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The emergence of agricultural commodity markets in China

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Abstract

By conscious design, reformers in China only gradually focused their efforts on expanding the role of markets for the allocation of goods and services in the economy. As a result, markets—especially in the agricultural sector—developed slowly. Throughout the 1990s there was a heated debate about the degree to which markets had emerged. The main goal in this paper is to bring together a number of simple and revealing facts on the emergence of China's markets. To do so we examine several sets of price data and analyze spatial patterns of market prices contours over time and text the extent to which market prices are integrated among China's regions. According to our analysis, we find that to a remarkable degree, agricultural commodity markets have emerged; price patterns look much like those in market economies in the rest of the world and prices are highly integrated across space.
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Although the initial reforms in China and other successful transition nations centered on improvements to property rights and transforming incentives (Fan, 1991; Lin, 1992; McMillan, Whalley, & Zhu, 1989), the other, equally important task of reformers was to create more efficient institutions of exchange (McMillan, 1997). Markets—whether classic competitive ones or some workable substitute—increase efficiency by facilitating transactions among agents to allow specialization and trade and by providing information through a pricing mechanism to producers and consumers about the relative scarcity of resources. But markets, in order to function efficiently, require supporting institutions to ensure competition, define and enforce contracts, ensure access to credit and finance and provide information (McMillan, 1997). These institutions were

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either absent in the Communist countries or, if they existed, were inappropriate for a market system. In assessing the determinants of success and failure of 24 transitions during their first decade of reform, Rozelle and Swinnen (2004) demonstrate that improved institutions of exchange were absolutely essential for nations to make progress. A study by de Brauw, Huang, and Rozelle (2004) has shown the positive effect that market development had on the efficiency of China's agricultural producers and their welfare during the 1980s and early 1990s. Continued success of transition nations during the second decade of reform and beyond almost certainly also will depend on continued market development. Somewhat surprisingly, despite the importance of market performance in the reform process there is little empirical work on the success that China (or any other transition nation) has had in building markets.

In part in response to the lacunae of research on the performance of markets in China's rural economy, our main goal is to bring together a number of simple and revealing facts on the emergence of China's markets. To do so we will have two specifics objectives. First, after briefly documenting the market-reform policy environment that has unfolded during the reform era, we examine several sets of price data by looking at spatial patterns of market prices contours over time. Second, we examine the extent to which market prices are integrated among China's regions.

In order to examine such a broad topic, it is necessary to limit the scope of the analysis. To do so, we restrict ourselves to China's main staple commodities—rice, maize and soybeans. These commodities —especially maize and soybeans—are ideal since the quality differences among regions are relatively narrow, a characteristics that facilitates integration analysis. Data on these commodities are available over time and across space. Data quality, however, restricts most of our analysis to after mid-1990s.

1. Commodity price and marketing policies

Although ever since the start of transition in the late 1970s China's leaders pursued price and marketing reform with different degrees of enthusiasm, there has been a steady shift towards more liberalization (Huang, Rozelle, & Chang, 2004). The key characteristic of the reform strategy, however, was gradual. For example, the initial price and market reforms in the late 1970s were aimed only at raising farm level procurement prices and gradually liberalizing the market. These reforms included gradual increases in the agricultural procurement prices toward market prices and reductions in procurement quota levels. In the initial years, however, there was little effort to move the economy to one in which resources and factors were allocated according market price signals.

As the right to private trading was extended to include surplus output of all categories of agricultural products after contractual obligations to the state were fulfilled, the foundations of the state marketing system began to be undermined (Sicular, 1995). After a record growth in grain production in 1984 and 1985, a second stage of price and market reforms was announced in 1985 aimed at radically limiting the scope of government price and market interventions and further enlarging the role of market allocation. Other than for rice, wheat, maize and cotton, reformers gradually began to eliminate planned procurement; government commercial departments still existed, but they could only continue to buy and sell at the market. For grain, incentives were introduced through the reduction of the quota volume and increase in procurement prices. In subsequent years, although mandatory procurement of rice, wheat, maize, soybean, oil crops and cotton continued, to provide incentives for farmers to raise productivity and to encourage sales to the government, quota procurement prices were raised over time (Huang et al., 2004).

True to the spirit of gradualism, as grain production and prices stabilized in the early 1990s, plans to abolish the grain ration system led a new round of reform (Rozelle, Park, Huang, & Jin, 2000). Urban officials discontinued sales at ration prices to consumers in early 1993. Although the

state compulsory quota system was not eliminated, in most parts of China in the mid-1990s, leaders once again lowered procurement level. The share of grain compulsory quota procurement in total production was kept only at 11% in 1995–1997. Local government grain bureaus and stations were encouraged to trade on their own accounts as way to increase the marketing of agricultural commodities and increase the incomes of grain bureau officials (Park & Rozelle, 1998). Moreover, despite the announcement of seemingly, retrenchment-oriented polices, such as the "Rice Bag" responsibility system, at the local level private traders emerged as an economic force that was difficult, even with considerable policing effort, to suppress. In fact, it was documented that a great number of efforts to restrict the flow of grain were not successful (Park, Jin, Rozelle, & Huang, 2002). Market flows continued as the share of total government procurement in domestic production fell; trade was driven by the profits that traders could earn by shipping grain from low to high priced areas (Huang et al., 2004).

In the early 2000s, marketing reforms were once more launched (Huang et al., 2004). Restrictions on marketing were removed. New efforts to commercialize the grain bureau were begun. Government intervention in grain prices (that had been given to farmers in certain regions of the country) was eliminated. In short, a new effort was made to push the policy environment to be even more market-oriented. Hence, while it took more than 20 years to achieve, gradually China's policy environment became one that condoned the market and sought to influence production primarily through the signal generated by market prices. What is unclear, however, is how effective the policy were in creating a functional market system—one that was relative efficient and integrated. It is to this question that we turn to in the rest of the paper.

2. Data

To assess the nature of China's markets in the last 10 years, we use data from a number of different sources. First, we use a set of price data collected by China's State Market Administration Bureau (SMAB—*dataset 1*). Nearly 50 sample sites from 15 of China's provinces report prices of agricultural commodities every 10 days. This means there are 36 price observations available for each market site for each commodity each year. The prices are the average price of transactions that day in the local rural periodic market. The Ministry of Agriculture assembles the data in Beijing and makes them available to researchers and policy makers. Unfortunately, after 2000, the quality of the data has deteriorated (which we, fortunately, do not have to depend on, since other data sources—discussed below—are available).

Using the SMAB data, we can examine rice, maize and soybean prices from 1996 to 2000 (except for maize that was only available through 1998). The three crops are produced and consumed in nearly every province in China. Rice price data are available for 31 markets. Because of quality differences among rice varieties in different regions of China, we look at price integration among markets within four regions, South China (South), the Yangtze Valley (YV), the North China Plain (and northwest China-NCP) and Northeast China (NE). [1] For the provinces included in the sample, rice prices are available for over 90% of the time periods. Prices for maize and soybean data are available for 13 and 20 markets, respectively. [2] Product homogeneity in the

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[1] Park et al. (2002) have a complete explanation of the nature of China's rice economy and the quality differences that exist among the different regions. We follow their regional breakdown in our analysis.

[2] Since we use data over time, we need to convert prices to a real basis. Nominal prices from our dataset are deflated using monthly consumer price indices calculated and reported by the China National Statistical Bureau. Deflation facilitates transaction cost comparisons across time and allows us to disregard transaction cost increases within periods associated with inflation.

case of maize and soybeans makes it possible to examine price integration among markets across a broader geographic range. We compare our results for the late 1990s (1996 to 2000) to results from 1988 to 1995 that were produced with the same data and published in Park et al. (2002). [3]

The second source of data on China's domestic market (*dataset 2*) comes from a price dataset collected by the Jilin Province Grain and Oil Information Center (GOIC). For maize, on a weekly basis between August 10, 1998 and February 24, 2003, prices are reported for 15 of China's main maize production and consumption provinces, including Heilongjiang, Jilin, Liaoning, Hebei, Shandong, Jiangsu, Zhejiang, Shanghai, Hubei, Sichuan, Hunan, Fujian, Guangdong, and Guangxi. Since September 7, 1998, there is a price from Liaoning for Dalian, the main port from which exports to foreign and other domestic markets (by ship) leave.

To examine maize markets in the northeast regions of the country and between major producing and consuming regions of the country in the post-WTO accession period, we use another set of data collected by the Jilin Province GOIC (*dataset 3*). The data in this dataset were first available after October 26, 2001; they continue through February 25, 2003. This dataset is more detailed than data in dataset 2 for two reasons. First, it is more spatially disaggregate. The dataset includes prices from three markets in Heilongjiang; three markets from Jilin; three markets from Liaoning (including two in production regions and Dalian); and market sites in Guangdong, Fujian, Jiangsu and Hubei. Dataset 3 also reports data more frequently, typically twice a week (every third day, then every fourth day).

The data from the Jilin Grain and Oilseed Price Information Center (datasets 2 and 3) appear to be of relative higher quality compared to the price series in dataset 1. For example, there are fewer missing observations. There are also relatively few inconsistencies in the data. In dataset 1, corrections frequently need to be made to the data to account for missing observations and to adjust for prices when they are written down in price "per jin" although the data category is supposed to be price "per kg".

The soybean data come from the same source, the Jilin Provincial GOIC, but are collected a bit differently (*dataset 4*). Soybean data are only available on a monthly basis. There are data for 20 markets. Similar to the maize data in datasets 2 and 3, the soybean data series are complete and overall the quality of the data appears to be high.

3. Price trends and spatial patterns of market emergence

In this section, we use our price data to sketch a descriptive picture of China's agricultural markets. To do so, we first plot the data over time and examine how prices move together in markets in the same geographic region and in markets separated by long distances. Next, we examine how price data points from different markets across space (but during the same time

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[3] To produce the results, we run cointegration tests on the each pair of markets using the data for each year. So, in other words, we use 36 observations (since the price data are available every 10 days) and count the number of pairs of markets that are cointegrated in a statistically significant way (see next Footnote 4 and text for explanation of testing). For example, for the case of soybeans, for the late 1990s (1996 to 2000), this means that we are examining the extent of integration between 190 (20 * 19/2) pairs of markets in each of 5 years, which equals a total of 950 pairs of markets. Hence, since we found that prices in 646 markets were integrated (according to the testing procedure), we report that 68% of markets are integrated in the late 1990s. Since we only use 36 observations per test, and since cointegration tests typically perform better with longer time series, by splitting our data into annual increments, we are biasing the results against accepting integration. We do this in order to make our analysis comparable to Park et al. (2002) which follows a similar procedure.

period) relate to one another graphically (which is done by tracing out transportation gradients in China's rice, maize and soybean markets). To put the results in perspective, we examine these over time and compare those of China with those of the US. Our assumption is that if prices in markets in different parts of China move together and if they create spatial patterns similar to those found in more market-oriented economies (like the US), then our data are suggesting that China's markets are becoming increasingly integrated and efficient.
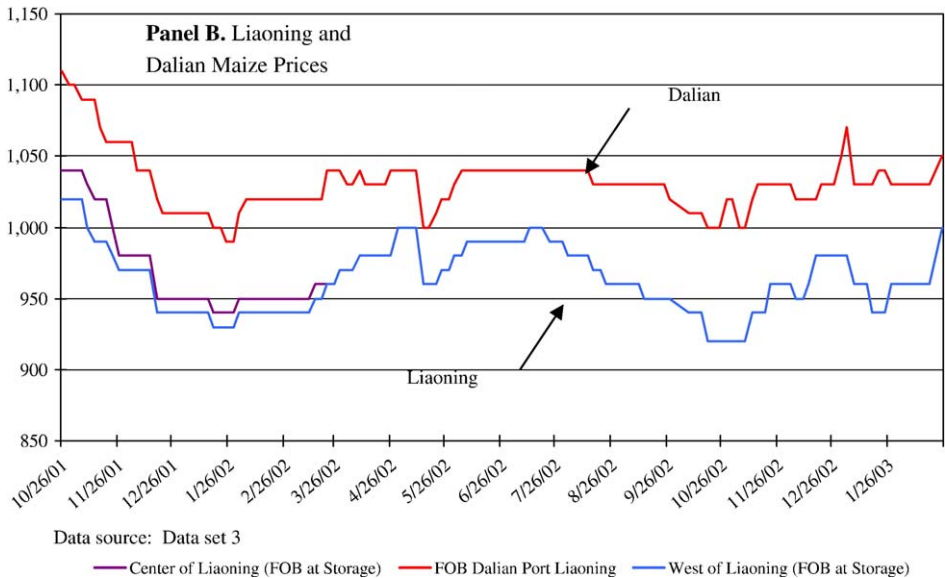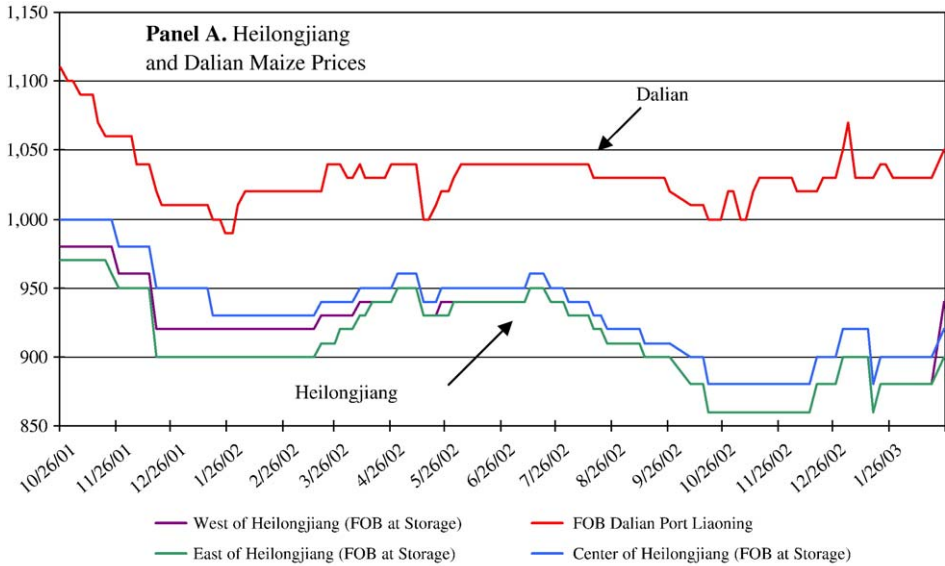
Fig. 1. Maize prices in Heilongjiang, Liaoning and Dalian (RMB/mt), October 2001 to February 2003.

3.1. Price trends

3.1.1. Maize

Using dataset 3, it can be shown that prices in different markets closely track one another in Northeast China (Fig. 1, Panels A and B). In Panel A we plot the Dalian domestic price versus the prices in the three Heilongjiang market sites (chosen because they are the furthest Northeast markets from Dalian). While varying over time, the Dalian domestic price remains between US $120/mt and US$130/mt from December 2001 to February 2003. During the same period, the prices in each of the three Heilongjiang markets move almost in perfect concert with one another; maize prices in Heilongjiang are around US$110/mt to US$115/mt. Most importantly, visual inspection shows that although the market in Dalian and those in Heilongjiang are more than 1000 km apart and prices vary by US$12/mt to US$17/mt, the prices in many periods are moving together. When the prices in Dalian move up (down), the prices in Heilongjiang tend to move up (down).
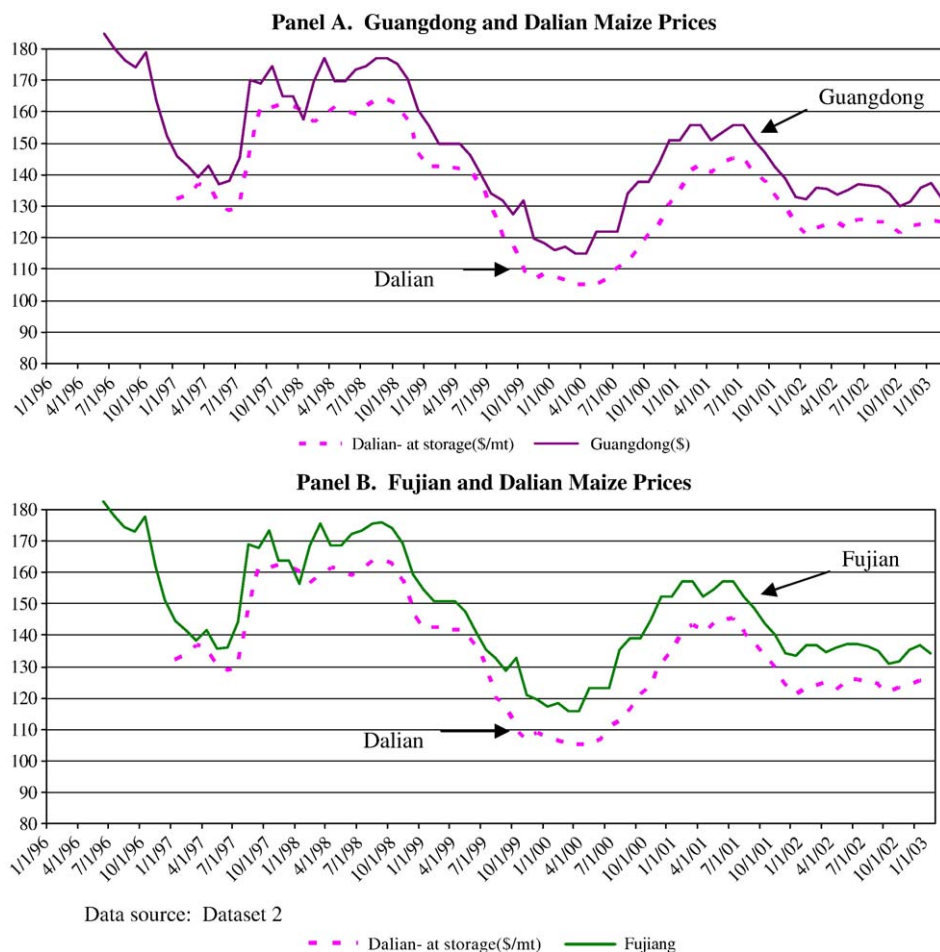

Fig. 2. Maize prices in Guangdong, Fujian and Dalian (RMB/mt), 1996 to February 2003.

Panel A. Jilin, Heilongjiang and Shanghai Soybean Prices

Panel B. Guangdong, Shanghai and Jiangsu Soybean Prices

Guangdong, Shanghai and Jiangsu
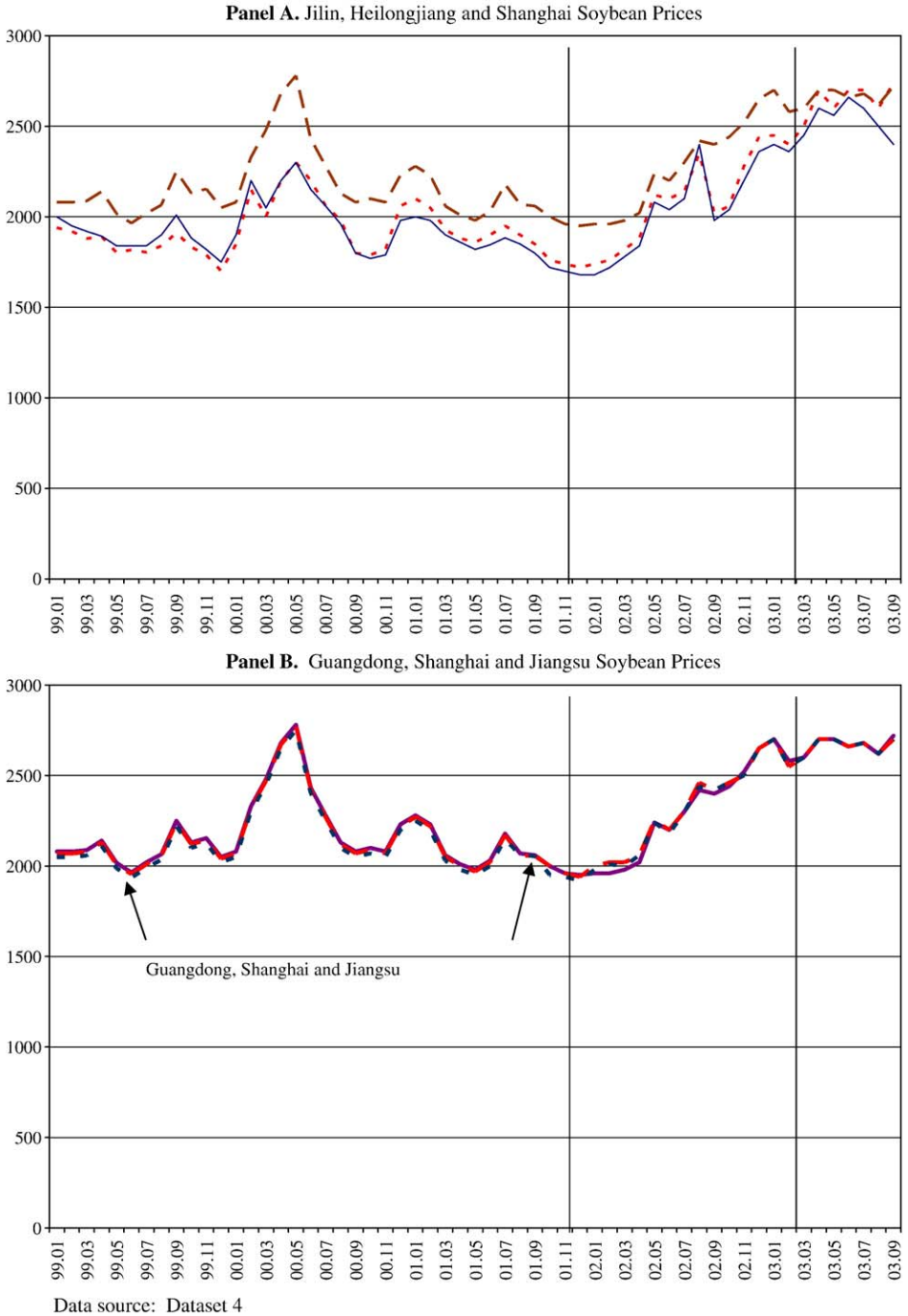
Data source: Dataset 4

Fig. 3. Soybean prices in Heilongjiang, Jilin, Guangdong, Shanghai and Jiangsu (RMB/mt), January 1999 to September 2003.

Similar patterns of price movements are found to exist between the two markets in western and central Liaoning and Dalian (Panel B). In fact, the prices in the two Liaoning producing areas track each other even closer than the markets in Heilongjiang, a finding that perhaps is not surprising given the fact that Liaoning is a smaller province with better transportation and communication infrastructure. The co-movements of prices among the producing areas in Liaoning and the consumption center of the province, Dalian, also are easily perceptible. The narrower price gaps among producer (lower trend lines) and consumer areas (higher trend line) are a reflection of the closer distance (than when compared to Heilongjiang–Dalian figure—Panel A).

Using dataset 1, the patterns of movement across further points of China display similar patterns of close movements of prices (Fig. 2, Panels A and B). While prices have moved together since the mid-1990s between Dalian and Guangdong and between Dalian and Fujian, the tracking among markets appears to be even closer in recent years. Almost every turning point in Guangdong and Fujian can be found in the Dalian market. The close movement of prices occurs although the primary way grain moves between the two sets of markets is by ocean. With the advent of private shipping and commercial trading, there are now many shipping lines and trading companies that move grain between the Northeast and South China's main consumption areas. The results from Fig. 2, Panels A and B, when linked with those from Fig. 1, demonstrate that prices in Heilongjiang appear to depend on shifts in feed demand and corn availability in Guangzhou and Fujian.

3.1.2. Soybeans

Using dataset 4, we find soybean prices similarly move together for pairs of markets both in the same region and across more distant locations. The bottom two price series in Panel A, Fig. 3, trace the price trends for soybeans in Heilongjiang and Jilin. The two series are almost indistinguishable
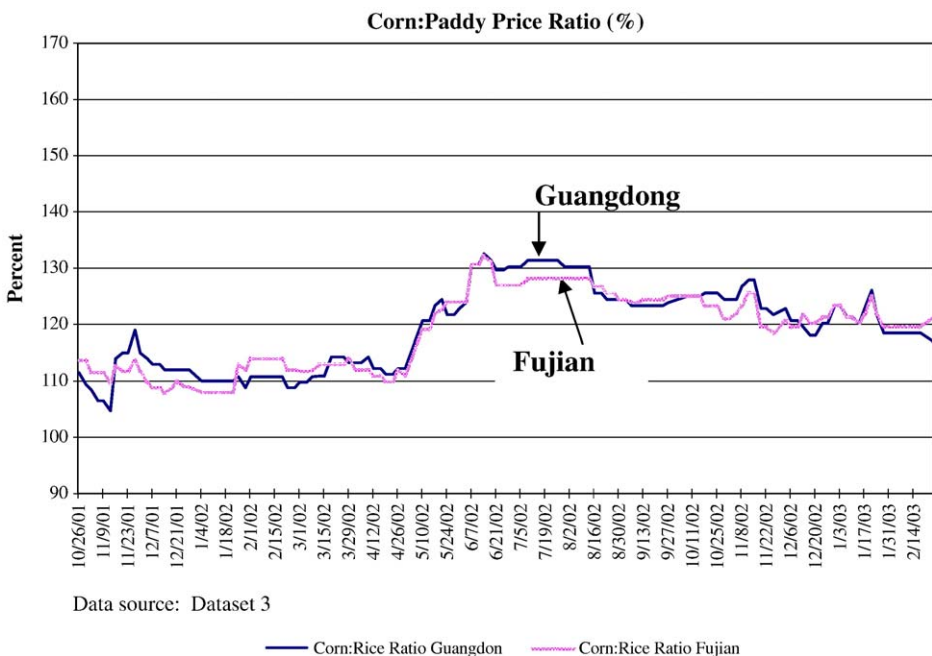

Fig. 4. The ratio of corn to feed rice (paddy) prices in Guangdong and Fujian provinces between October 2001 and February 2003.

from one another, with Heilongjiang prices slightly lower from almost the entire period. The Guangdong price series, the top line in Panel A, also shows that prices move in concert with one another inside China's domestic market even though the markets are thousands of kilometers apart. In only two short periods—early 2000 and late 2002—does the gap between the two markets deviate from a fixed margin which is almost equal to the transport price between the Northeast and the South.

Panel B in Fig. 3 shows that price appears to be even more integrated in the South. The prices throughout the entire period are so close that it is difficult to distinguish the individual price series. Although we are unable to draw conclusions that are based on descriptive statistics with any degree of statistical confidence, the patterns of price movements would seem to indicate that China's markets are highly integrated; it is hard to imagine that planner could generate such closely shifting sets of prices.

3.1.3. Cross commodity trends

In addition to observing co-movements of maize prices between regions over time during the post-WTO accession period, our data (dataset 3) also shows that prices of different feed types move together (Fig. 4). In south China, early rice is frequently used as a feed, albeit in the view of most livestock producers, a slightly inferior one. However, although the price of maize is higher than feed rice across China, the ratio of maize to feed rice is almost identical in markets in different province. Fig. 4 illustrates that although the ratio of maize to feed rice varies over time in Guangdong and Fujian, the trend of the ratios in each of the province almost perfectly tracks one another.
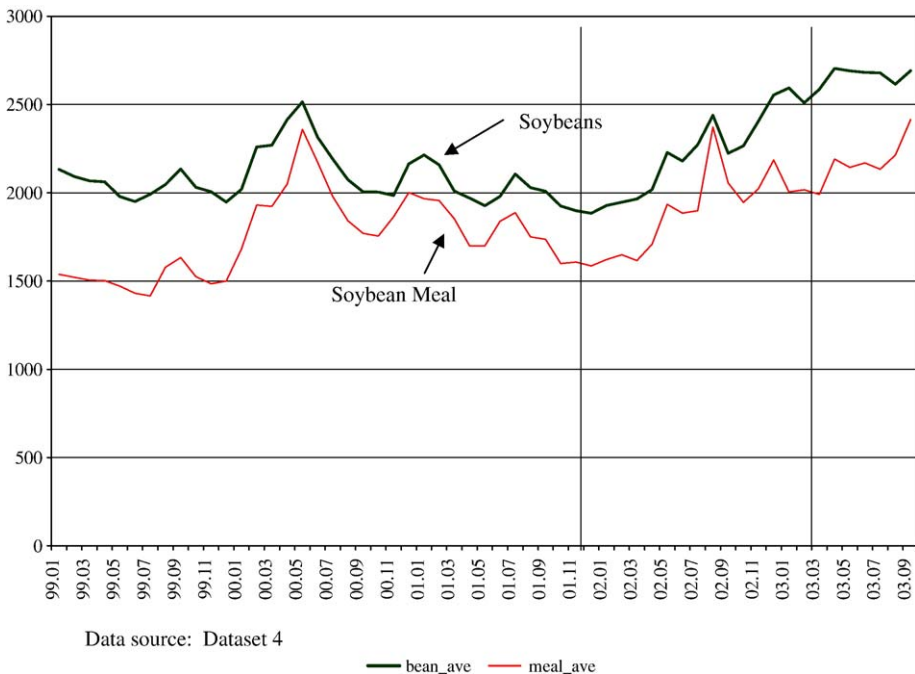

Data source: Dataset 4

Fig. 5. Comparisons of China's average soybean and soybean meal prices (RMB/mt), January 1999 to September 2003.

Fig. 5 shows that the same co-movement of prices occurs in the case of different soybean-based products within the soybean market. The prices of soybeans and soybean meal almost perfectly track one another for the entire sample period between 1999 and 2003. Interestingly (although not shown), when the price of soybean oil is added, after 2000, oil prices (albeit higher) also move together with soybean and soybean meal. Before 2000, restrictions in the import market for oil kept the soybean oil price *abnormally* above the price of soybeans and soybean meal.

3.2. Price patterns across space

We also can use our data descriptively and in conjunction with relatively simple multivariate analysis to examine price behavior across space, holding time constant. If China's markets function well, then there should be well-defined relationships across space. At any given point of time, the price in the consumption center should be the highest, while the price in the most remote production location lowest. If all prices are plotted as a function of their distance from the consumption center, the plot of these points traces out a "transportation gradient". It is called the transportation gradient because in the absence of other distortions, the fall of the line reflects the rising transportation costs. Higher per kilometer transport costs and distance-varying distortions and other costs also will increase the steepness of the line. Thus, the nature of the transportation gradient can be used to measure the efficiency of a marketing/transportation system. In examining transportation gradients, the less steep the slope, the more efficient commodities move across space (everything else held equal).

A simple plotting of the relationship between the price of maize in Dalian and those in Liaoning, Jilin and Heilongjiang during post-accession period (after December 2001) illustrates a
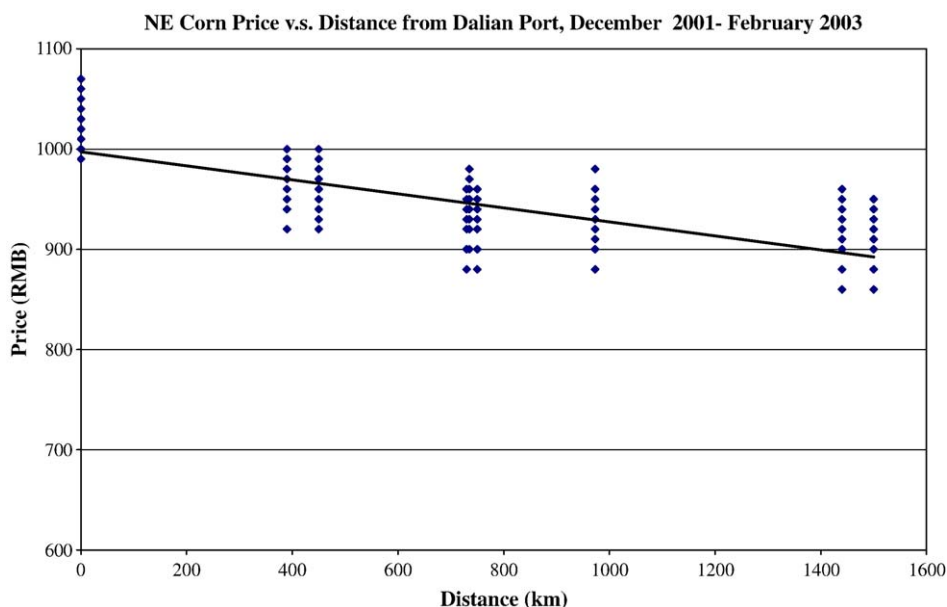

Fig. 6. Changes in maize prices across Northeast China as markets increase distances from the port of Dalian, 2000–2003.
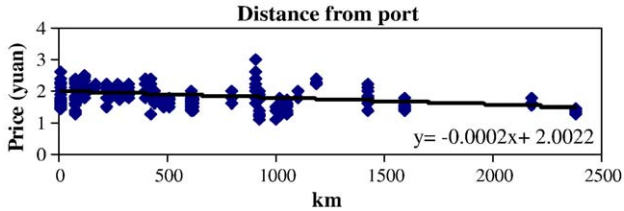
Fig. 7. Changes in rice prices across China as markets increase distance from the port (in four marketing areas – southern China, Yangtze River Valley, northern China and Northeast China), July 1998.

price contour that is consistent with the existence of well-functioning markets (Fig. 6). Since the main demand center in the Northeast and point of export for maize to foreign markets and the point of transshipment to south China is Dalian, one would expect that in an integrated marketing system, as a market became more remote, the price should fall according to a well-defined "transportation gradient". [4] Indeed, the price in a market 1000 km away from Dalian (e.g., the Jilin market) is, on average, about RMB 70/mt lower than the price in Dalian. In percentage terms, this means the price of Jilin maize is about 6% lower than the price of maize in Dalian.

The patterns of the price data (i.e., the transportation gradients) are even more evident when using dataset 1 to look at the case of rice (Fig. 7). In Fig. 7 the points at the origin are those in one of four of China's main consumption points and the rest of the points are prices in the markets that are in supply points of the marketing areas that service the consumption points. Specifically, in southern China the main demand point is Guangzhou and the supply points are markets in the southern China marketing region (e.g., Guangdong's rural area, Hunan, Fujian, Guangxi and Yunnan). In the Yangtze River Basin the main consumption point is Shanghai and the other marketing points are in supply regions up the Yangtze River. In northern China the main consumption center is Beijing/Tianjin and the marketing points are in supply regions up the Yellow River Basin. And, in the Northeast the main consumption center is Dalian and the main marketing points are in Liaoning and Heilongjiang. When data are arranged like this, rice prices in China's four marketing regions trace out a well-defined transportation gradient. [5]

When looking at *average transportation gradients* for 1998 to 2000 for maize, soybeans and rice in China (and the US), three findings suggests that China's markets are indeed performing relatively efficiently. [6] First, and interestingly because they build the case for robustness, the magnitudes of the transportation/transaction costs are similar to those reported in Park et al. (2002). Unlike our regression based method (see Footnote 6 and Table 1), Park et al. (2002) used a completely different methodology, a method that uses a maximum likelihood estimator examining the price differences

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[4] China's custom data demonstrate overwhelmingly that most of China's maize is exported from Dalian (more than 90% over the past 5 years). By far most of the maize from the north part of the nation that moves to the south part of the nation also flows through Dalian.

[5] See Park et al. (2002) for a complete discussion of the major channels of flow of China's rice trade. According to extensive interviews with rice traders between 1995 and 2001, the largest flows of rice from each of the four clearly designated regions end up in the major consumption centers in Guangzhou, Shanghai, Beijing and Dalian.

[6] An average transportation gradient (which are reported in Table 1 for maize, soybeans and rice for China for 1998 to 2000 and for maize and soybeans for the US for 1998) is the coefficient on the "distance variable" (a variable that is measuring the distance in 1000 km from the port of the location of the market) from regressions that explain commodity-specific prices for each year (in logs) as a function of the distance variable and a series of period dummies (one for each week of the year). In other words, the coefficient is the average percent change in price for each 1000 km that a marketing site is removed from the port, holding constant the average price change for all sites during each week of the year. Regression results available from authors upon request.

Table 1
Percentage change in price for every 1000 km of distance from the port, 1998 to 2000 [a]

	Maize (%)	Soybeans (%)	Rice (%)
China			
1998	−4	−10	−10
1999	−4	−11	−9
2000	−3	−8	−7
US			
1998	−5	−3.5	n.a.

Data sources: China rice, soybeans and maize prices (1998) are from dataset 2. Maize for 1999 and 2000 are from dataset 1. The US data come from the Chicago board of trade website.

[a] The figures in the tables can be thought of as the average transportation gradient for each year. It is the coefficient on the "distance variable" (a variable that is measuring the distance in 1000 km from the port of the location of the market) from regressions that explain commodity-specific prices for each year (in logs) as a function of the distance variable and a series of period dummies (one for each week of the year). In other words, the coefficient is the average percent change in price for each 1000 km that a marketing site is removed from the port, holding constant the average price change for all sites during each week of the year. Regression results available from authors upon request.

between markets when traders arbitrage away price difference between markets. Second, the transportation gradients for all crops are falling over time. Although we cannot pinpoint the exact source of the fall in the transportation gradient, as in Park et al. (2002), the patterns are consistent with a marketing environment in which there is an improving infrastructure and more competitive markets. Finally, the results show that the transportation gradients in China are similar to those found in the US. When plotting similar data and running similar regression on corn in the Mississippi Valley we find pattern of spatial price spread similar to those in China—especially in the case of maize. While we are not suggesting that China's commodity markets are as efficient in all dimensions as those in the US, it does appears as if the marketing reforms (as well as aggressive investment in roads and other infrastructure projects in the past decade—Park et al., 2002) have dramatically improved the ability of traders to move agricultural commodities (at least maize) around China at costs that rival those of the US.

4. Market integration in China

This section uses more formal tests of market integration. Cointegration means that although many developments can cause permanent changes in the individual elements of a tested series (e.g., grain prices in this paper), there is some long-run equilibrium relation tying the individual

Table 2
Percentage of market pairs in rural China that test positive for integration based on Dickey–Fuller test, 1988–2000

Commodity	1989–1995	1996–2000
Maize	28	89
Soybeans	28	68
Japonica rice (Yellow River Valley)	25	60
Indica rice (Yangtze Valley and South China)	25	47

Results are for two periods from same data set. For the results for 1989–1995 for maize and rice, see Park et al. (2002). Rice results are for the whole country in 1989–1995. Results for soybeans for 1989–95 and all results for 1996–2000 are from the authors.
Source: Dataset 1.

components together. Here, the Engle–Granger cointegration approach is applied to test China's market integration.

According to this approach (assuming that one is using stationary price series), one price series is then regressed on another using ordinary least squares:

$$P_t^i = \alpha + \lambda t + \beta P_t^j + e_t \tag{1}$$

where t is the common trend of the two price series and e_t is the error term. The residual, e_t, is then used in the augmented Dickey–Fuller test:

$$\Delta e_t = \delta e_{t-1} + \sum_{j=2}^{N} \gamma \Delta e_{t-j} + \xi_t. \tag{2}$$

If the test statistic on the δ coefficient is less (more negative) than the relevant critical value from the Dickey–Fuller table, the null hypothesis is rejected and the two series are said to be cointegrated of order (1). According to Engles and Granger, this implies that the two markets are integrated. The analysis assumes that markets are integrated when the absolute value of the test statistic is greater than 3 (implying significance at the 10% level).

4.1. Results

The cointegration analysis shows that China's markets have continued to develop in the late 1990s, especially when the results are compared with the market integration research of the late 1980s and early 1990s (Table 2). In the middle part of the reform era (1988–1995), a time when markets were starting to emerge, some 20–25% of markets showed signs of prices moving together (Park et al., 2002).

Using the results from the early 1990s as a baseline, the current analysis shows that during the late 1990s China's markets continued along their path of maturation. The comovement of prices among pairs of markets in the sample shows a significant increase in the share of market pairings that are integrated. In the case of maize, for example, prices in paired markets moved together in 89% of the cases, up from 28% in the early 1990s (Table 2). The share of market pairs showing price integration also increased for soybeans, japonica rice, and indica rice. The integration is especially notable because in many cases the paired markets are more than 1000 km apart. For example, in many years soybean and maize prices were found to be integrated between markets in Shaanxi and Guangdong Provinces and between Sichuan Province and southern Jiangsu.

Despite significant progress in integration, the results also show pairs of markets that are not integrated. For example, in a third of cases japonica rice prices moved in one market but not in another. One explanation is an institutional breakdown or infrastructure barrier (a policy measure or a weak link in the transportation or communication infrastructure) that is fragmenting China's markets for certain commodities, as shown in Park et al. (2002). But since every province in China produces and consumes rice, it is also the case that if supply in one region during one period is just equal to demand and if regional price differentials stay within the band between regional "export" and "import" prices, then moderate price movements in another area might not induce a flow into or out of the region that is in equilibrium. For that reason, despite the nontrivial number of cases in the late 1990s in which market prices in pairs of markets do not move together, it must be concluded that the impacts of WTO accession on China's agriculture will increasingly be experienced across wide regions of the nation from coastal to inland areas.

Although we do not show the results here for brevity, the shift towards integration has apparently continued. For example, for the case of maize, using dataset 3, almost 100% of all pairs of markets are integrated after 2000. The same is true for soybeans (using dataset 4).

4.2. Other studies finding increased market performance

The only truly systematic attempts at trying to measure both the improvements in markets and their returns (in terms of impact on producer welfare) are in de Brauw et al. (2004). These papers develop measures of increased responsiveness and flexibility within a dynamic adjustment cost framework to estimate the return to market liberalization reforms, holding the incentive reforms and other factors constant. The authors find that the behavior of producers in China has been affected by market liberalization, but that the gains have been relatively small. Gains in responsiveness (that are measured by price elasticities of factor demand for variable inputs—in this case, fertilizer) between the early and late reform periods are attributed to the gradual market liberalizing changes of the late 1980s. Farmers also have increased their speed of adjustment of quasi-fixed factors (which in the case of China's agriculture includes labor and sown area) to price changes (and other shifts in exogenous factors) between the early and late reform period. The work in de Brauw et al. (2004) also measures the effects on overall welfare of the increased flexibility and responsiveness and finds that the magnitude of the gains in efficiency from increased responsiveness and flexibility in the late reform period is positive and significant.

5. Conclusions

In this paper, we have shown in a number of ways the steady improvement in agricultural commodity markets that have occurred in China during the past decade. Regardless of using descriptive statistics or more formal techniques, our results are consistent with the emergence of markets for rice, maize and soybeans. Moreover, markets are robust, even when looking across long distances and at different time periods. Transaction (or at least transportation) costs also appear to have fallen.

Although people that visit rural China are not surprised, such a picture of markets may be surprising when juxtaposed against the policy background. Even during the late 1990s China's leaders were taking a cautious, gradual approach to reforming markets. Our results show that despite the gradualist strategy, the operation of markets during this time commodity markets have steadily strengthened in rural China.

The power of markets to continue to integrate perhaps more than anything shows the power of China's gradual method of transition. As argued by McMillan (1997), China's market reform has really been one of entry-driven competition. In case of China entry has come from both the commercialization of the state and the emergence of a private trading sector. In doing this, China enfranchised millions of individuals to be involved in commodity trade. While this has produced the rise in integration and fall in transaction costs that has been documented in the paper, it also has eroded the power of the state to control the markets with the traditional command and control methods. Our results suggest that if the nation's leaders want to control markets in the future, they are going to have to devise new ways to intervene, ones that use indirect methods instead of trying to suppress traders. There are now just too many traders to deal with as shown by the integration trends that continued to increase even when the nation tried to stop trading.

Indeed, one of the real lessons of our work is that both China's leaders and domestic and foreign traders and other observers should realize that rural China now has commodity markets that are

much less distorted than previously. This fact will become of significance in future international trade talks as China attempts to be declared a "market economy", a status that will benefit it in its ability to defend itself against anti-dumping cases. Of course, for poverty alleviation and other purposes this is often a two-edged sword. When prices rise (for whatever reason) in consumption centers, integrated markets mean that farmers all over China, even those in more remote areas, will benefit. However, if prices fall (e.g., from increased trade liberalization), the downward effects of price shifts will also be experienced throughout the nation.

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