land allocation. Following the economic reforms initiated in 1979, sown-area plans were abolished in favor of more local autonomy and improved economic efficiency. Grain and cotton purchasing prices were raised by a large margin (20% alone for grain in 1979). As a result, output of both grain and cotton increased very quickly in the early 1980s. At the same time, delivery quotas were reduced and a larger portion of the total delivery was purchased at a higher above-quota price. Because the pressure on the above-quota deliveries was not as great as that on quota deliveries, peasants who delivered above-quota quantities of grain and cotton were relatively free to make their own decisions regarding land allocation between the two crops. It is quite reasonable to assume that their actions would have responded to the productivity differential of their land.

It is also true that China's farmers are still not free to make decisions as they remain subject to procurement and "contracted purchasing" of quotas. However, they have obtained a significant degree of autonomy since 1979. Prior to the reforms, there were mandatory "sown-area plans" in addition to procurement quotas. Farmers had virtually no decision-making authority, because they were forced to follow the acreage plans even if they expected to make above-quota deliveries of grain and/or cotton to the state. Since 1979 they have only been subject to procurement on "contracted purchasing" quotas.[3] Under this policy, if they can produce more grain and/or cotton than called for under quota requirements, they are relatively free to make decisions regarding land allocation.

ton is considered an "industrial" crop. Additional industrial crops include peanuts, rapeseed, sesame, sugar, jute, hemp, tobacco, etc. The area sown in cotton is normally about one-fourth to one-third of the total industrial crop sown area.

[3] The quota procurement scheme was amended at the beginning of the 1985 crop year. The government introduced a new "contracting" arrangement for state grain purchases in place of the procurement quota system. In principle, the new system gave farmers more freedom to decide how much grain (or cotton) to sell to the state. In practice, the state continued to maintain control, and the new system does not differ significantly from the 1979 system it replaced (Tuan).

The size of the grain quotas has been reduced several times, hence the farmer's autonomy has increased. In 1984 the above-quota delivery of grain was about 70% of the total procurement for the whole country. This ratio was reflected in the lower 1985 "contract" price. Although the above-quota delivery of grain was encouraged and even required by the state, the quantities were much less restrictive. Therefore, the ratio of 70:30 provides an indication that farmers attained some degree of autonomy after 1979.

The case of cotton is somewhat different. The government was and still is the sole buyer of cotton. Farmers in some areas are free to decide on cotton acreage, but they must sell surplus output to the state. Just because they sell marketable surplus to the state does not mean the state dictates how many acres they must sow to cotton. The entire textile industry is supplied by the state so there is really no free market for cotton. Cotton producers normally keep only a small quantity for their own use (usually less than 5% of production). Prior to 1984, the above-quota delivery price was used by the state when necessary to give farmers an incentive to expand cotton production. When the government cut its cotton purchasing plan by about 25% in 1985, farmers reduced production. Technically, they were allowed to sell their surplus production in the free market, but actually there was no such market. According to Luo Wenpin,[4] the decrease in cotton production was planned in order to reduce government spending.

As mentioned above, regional specialization in Chinese agriculture has not developed along the lines suggested by the theory of comparative advantage. Lardy provides evidence to suggest there was some regional specialization in Chinese agriculture from 1949 through 1957, but this was limited to animal husbandry and economic crops. The policy was abandoned in 1965 in favor of one which stressed regional self-sufficiency in food grain production. As a consequence, meat and industrial crops could only be produced if there were surplus resources available (Lardy). The Chinese policy of regional self-sufficiency was clearly in line with Mao's objection to international trade. Mao argued that no province in China should

[4] See page 76, China's Agricultural Yearbook, 1986 (Ministry of Agriculture, Animal Husbandry, and Fisheries).

be dependent on other provinces for its grain supply (Lardy).

Provincial self-sufficiency objectives reduced the extent of interprovincial grain shipments in China. Lardy's figures showed total provincial grain exports declined from 7–8 million metric tons (mmt) (or 4.5–5.5% of production) in the 1950s to only 2–3 mmt (.8–1.1% of production) in the late 1970s. These figures are similar to Walker's. He estimated that interprovincial grain exports were about 10 mmt during most of the late 1950s and then declined to about 2.5 mmt by 1978.

With the implementation of the 1979 economic reforms, it was expected that interprovincial grain shipments would increase as there was some relaxation of the self-sufficiency policy. The World Bank estimated that interprovincial grain transfers were about 22 mmt in 1982.[5] Of this, an estimated 17 mmt moved by rail and 5 mmt by water. The North and Northeast regions imported rice and exported wheat and corn. Overall, the northern part of China is a grain importer and receives grain from all regions (World Bank 1985a). The East and South-Central regions are net exporters, while the West and Southwest regions are net importers.

Table 2 shows the quantity of interprovincial grain flows in the early 1980s. Figures are shown for both shipments and receipts by government agencies. The difference between imports and exports, through the state-planned grain marketing scheme, is representative of imports from abroad. According to these data, the quantity of total interprovincial grain transfers was about 14 to 17 mmt per year, which is lower than that estimated by the World Bank for 1982. It is interesting to note from table 2 that interprovincial transfers under state planning did not increase after the 1979 economic reforms. On the other hand, interprovincial grain transfers outside state planning increased from 1.9 mmt in 1980 to 5.1 mmt in 1985. Therefore, if increased specialization in grain production is the new trend, it is developing at a slow pace. These data in table 2

Table 2. Interprovincial Grain Transfers 1980–85

| Year | Through State Planned Purchases and Sales | | Through Bilateral Agreements Between Provinces at Negotiated Prices |
	Imports	Exports	Exports
	million metric tons		
1980	12.4	1.9	1.9
1981	12.3	1.3	2.9
1982	13.7	1.4	3.1
1983	12.3	1.0	3.0
1984	12.4	1.6	4.5
1985	n/a	n/a	5.1

Source: China's State Statistics Bureau, Beijing, unpublished data.
Note: State planned purchases and sales are shipped through interprovincial channels and are handled through the Chinese Ministry of Commerce. Exports are interprovincial exports sold to the Ministry of Commerce by an individual province. The difference between provincial exports and imports represents international imports.

on interprovincial shipments appear to contradict the World Bank results in table 1. The World Bank results implied the existence of regional specialization in Chinese agriculture. If this were the case, we would expect to see a significant amount of interprovincial trade, but this is not reflected in the data in table 2. This conflicting evidence is a clear indication of the need for further research on the topic of comparative advantage in Chinese agriculture.

Regional Comparative Advantage in Chinese Agriculture

In China the state is by far the largest buyer of farm products, especially in the case of grain and cotton. The purchase prices are set by the state and thus the "small" country assumption can be applied to each province. We express the comparative advantage of Chinese farmers in terms of land productivity—the yield ratio of different crops. If price changes are considered, the return ratio of different crops could be used instead. If a province has a relatively high cotton/grain yield ratio compared with other provinces, the theory predicts it will tend to specialize in cotton production and sell more cotton to the state. This is the hypothesis we wish to test.

Table 3. Ratios of Cotton/Grain Sown Areas and Yields

Prov-ince	Ratios	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Jiangsu	Yield	.229	.178	.216	.190	.207	.181	.167	.157	.161	—
	Area	—	.099	.104	.106	.105	.110	.092	.075	.084	.094
Henan	Yield	.153	.266	.216	.175	.254	.233	.225	.238	.252	—
	Area	—	.071	.071	.084	.085	.129	.090	.066	.077	.101
Hubei	Yield	.241	.185	.184	.156	.184	.263	.246	.235	.226	—
	Area	—	.111	.112	.109	.106	.102	.091	.081	.084	.089
Anhui	Yield	.126	.155	.159	.150	.180	.196	.192	.203	.209	—
	Area	—	.054	.055	.054	.053	.054	.040	.034	.036	.044

Source: Calculated from *China's Agricultural Yearbook,* 1980–88.

The ratio of sown areas of cotton to grain will be taken as the appropriate measure of specialization. In China there is a further reason not to expect complete provincial specialization in crops other than grain. Given the constraints on transportation and the politics between the central and provincial governments, each province is supposed to attain self-sufficiency if at all feasible. Hence grain production is dominant through all regions of China.

We selected grain and cotton for two reasons. First, they are the two major crops in China. Second, in the past they have also been major imports, and hence the production and sale of the two crops have been encouraged by the state. Of the 29 provinces in China, there are only nine provinces where the area sown to cotton exceeds 3% of the total area. However, five of these nine provinces, Hebei, Shanxi, Shandong, Shaanxi, and Xinjian imported grain during the period studied here. As each province is required to make an effort to achieve grain self-sufficiency,[6] these five provinces were not in a position to freely make decisions regarding the allocation of land among nongrain crops. Therefore, we chose the remaining four provinces of Jiangsu, Henan, Hubei, and Anhui for more careful study. These four provinces are all grain exporters. It is reasonable to assume that these four provinces are relatively free to make decisions concerning the areas sown to grain versus cotton given the relative land productivity, which is expressed in terms of their yield ratio (or return ratio). As the four provinces differ in size, the

ratio of sown area of cotton to grain will be used to measure the relative degree of specialization. Our working hypothesis is that the ratio of sown areas of cotton to grain is determined by the expected ratio of yields. The actual yield ratio in the previous year is taken as the proxy for the expected value.

Empirical Analysis

The period chosen was 1979–88 because of data availability and because it marks the dramatic change in government policy which took place in 1979. Before then direct planning was used to control the sown areas of major crops, and farmers were unable to respond to the comparative advantage embodied in land productivity. The introduction of the Production Responsibility System in 1979 has given farmers much more freedom to make production decisions.

Based on the sown area and yield (per sown hectare) ratios shown in table 3, two methods are used to test the hypothesis of production according to comparative advantage. The first method is the rank correlation test and the second uses linear regression. The Spearman rank correlation coefficient (Koutsoyiannis), r', is a measurement of the relationship between two variables, based on the observations' ranks rather than on their numerical values. The value of r' varies between -1 to 1. A value of 1 means perfect positive correlation, -1, perfect negative correlation, and 0, no correlation at all.

This measurement is justified on the assumption that if a province has a relatively high cotton/grain yield ratio in one year, it is likely to have a relatively high expectation of that ratio and hence a relatively high cotton/

[6] See "Grain Importing Provinces Symposium on Grain Production" in *China's Statistical Yearbook,* 1983, p. 315 (China's State Statistics Bureau).

Table 4. Ranks of Cotton/Grain Sown Areas and Yields

Province	Ranks	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Jiangsu	Yield	2	3	1	1	2	4	4	4	4	—
	Area	—	2	2	2	2	2	1	2	1	2
Henan	Yield	3	1	2	2	1	2	2	1	1	—
	Area	—	3	3	3	3	1	3	3	3	1
Hubei	Yield	1	2	3	3	3	1	1	2	2	—
	Area	—	1	1	1	1	3	2	1	2	3
Anhui	Yield	4	4	4	4	4	3	3	3	3	—
	Area	—	4	4	4	4	4	4	4	4	4

Source: Calculated from *China's Agricultural Yearbook,* 1980–88.

grain sown area in the following year. The corresponding ranks of yield ratio and sown-area ratio are likely to move in the same direction. The rank correlation statistic has some advantages over the linear correlation coefficient because it involves less restrictive assumptions on the data, and we are measuring the expected yield ratio which in some ways is a qualitative variable. The expectation is for either a "high" or "low" relative yield, and acreage will shift from grain to cotton where and when the expectation is for a relatively high cotton yield.

The ranks of the area and yield ratios of each province in each year are computed from the data in table 3 and are listed in table 4. The rank correlation coefficient is given by the formula shown below.

During 1979–84, the rank correlation coefficients were positive as expected. They were very high, 1, in two years and relatively low, .4, in three years. The average value was .6 for the first five years (i.e., 1979–84). Perfect positive correlation every year is not likely to exist for several reasons. Besides random disturbances, regional disparity in land productivity within a province, different cost ratios, and lagged processes are all relevant factors influencing production decisions. The ratio of expected yields is only one factor affecting changes

in the ratio of sown areas. From 1984/85 to 1987/88, only two out of four rank correlation coefficients were of the expected sign, and the average was close to zero. There was a major policy change which affected cotton acreage in 1984/85 which led to the negative coefficients. The overall 1979–88 average rank correlation coefficient was .4, which is of the correct sign but statistically insignificant from zero. The critical r' is .5 at a significance level of .10 (Conover).

Although the statistical results are weak (especially for the latter part of the period), these results suggest that if a province has relatively high land productivity in cotton production, it is likely that it will devote more farmland to cotton production. Since all provinces face approximately the same prices each year, the return ratio will provide the same ranks to each province as does the yield ratio. It is therefore unnecessary to consider the price changes in calculating the rank correlation coefficients.

A further test of regional comparative advantage is based on linear regressions. The annual percentage change in the ratio of sown area is used as the dependent variable upon which are regressed the percentage change in lagged yield ratios. A pooled time-series and cross-sectional model is used to maximize the

$$r' = 1 - \frac{6 \sum D^2}{n(n^2 - 1)},$$

where D is the difference between the two corresponding ranks, and n is the number of observations.

The estimated rank correlation coefficients are as follows:

Year	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88
r'	1.0	0.4	0.4	0.4	1.0	−0.2	0.4	−0.4	0.4

degrees of freedom. The first regression model is:

$$(1) \quad \dot{A}_{ij} = a_1 + a_2 D_2 + a_3 D_3 + a_4 D_4 + b\dot{Y}_{ij-1} + e_{ij},$$

where $\dot{A}_{ij}$ is the estimated percent change ratio of cotton to grain sown area in the ith province and the jth year; $\dot{Y}_{ij-1}$ is the actual percent change in the ratio of cotton to grain yield in the ith province and the $j-1$th year;[7] and D_i is a dummy variable, which equals one for the ith province and zero for the other provinces. The random disturbance term is e_{ij}. The provinces are considered in the same order as shown in table 3, and the dummy variable for Jiangsu province is left out of the regression.

Using the 1979–88 data in table 3, the OLS results are as follows:

$$(2) \quad \dot{A}_{ij} = .008 - .017D_2 - .018D_3$$
$$\quad\quad\quad (.13) \quad (-.19) \quad (-.21)$$
$$\quad\quad - .084D_4 + .338\dot{Y}_{ij-1}$$
$$\quad\quad (-.97) \quad\quad (2.21)$$
$$F = 1.53 \quad\quad R^2 = .17 \quad\quad DW = 1.66$$

The figures in parentheses are t-ratios.

The estimated coefficient associated with the yield variable is significant at the 5% level and this is of interest. This statistical result is not only stronger than that obtained from the rank correlation coefficient but also shows the numerical relationship between the area and yield ratios. It can be expected that, on average, if the yield ratio of cotton to grain in a province increased by 1%, the sown area would increase by .338% in that province in the following year. The insignificant coefficients of the dummy variables indicate that the intercept of the function does not vary from province to province.

Therefore, it may be concluded that if a province has a relatively higher yield ratio of cotton to grain, it is also likely to have a relatively higher sown-area ratio of cotton to grain. If a province's cotton yield increases faster than its grain yield, it is likely that its sown-area ratio of cotton to grain will increase over time.

Taking price changes into consideration, a similar regression model is estimated in which the independent variable is the return ratio,

rather than the yield ratio. The percent change in the return ratio, $\dot{R}$, is the product of the yield ratio and price ratio. The price ratio is the average price received and reported in *China's Statistical Yearbook* (China's State Statistics Bureau). This model gives the following results with 1979–88 data:

$$(3) \quad \dot{A}_{ij} = .01 - .018D_2 - .022D_3$$
$$\quad\quad\quad (.17) \quad (-.20) \quad (-.25)$$
$$\quad\quad - .087D_4 + .289\dot{R}_{ij-1}$$
$$\quad\quad (-.99) \quad\quad (1.99)$$
$$F = 1.28 \quad\quad R^2 = .15 \quad\quad DW = 1.72$$

where $\dot{R}_{ij-1}$ is the annual percent change in the cotton-to-grain return ratio in the ith province and $j-1$th year, and where all other variables have the meanings stated previously.

This model indicates that when prices are changing over time, the comparative advantage of a province in cotton or grain production can be expressed in terms of the return ratio. With this model, both the relative physical productivity of land and the relative prices will determine a province's comparative advantage over time. The changes in relative yields and the changes in relative prices are both important in allowing each province to make decisions regarding the allocation of its fixed arable land between cotton and grain production.

As the return here is the product of yield and price, it does not take into consideration the different costs among provinces and the different prices for different grain crops. Because of data restrictions, net returns could not be used as an indicator of land productivity. If the data on cost structures and prices for different grains become available in the future, a more precise study would be possible.

The Cotton Purchasing Policy and the Implications for Sown Area

During the 1979–84 period, the Chinese government lifted direct controls on crop sown area and used price incentives to encourage both cotton and grain production. The relative price was in favor of cotton and its sown area, and output increased much faster than that for grain. In the five-year period, the cotton sown area increased by 53.4% and output by 183.6%, compared with a 5.4% decrease in grain area sown and a 22.6% increase in grain output. The increase in cotton sown area varied from

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[7] As an alternative to using a one-year lagged change in yield as an explanatory variable in equation (1), we tried using a lagged two-year moving-average change in yield. However, the statistical results were not as good as reported in equation (2).

province to province: 22.5% for Jiangsu, 109.4% for Henan, −6.8% for Hubei, and 11.6% for Anhui. This indicates that cotton producers responded not only to the more favorable price but also to their own comparative advantage.

As consumption and exports of cotton products experienced only moderate growth, the Chinese government acquired large cotton stocks during this period. These stocks not only enabled China to cut its cotton imports by 84.5% in 1984 over 1983, but also forced China to reduce domestic cotton production substantially.

For political reasons the Chinese government could not reduce the cotton purchasing price in order to discourage cotton production. Instead, it cut cotton procurement quantities through reducing "contracted" purchasing quotas. As there were no other market outlets available, Chinese farmers had to reduce their cotton sown area in accordance with the quota. The data show that decreases in cotton sown area in 1985 over 1984 were 17.9% in Jiangsu, 13.8% in Henan, 31.7% in Hubei, and 19.6% in Anhui.

It is reasonable to expect that had the reduced acreage been encouraged by price changes, farmers would have responded according to their comparative advantage as they did when prices increased. It is also reasonable to assume that either price changes or selective purchasing quotas could have resulted in the same total acreage levels. These selective quotas could be implemented if the government wished to maximize social welfare through exploitation of provincial comparative advantage.

However, when 1984/85 through 1987/88 data are applied to the rank correlation test, the estimated coefficients turn out to be low or negative, indicating low correlation between the yield ratio and the sown-area ratio. This result suggests that when the Chinese government imposed the lower cotton purchasing quotas in 1985, regional comparative advantage was not used as a major criterion.

Summary

In this article land productivity was suggested as a measure of comparative advantage in Chinese agriculture. Provincial data were used to test the well-known hypothesis that regions will tend to specialize in the production of that commodity where comparative advantage lies. The empirical results indicate that the level of Chinese regional specialization in cotton and grain responded according to comparative advantage during the 1979–84 period when farmers were given the freedom to make decisions. However, for cotton there was a marked departure in 1985 when all of a sudden farmers had less freedom to make production decisions. These results suggest the basic principle of comparative advantage could take hold and lead to regional specialization in Chinese agriculture because farmers will respond if they are given the opportunity. However, if China is to realize gains from increased regional specialization and trade, additional investment in infrastructure, particularly in transportation, will be required.

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