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levels and determinants of agricultural market integration: the impacts of policies on marketisation

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Du Yang works in the Chinese Academy of Social Sciences.

Key to symbols used in tables

- n.a. not applicable
- .. not available
- zero
- . insignificant

Abbreviations

ADF	augmented Dickey–Fuller
CCAP	Center for Chinese Agricultural Policies
GRS	Governor Responsibility System
HRS	Household Responsibility System
LOP	Law of One Price
RCRE	Research Center of the Rural Economy
WTO	World Trade Organization

Levels and determinants of agricultural market integration: the impacts of policies on marketisation

Degree of market integration has often been used as a gauge of the success of market liberalisation and structural adjustment policies in developing countries. China is both an emerging economy and the world's largest transitional economy. The target of its economic reform is the formation of an efficient market-oriented economy. Since it provides a wealth of evidence of the workings of a transitional economy, the performance of China's market is of great interest to transitional economists.

There are two reasons to believe that market integration must be tested if the progress of economic reform in China is to be determined. The first reason relates to debates about assessment of market performance. On the one hand, China has been praised for facilitating market competition among state-owned, collective and private sectors (Qian and Xu 1993; Sicular 1995). On the other hand, Young (2000) argues that, despite market-oriented reform, segments of the Chinese economy freed from central control tend to exploit rent-seeking opportunities implicit in distortions of the economy. As Young puts it, 'distortions beget distortion'. It is possible China's ongoing reform will stimulate sustained economic growth. If Young's prediction is accurate, however, China's markets have been getting less rather than more integrated and sustained economic growth in the future is unlikely. It is necessary, then, to test rather than assume market integration.

The second reason to believe market integration must be tested has to do with China's accession to the World Trade Organization (WTO) at the end of 2001. Although China is classified as a developing country, no one doubts that its markets will be more integrated with world markets after its WTO entry. A well-functioning market needs many different forms of support, such as infrastructure, institutions and policies. Studies on key determinants of market integration have promising policy implications for the establishment of Chinese market institutions.

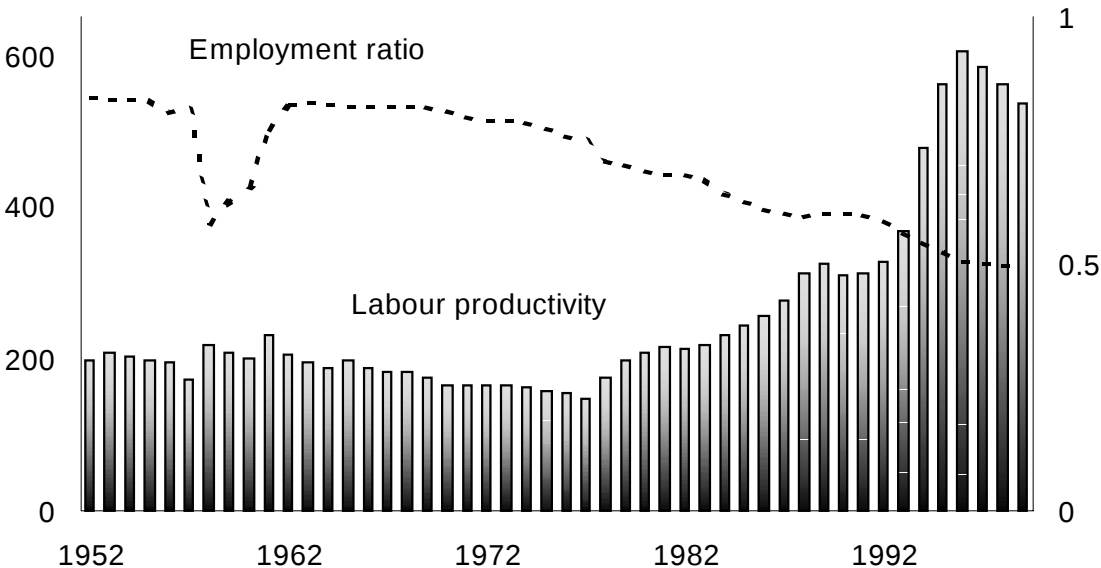
Agricultural markets are indispensable for China, and they emerged at the very beginning of reform. Ever since, however, they have been subject to strong government intervention. A high level of agricultural market integration will benefit Chinese agriculture in various ways. For example, it will be possible to allocate endowments more efficiently. Existing studies (Cai Fang and Du Yang 2000) show that allocation has an effect on patterns of regional economic growth and disparity, and that price and production fluctuate less in more integrated markets. Many other ongoing reform strategies, such as urbanisation, industrialisation and so on, are related to level of agricultural market development. Methodologically, the agricultural markets, especially the grain markets, provide an excellent window for examining market development during transition (Park et

al. 2002). Unlike factor markets (for example, labour markets), commodity markets (for example, grain markets) are ideal for the study of market integration because their product homogeneity makes prices comparable in different regions and across time.

Background

China began its rural reform at the end of the 1970s, with marketisation clearly the most important feature of its reform policies. Unlike many other developing countries, China liberalised food and agricultural commodity markets and output at the very beginning of reform (Seshamani 1998; Chilowa 1998; Maddock 1995; Babu and Tashmatov 1999). Since then, agricultural productivity and output have increased greatly (Figure 1). In fact, this progress has been brought about by two fundamental forces. The first is the improvement of the microeconomic incentive system. The introduction of the Household Responsibility System (HRS) and its impact on agricultural growth have been well documented (Lin 1992; Fan 1991; McMillan et al. 1989). The second force is increased efficiency due to marketisation, which has dominated growth since the late 1980s (Lin et al. 1996). Both factor and product markets have expanded. With the establishment of market mechanisms, farmers have become ever more sensitive to changes in market prices. Allocative efficiency improvement continues to contribute to agricultural growth. Nevertheless, little research has focused on the second stage of marketing reform in order to evaluate the level of market development as well as its determinants.

Figure 1 Labour productivity in agriculture, 1952–99



The development of the agricultural market has had a strong correlation with the progress of marketisation in the national economy. Some economists, such as Qian (1999), point out that each stage of China's economic reform has had a particular emphasis. The first stage (1978–93) emphasised microeconomic incentives and a dual-track approach to market liberalisation, implying a process of gradual reform ('crossing the stream by feeling the rocks'). The second stage (from 1994 onwards) has emphasised best-practice market institutions. Measures such as fiscal system overhaul, government downsizing and privatisation of state-owned enterprises have been proposed.

Reform in agriculture has taken almost the same steps as national economic reform, but it has always been slowed by reformers' reactions to unstable macroeconomic conditions. Thus, two mutually contradictory policy packages operate at the same time to influence agricultural reform. On the one hand, agriculture is marketised. At the end of the 1970s, exchange of grains was allowed for the first time since the 1950s and markets began to emerge. Inter-provincial grain trading was permitted in 1983. The number of periodical markets increased significantly (Table 1).

Table 1 **The development of rural periodic markets in China, 1980–97**

	Number of markets	Trade value (million yuan)
1980	37,890	21,170
1981	39,715	24,797
1982	41,184	27,639
1983	43,508	31,202
1984	50,356	33,321
1985	53,324	44,173
1986	57,909	54,448
1987	58,775	62,707
1988	59,178	71,072
1989	59,019	69,481
1990	59,473	71,644
1991	60,784	81,456
1992	64,678	98,932
1993	66,551	..
1994	66,583	..
1995	63,000	..
1996	64,559	..
1997	64,753	..

Source: Weersink, A. and Rozelle, S., 1997. 'Marketing reforms, market development and agricultural production in China', *Agricultural Economics*, 17(2–3):95–114; and State Administration for Industry and Commerce (SAIC), 1998. *Year Book of Industrial and Commercial Administration 1997*, State Administration for Industry and Commerce (SAIC), Beijing.

Table 2 **Summary of policies influencing grain market development, 1988–95**

	1988–89	1990–91	1992–93	1994–95
Policies	Tight marketing restrictions	Relaxation of restrictions	Market liberalisation	Local protectionism after rapid rise in food prices
Managerial incentives	Grain bureaus run mainly as government agencies Crackdown on private traders	Reduced role of state grain-trading organisations Profit-based contractual incentives introduced	Widespread commercialisation and elimination of quotas and rationing Rise of private grain trade	Reluctant commercialised grain agency asked to implement policies again
Market infrastructure investment	Legacy of Mao's under-investment in transport system	Rail and road systems expanded Establishment of wholesale markets (1991) and futures markets (1993), improved communication and marketing		Reports of congestion, especially on north–south trunk line

Source: Park, A., Jin, H., Rozelle, S. and Huang, J., 2002. 'Market emergence and transition: arbitrage, transaction costs, and autarky in China's grain markets', *American Journal of Agricultural Economics*, 84(1):67–82.

Market institutions, such as wholesale markets, futures markets, and information systems, developed gradually in the early 1990s. During periods of grain price stability, the government encouraged the free flow of market grain from region to region. According to Park et al. (2002), trade liberalisation policies, managerial incentives and market infrastructure investment influenced the development of grain markets (Table 2).

On the other hand, state intervention did occur during the period. One of the most obvious examples of this was the procurement policy, actually a legacy of traditional systems of agricultural management. In addition, policy instruments were occasionally used in reaction to changes in the macroeconomic situation. For example, in late 1988 and 1989, the central government severely restricted rice trading because of concerns that rising demand and falling production in coastal areas were causing price rises. Another example occurred after bouts of inflation in 1993–94, when the central government created the Governor Responsibility System (GRS), meant to encourage provincial self-sufficiency in food. Later, we show how such state interventions negatively affected the development of grain markets.

Methodology

Existing studies use several different methods to test the hypothesis of market integration. Each method has its advantages, according to the cases in which it is applied. In general, the methods can be classified into three groups: price co-movement analysis, the parity-bound model, and the co-integration method.

Price co-movement analysis

Standard neoclassical theory maintains that, in the absence of impediments, resources will be allocated freely and efficiently, and factor and product prices in different locations will be equalised. According to this thinking, spatial co-integration can be expressed as a process of price co-movement among different price series. The Law of One Price (LOP) is one case of the application of this method. Assuming there are two price series, if the price differential between them is stationary, then we can conclude that price signals are transmitted from one market to another and therefore that, in the long run, the two markets are integrated.

Studies indicate, however, that price convergence does not necessarily imply efficient allocation of resources, unless the market is competitive (Faminow and Benson 1990; Baulch 1997). In the extreme case, two duopolists agree to charge the same price in two segmented markets. In addition, common factors may affect the markets in question simultaneously, but this might have nothing to do with price linkage among the markets. In China, the government annually procures grain from farmers, and this has a great impact on spatial price convergence. It cannot, however, reflect degree of market integration. Hence, an understanding of the determinants of market integration is necessary.

The parity-bound model

Measures of market integration that focus on price co-movement in different locations have been criticised for ignoring the complexity of trade flows (Baulch 1997). Park et al. (2002) argue that, in well-developed markets, profit-seeking traders tend to exploit spatial price differences that exceed transaction costs quickly. Assuming fixed transaction costs between two locations, there are three possible trade and price outcomes:

- the difference between the two regions' prices is less than the transaction costs, in which case trade does not occur (autarky);
- trade does occur, and the price difference equals the transaction cost (arbitrage);
- and
- the price difference exceeds the transaction costs because trade does not occur.

Johansen co-integration method

Johansen (1988) and Johansen and Juselius (1990) provide a method, used primarily in macroeconomics, of detecting co-integrated relationships among different time series. As Engle and Granger (1987) suggest, before running co-integration tests, one should determine the stationarity of each time series by doing augmented Dickey–Fuller (ADF)

tests, derived from the following regression

$$\Delta P_t = \rho P_{t-1} + \sum_{i=1}^p \delta_i \Delta P_{t-i} + e_t \quad (1)$$

The ADF test statistics are the ratio of estimated ρ to their standard errors. If the estimated value of δ is negative and significantly different from zero, the null hypothesis will be rejected. The critical assumption in the Johansen method is that each individual time series is integrated of order one, I(1), meaning they are non-stationary in levels but stationary in first differences.

Adopting the approach of Johansen and Juselius (1990), one should estimate the following likelihood functions for Y_t

$$\Delta Y_t = \mu_{0t} + \sum_{i=t}^{k-1} \theta_{0i} \Delta Y_{t-i} + v_{0t} \quad (2)$$

$$Y_{t-k} = \sum_{i=1}^{k-1} \theta_{1i} \Delta Y_{t-1} + v_{1t} \quad (3)$$

In equations 2 and 3, Y is a vector of time series to be investigated. Using canonical correlation techniques, one can identify the co-integrated relations. Two tests, the trace test and maximal eigen value test, will be used. The trace test is given by

$$\tau_{trace} = -N \sum_{i=r+1}^p \ln(1 - \Pi_i^2) \quad (4)$$

where N is number of time periods available in the data, $\pi_{k+1} \dots \pi_n$ are the $n-k$ smallest canonical co-relations of v_{0t} with respect to v_{1t} . The trace test evaluates the null hypothesis that there are k or less co-integrating vectors.

The maximal eigen value test uses the $k+1$ largest squared eigen value. It is given by

$$\tau_{max} = -N \ln(1 - \Pi_{k+1}^2) \quad (5)$$

This test evaluates the null hypothesis that there are exactly k co-integrating vectors in Y_t . If both tests' statistics are beyond the critical value, the null hypothesis will be rejected.

The advantages of the Johansen method are clear: it makes it possible to detect co-integration relations among different time series directly; it indicates the relative level of the time series' co-integration; and it enables us to see the determinants of market

integration by endogenising the maximal eigen value. This paper uses the Johansen method to test the functioning of Chinese grain markets and identify the determinants or constraints of marketisation.

The integration of agricultural product markets: level and determinants

In this section, the econometric approach is used to analyse the level and determinants of China’s grain market. The monthly data of wheat prices come from the Research Center of the Rural Economy (RCRE) and include information collected in 15 provinces from 1987 to 1997. The procurement data were collected by the Center for Chinese Agricultural Policies (CCAP). Information about roads, income per capita and so on is published in yearbooks.

The time series analysis is done using SHAZAM, software that is especially suitable to Johansen and Juselius’s co-integration test. The other regression is done using STATA 7.0.

Augmented Dickey–Fuller test

As mentioned earlier, to investigate the stationarity of price series, an ADF test has to be performed before the Johansen and Juselius method is applied. Table 3 reports the results of ADF unit root tests using monthly price series from wheat markets during the period 1987–97. Both levels and first difference are calculated. The whole period of the data is divided into two sub-periods—before and after 1996, the year in which the GRS was

Table 3 Augmented Dickey–Fuller tests for wheat markets, 1987–97

Price series	Levels		First difference	
	ADF	Lag order	ADF	Lag order
Beijing	-2.14	2	-11.73	3
Tianjin	-1.54	3	-13.26	2
Hebei	-1.66	3	-12.27	5
Shanxi	-1.61	7	-14.44	4
Jiangsu	-1.33	3	-11.74	6
Zhejiang	-1.09	4	-16.66	3
Anhui	-1.13	5	-11.41	2
Shandong	-1.58	3	-10.88	8
Henan	-1.42	3	-4.19	5
Sichuan	-1.26	4	-11.20	4
Guizhou	-1.35	2	-12.83	4
Yunnan	-1.11	6	-11.90	6
Shannxi	-1.05	3	-11.16	7
Gansu	-1.34	2	-17.94	2
Ningxia	-0.89	4	-15.35	3

Note: For each price series of first difference, the null hypothesis is rejected at 0.01 level.

Table 4 **Johansen and Juselius co-integration tests for wheat markets**

Null hypothesis	Co-integration test statistics				
	1987–97	1987–95	Eastern	Central	Western
Trace Test					
$r = 0$	783.74*	946.69*	79.13*	94.12*	96.06*
$r \leq 1$	650.36*	777.47*	40.35	49.59	56.31
$r \leq 2$	527.02*	617.19*	22.57	29.86	29.01
$r \leq 3$	427.57*	503.14*	9.94	13.21	9.76
$r \leq 4$	337.02*	400.97*	1.12	2.24	2.21
$r \leq 5$	259.69*	306.49*	-	-	-
$r \leq 6$	200.74*	240.33*	-	-	-
$r \leq 7$	146.35*	180.54*	-	-	-
$r \leq 8$	105.46*	130.80*	-	-	-
$r \leq 9$	73.17	95.74*	-	-	-
$r \leq 10$	49.00	67.26	-	-	-
$r \leq 11$	30.21	41.42	-	-	-
$r \leq 12$	17.62	22.77	-	-	-
$r \leq 13$	7.07	9.09	-	-	-
$r \leq 14$	1.36	0.62	-	-	-
Maximal eigen value test					
$r = 0$	133.38*	169.21*	38.78	44.53	39.75
$r \leq 1$	123.34*	160.28*	17.77	19.74	27.30
$r \leq 2$	99.45*	114.06*	12.64	16.65	19.25
$r \leq 3$	90.55*	102.17*	8.82	10.97	7.55
$r \leq 4$	77.33*	94.47*	1.12	2.24	2.21
$r \leq 5$	58.96	66.16*	-	-	-
$r \leq 6$	54.39	59.80	-	-	-
$r \leq 7$	40.89	49.73	-	-	-
$r \leq 8$	32.29	35.06	-	-	-
$r \leq 9$	24.17	28.48	-	-	-
$r \leq 10$	18.79	25.84	-	-	-
$r \leq 11$	12.59	18.65	-	-	-
$r \leq 12$	10.56	13.68	-	-	-
$r \leq 13$	5.71	8.47	-	-	-
$r \leq 14$	1.36	0.62	-	-	-

Note: An asterisk (*) indicates that the null hypothesis at least is rejected at 0.05 level.

implemented. The number of lags is determined by the Akaike Information Criteria. The results indicate that each of the price series integrated to order one. The null hypothesis of a unit root series is rejected using difference data. One can therefore conclude that they are individually stationary in first difference or I(1), and it is possible to test for dynamic price relationships using the Johansen and Juselius method.

Johansen and Juselius co-integration test

Table 4 reports the results of Johansen and Juselius co-integration tests, including trace tests and maximal eigen value tests. The 15 provinces are divided into three groups according to their geographic locations, in order to test for differences among regional grain markets. The eastern group comprises Beijing, Tianjin, Jiangsu, Zhejiang and Shandong; the central group Anhui, Shanxi, Hebei, Sichuan and Henan; and the western group Yunnan, Guizhou, Shaanxi, Gansu and Ningxia.

The trace tests show that during 1987–97 there were nine co-integrating vectors and five common trends, while the maximal eigen value tests show five co-integrating vectors and nine common trends. The trace tests show that the 15 provinces' wheat markets are strongly co-integrated and converge in the long run because nine price series can be expressed in terms of the rest of five prices.

To determine possible effects of the GRS, Johansen and Juselius's co-integration test is also used for the sub-period before 1996, when GRS had not yet been implemented. Unfortunately, we cannot observe effects after implementation because of a lack of long-run price series. Both tests show, however, that the level of co-integration for the sub-period before 1996 was stronger than for the whole period.

From the last three columns of Table 4, we can conclude that there were no significant disparities of wheat market co-integration among eastern, central and western regions. This might imply that policy points other than regional effects determine the level of market integration.

Regression technique

To determine the factors that influence market integration, panel data regression is used. In the following regression equation, the dependent variable is the level of market integration and $\mathbf{X}$ is the vector of determinants.

$$CINT_{i,t} = \alpha' \mathbf{X} + e_{i,t}$$

In panel analysis, what is important is the structure of the error term. In general, two sets of factors affect the error term, first, those which vary from region to region but remain constant over time, and second, those which change over time but not from region to region. Hence, the structure of the error term can be expressed as

$$e_{i,t} = u_i + v_t + \varepsilon_{i,t} ,$$

where u_i is the error term that varies among regions and v_t is the error term that changes over time. For this purpose, the two-way fixed-effect model is preferred to this regression. The detailed formula is

$$CINT_{i,t} = \alpha_0 + \alpha_1 CONTRACT_{i,t} + \alpha_2 NEGOT_{i,t} + \alpha_3 ROAD_{i,t} + \alpha_4 INC + \sum_{i=1}^{n-1} \beta_i DPROV_i + \sum_{t=1}^{T-1} \beta_t DYEAR_t + e_{i,t}$$

where $CINT_{i,t}$, the dependent variable, is the co-integration test statistics in market i at year t , and reflects the degree of market i 's integration with other markets; $CONTRACT_{i,t}$ represents the government contract procurement in year t in province i ; $NEGOT_{i,t}$ stands for the negotiated procurement in year t in province i ; $ROAD_{i,t}$ represents the infrastructure development in province i in year t ; and $DPROV_i$ and $YEAR_t$ are the provincial dummy variable and the year dummy variable respectively.

Results and analysis

The regression results are reported in Table 5. In order to analyse factors influencing wheat market integration, Johansen and Juselius co-integration tests are performed annually for each of the provinces. Test statistics for $H_0: r=0$ were selected using maximal eigen value. For each province, we can get an eigen value with any one of the other provinces, with the average value representing its market integration level. These statistics can be regarded as a measure of market integration over time. The larger the value, the stronger the degree of market integration (Ismet et al. 1998). The explanatory variables include policy variables, income per capita, infrastructure and dummy variables. Income per capita is generally

Table 5 The determinants of grain market integration: GLS fixed model

	1987–94		1987–90		1991–94	
	Coefficients	Z	Coefficients	Z	Coefficients	Z
Contract	-0.295	1.82	-0.435	2.81	-0.342	-0.38
Negotiated	0.02	0.18	-0.0077	0.14	0.41	2.14
Road*	8.19	1.68	45.42	3.84	-82.99	2.54
Income*	18.42	1.96	-7.37	0.24	21.89	0.98
Number of groups	15		15		15	
Number of time series	8		4		4	
Log likelihood	-369.82		-161.5		-166.82	
Prob> χ^2	0		0		0	

Note: An asterisk (*) indicates that variables are in log form.

proxy for regional development. The two sorts of dummy variables, provincial dummy variables and year dummy variables, are incorporated into the model, but owing to lack of space the table does not contain their statistics.

For comparison, the whole period is divided into two sub-periods. The first sub-period, from 1987 to 1990, was more market restricted, while the second was more liberalised.

Table 6 Share of contract procurement in production by province, 1987–94 (per cent)

	1987	1988	1989	1990	1991	1992	1993	1994
Beijing	9.27	6.50	6.11	7.26	6.62	6.01	7.73	8.88
Tianjin	2.95	2.62	2.28	2.61	2.50	2.26	2.20	2.36
Hebei	16.50	15.40	14.40	15.40	15.10	16.40	16.00	14.70
Shanxi	18.10	17.70	16.70	17.50	17.30	18.50	17.80	21.60
Jiangsu	20.04	19.83	17.02	18.42	17.72	22.06	22.41	22.37
Zhejiang	18.10	18.85	13.56	16.90	16.40	12.36	37.75	10.48
Anhui	19.77	20.10	20.33	20.30	20.20	20.61	17.23	16.83
Shandong	16.16	15.77	15.15	15.60	15.50	14.56	13.04	12.95
Henan	19.05	19.04	18.42	18.80	18.70	19.20	16.83	17.25
Sichuan	23.18	25.87	22.83	23.90	24.20	13.09	20.10	21.01
Yunnan	11.26	13.47	11.77	12.20	12.50	11.97	14.15	8.39
Guizhou	4.44	3.92	3.16	3.54	3.35	1.64	1.24	1.87
Shaanxi	18.08	17.73	16.70	17.50	17.30	18.48	17.76	21.56
Gansu	18.31	18.25	17.66	18.10	18.00	18.67	18.93	18.51
Ningxia	22.03	20.94	19.69	20.90	20.50	27.45	15.97	19.22

Table 7 Share of negotiated procurement in production by province, 1987–94 (per cent)

	1987	1988	1989	1990	1991	1992	1993	1994
Beijing	11.13	13.93	22.82	18.38	20.60	31.51	31.97	10.42
Tianjin	1.89	3.23	4.72	4.00	4.36	12.74	19.63	36.42
Hebei	6.28	6.36	10.17	8.30	9.25	13.17	8.90	9.37
Shanxi	11.37	12.39	21.41	16.90	19.16	18.25	9.90	12.12
Jiangsu	23.17	18.97	13.10	16.03	14.56	16.73	13.95	14.46
Zhejiang	14.98	17.41	16.85	17.13	18.00	25.72	0.00	8.64
Anhui	14.00	15.91	9.94	12.92	11.43	15.77	12.96	11.70
Shandong	7.10	8.86	10.00	9.43	10.00	16.54	19.12	13.67
Henan	8.32	7.79	8.89	8.34	8.61	14.74	12.73	13.90
Sichuan	8.23	7.74	9.70	8.72	9.21	17.15	4.39	9.24
Yunnan	5.71	5.88	5.72	5.80	5.76	9.63	4.66	3.43
Guizhou	13.00	13.96	15.12	14.52	14.82	17.80	9.78	11.10
Shaanxi	6.42	5.58	10.81	8.20	9.50	12.96	7.18	7.39
Gansu	10.60	6.18	11.26	8.72	10.00	13.04	5.97	11.38
Ningxia	4.32	10.87	12.80	11.84	12.32	26.85	6.71	13.87

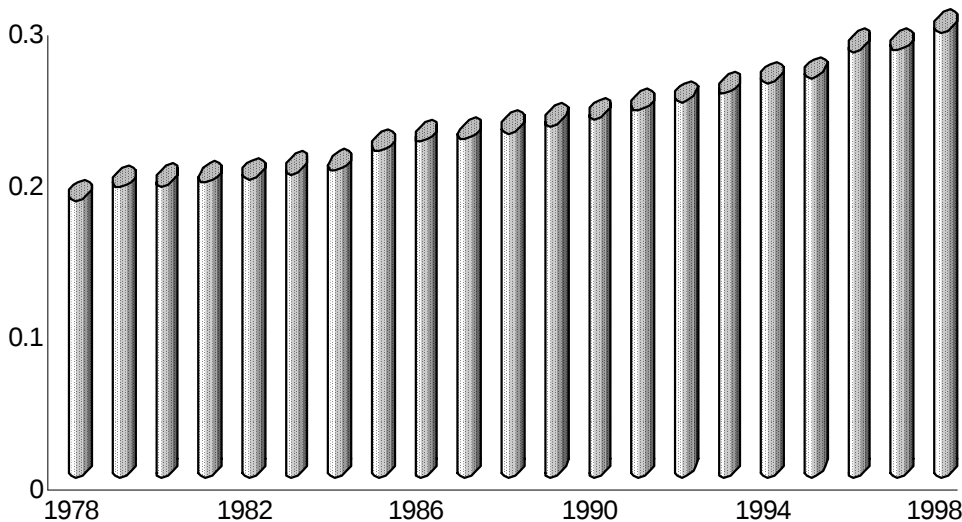
Procurement. Procurement is the main intervention instrument used by the government. As Table 5 shows, procurement has significant effects on market integration level. In China, most commercial grain trade has been carried out by state grain managers in charge of local grain stations (Sicular 1995). Contract procurement is the most prominent type of procurement. During the period 1987–94 as a whole, contract purchase had negative effects on market integration level. During the sub-period 1987–90, a period characterised by relatively strong policies of agricultural market control, the variable had more negative impacts on market integration. This regression result therefore indicates that contract procurement negatively affected the development of wheat markets.

In addition to state procurement plans, local governments have since 1985 been permitted to engage in market trade at negotiated prices. In the period of this study, two types of procurement, contract procurement and negotiated procurement, were used jointly to intervene in the market (Tables 6 and 7). Table 5, however, does not show any significant effects of negotiated procurement on marketisation level.

Infrastructure. Markets require supporting infrastructure, institutions and policies, and are mediated through existing social and economic relationships. This is partly why so many developing countries have met with difficulties during the process of agricultural market liberalisation (Jones 1995; Brooks 1995).

Figure 2 shows how the length of road per square kilometre in China has tended to increase steadily since 1978. Economists have pointed out that better infrastructure supports the progress of marketisation (Park et al. 2002). The regression carried out here, however, does not report a significant coefficient on the variable of road, although the variable has a positive sign.

Figure 2 Road per square kilometre in China, 1978–98



Conclusion

Using a fairly rich data set, this paper has examined wheat market integration and produced the following main findings. First, the augmented Dickey–Fuller test shows the stationarity of each price series, which reflects price stability in the long run. Second, the co-integration test verifies that wheat markets are integrated in the long run, thanks to marketisation reform. The regional co-integration test does not provide evidence that wheat market co-integration is linked to regional factors, implying that it is primarily policy effects that determine market integration level. Third, the fixed-model analysis tells us that policy instruments such as procurement affected degree of market integration.

China is expected to enter the WTO by the end of 2001. No one doubts that high levels of marketisation will be a basic requirement after entry. Government interventions, however, still negatively affect the development of markets. The government must therefore change its approach if a more efficient market is to be created.

References

- Babu, S.C. and Tashmatov, A., 1999. 'Attaining food security in Central Asia: emerging issues and challenges for policy research', *Food Policy*, 24(4):357–62.
- Baulch, B., 1997. 'Transfer costs, spatial arbitrage, and testing for food market integration', *American Journal of Agricultural Economics*, 79(2):477–87.
- Brooks, J., 1995. 'Policies and institutions in transition economies: a political economy perspective on the agri-food sector', *Food Policy*, 20(6):487–500.
- Cai Fang and Du Yang, 2000. 'Convergence and disparities in Chinese regional economic growth: hints for Western development strategy', *Journal of Economic Research*, 10.
- Chilowa, W., 1998. 'The impact of agricultural liberalisation on food security in Malawi', *Food Policy*, 23(6):553–69.
- Engle, R.F. and Granger, C.W.J., 1987. 'Co-integration and error correction: representation, estimation, and testing', *Econometrica*, 55(2):251–76.
- Faminow, M.D. and Benson, B.L., 1990. 'Integration of spatial markets', *American Journal of Agricultural Economics*, 72(1):49–62.
- Fan, S., 1991. 'Effects of technological change and institutional reform on production growth in Chinese agriculture', *American Journal of Agricultural Economics*, 73(2):266–75.
- Ismet, M., Barkley, A.P. and Llewelyn, R.V., 1998. 'Government intervention and market integration in Indonesian rice markets', *Agricultural Economics*, 19(3):283–95.
- Johansen, S., 1988. 'Statistical analysis of co-integrating vectors', *Journal of Economic Dynamics and Control*, 12(2):231–54.

- Johansen, S. and Juselius, K., 1990. 'Maximum likelihood estimation and inference on co-integration—with application to the demand for money', *Oxford Bulletin of Economics and Statistics*, 52(2):169–210.
- Jones, S., 1995. 'Food market reform: the changing role of the state', *Food Policy*, 20(6):551–60.
- Lin, J.Y., 1992. 'Rural reforms and agricultural growth in China', *American Economic Review*, 82(1):34–51.
- , Cai Fang and Zhou Li, 1996. *The China Miracle: development strategy and economic reform*, Chinese University Press, Hong Kong.
- Maddock, N., 1995. 'Agriculture after socialism: the transformation and development of Lithuanian agriculture', *Food Policy*, 20(2):129–37.
- McMillan, J., Whalley, J. and Zhu, L., 1989. 'The impact of China's economic reforms on agricultural productivity growth', *Journal of Political Economy*, 97(4):781–807.
- Park, A., Jin, H., Rozelle, S. and Huang, J., 2002. 'Market emergence and transition: arbitrage, transaction costs, and autarky in China's grain markets', *American Journal of Agricultural Economics*, 84(1):67–82.
- Qian, Y., 1999. The institutional foundations of China's market transition, Paper presented at the High-Level Dialogue on Development Paradigms, Second Anniversary of the Asian Development Bank Institute, Tokyo, December 10.
- Qian, Y. and Xu, C., 1993. 'Why China's economic reforms differ: the M-form hierarchy and entry/expansion of the non-state sector', *Economics of Transition*, 1(2):135–70.
- Seshamani, V., 1998. 'The impact of market liberalisation on food security in Zambia', *Food Policy*, 23(6):539–51.
- Sicular, T., 1995. 'Redefining state, plan, and market: China's reforms in agricultural commerce', *China Quarterly*, 144:1020–46.
- State Administration for Industry and Commerce (SAIC), 1998. *Year Book of Industrial and Commercial Administration 1997*, State Administration for Industry and Commerce (SAIC), Beijing.
- Weersink, A. and Rozelle, S., 1997. 'Marketing reforms, market development and agricultural production in China', *Agricultural Economics*, 17(2–3):95–114.
- Young, A., 2000. 'The razor's edge: distortions and incremental reform in the People's Republic of China', *Quarterly Journal of Economics*, 115(4):1091–135.