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Market Integration and Economic Development: A Long-run Comparison

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Abstract

How much of China's recent economic performance can be attributed to market-oriented reforms introduced in the last two decades? A long-run perspective may be important for understanding the process of economic development occurring today. This paper compares the integration of rice markets in China today and 270 years ago. In the eighteenth century, transport technology was non-mechanized, but markets were close to being free. We distinguish local harvest and weather from aggregate sources of price variation in a historical sample and in a similarly constructed contemporary sample. Findings indicate the degree of market integration in the 1720s is a very good predictor of per capita income in the 1990s. Moreover, the current pattern of interregional income in China is strongly linked to persistent geographic factors that were already apparent several centuries ago, well before the enactment of modern reform programs.

1. Introduction

Studies of economic growth in China generally begin their discussion with 1978, the year when contemporary reforms began, and circumscribe the analysis to the years since the mid-1980s, when data are more available. A longer-term perspective, however, may be important for understanding the process of economic development. In the case of Europe, there is now suggestive evidence that market integration and trade led to growth effects that took decades if not centuries to materialize (O'Rourke and Williamson, 2004; Acemoglu et al., 2002). This paper fills the gap by taking a longer view on China. We examine market integration and trade in a sample of twelve Chinese provinces, home to about 17% of the world population, over almost three centuries (the years 1723 to 1993).[1] Our point of departure is that assessments of China's reforms need to take into account differences across provinces that were already present before reforms began. Failure to do so would tend to lead to overestimates of the impact of reform.

This paper asks how market integration and trade for these economies have changed by distinguishing local from aggregate sources of price variation, an approach that has been widely adopted in economic history, development, as well as international economics (Clark, 2002; Crucini, 1999). Our findings indicate that in the late twentieth century local and national prices essentially move one-to-one, and compared to historical levels of market integration, contemporary markets are more integrated. But we also find a significant degree of market integration for distances up to about

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700 kilometers in China in the early eighteenth century. Moreover, the degree of market integration in the 1720s is a very good predictor of per capita income in the 1990s. This suggests that income differences across provinces today can to some extent be traced back for about three centuries.

This paper contributes to recent research in a number of areas. First, our analysis is related to the large literature on the impact of international trade on growth (Coe and Helpman, 1995; Dinopoulos and Segerstrom, 2003; Frankel and Romer, 1999; Keller, 1998; Xu and Wang, 2001). Our analysis differs however, in that instead of international trade, we focus on trade within China's borders.[2] We also provide some important historical background to research on economic reform and regional growth in China (see Young, 2000 for a good introduction). In addition, this paper contributes to what is known on pre-industrial China, important because it may give clues to why China grew so much slower than Western Europe and North America from about 1750 to 1950 (Pomeranz, 2000; Shiue, 2002; Shiue and Keller, 2004). What is different here is that our analysis spans from the pre-industrialization to the modern era. Finally, if markets themselves are viewed as economic institutions—a view that we are inclined to take—our analysis mirrors the new emphasis on the importance of institutions for growth (Acemoglu et al., 2001; Banerjee and Iyer, 2003).

The paper is organized as follows. Section 2 introduces our empirical approach. We highlight major characteristics of the data in the following section. All empirical results are contained in section 4, while section 5 provides a concluding discussion.

2. Approach

We distinguish local from global shocks that influence local prices. Conditional on demand, if markets are fully integrated then only global supply shocks determine how prices move in all regions. This is because even if there are region-specific shocks, the regions can achieve full risk sharing through trade (high-output regions export, low-output regions import). By contrast, the existence of trade barriers will give rise to a partial segmentation of markets. In this case local supply shocks will play a role in determining local price movements. Thus, in a regression framework, the local price P_{it} may be determined by both local (L) and national (N) factors

$$P_{it} = \alpha + \beta_L L_{it} + \beta_N N_t + \varepsilon_{it}, \tag{1}$$

where i indexes province, $i = 1, \ldots, I$, and t indicates time $t = 1, \ldots, T$.[3]

We do not have data on the provinces' supplies for our entire sample period. Instead, we use the aggregate price as our measure of global supply, defined as

$$\overline{P}_{it} = \sum_{i \neq j, j=1}^{I} s_{ij} P_{jt}, \quad \forall\, i,t, \tag{2}$$

where s_{ij} denotes the size of province j in the computation of the aggregate price for province i $\left(\Sigma_{i \neq j, j=1}^{I} s_{ij} = 1, \forall i\right)$.

We have two types of measures of the local conditions: the first is local weather (denoted w). Weather, and more generally, climatic conditions, have an important effect on agricultural production. The second local variable is a measure of the harvest quality relative to what is normal in that province (denoted by h); this captures a number of unobserved factors that influence rice output in addition to weather, including technology shocks. All else equal, favorable local weather and a high local harvest quality will lower the local relative to the national price as long as there is no perfect arbitrage across provinces.

The definition of the aggregate price in equation (2) implicitly assumes that conditional on size differences, all provinces are equally important in determining the aggregate price. This may be plausible if indeed trade barriers are close to zero, but not if they are still significant. Even in the United States today, for example, prices in New York matter often more for Connecticut prices than those prevailing in California, and based on direct evidence from historical sources on grain trade in early eighteenth-century China, we know that trade barriers limited trading possibilities over long distances.

The bilateral unit trade costs between provinces i and j can be expected to rise with geographic distance between i and j (denoted d_{ij}).[4] Thus, the national market condition from the point of view of province i might be determined by only a subset of other provinces. If we denote this as the *effective* aggregate price, it may for province i be written as

$$\overline{P}_{it}^{e} = \sum_{i \neq j, j=1}^{I} s_{ij} \psi(d_{ij}) P_{jt}, \quad \forall\, i, t, \tag{3}$$

where the function $\psi(d_{ij})$ captures this dependence on distance. A particularly simple version of this function that we will employ below is an indicator function, returning the value 1 if d_{ij} is less than some threshold level, and 0 otherwise.

To summarize, we will employ regressions of the following form:

$$p_{it} = \beta_0 + \beta z_{it} + \beta_1 \overline{p}_{it}^{e} + \beta_2 w_{it} + \beta_3 h_{it} + \varepsilon_{it}, \tag{4}$$

where the z's are control variables, $p_{it} = \ln P_{it}$, analogously, $\overline{P}_{it}^{e} = \ln\, \overline{P}_{it}^{e}$, and ε_{it} is assumed to be a mean-zero error term.[5]

3. Data

The sample consists of twelve Chinese provinces. These are Anhwei, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, and Zhejiang; they are contiguous and are located in the central and southern part of China, see Figure 1.[6] The maximum distance between the capitals of any two provinces is almost 1800 kilometers (km). We focus on rice, the most important agricultural crop in this part of China. This study does not cover the northern provinces and the metropolitan area around the capital of Beijing (Zhili province), because, unlike in the South, the climate in the North was not suited to rice farming, and rice prices were thus less frequently recorded.

Our sample period consists of two sets of years, one in the eighteenth and one in the twentieth century. The eighteenth-century period covers the years 1723 to 1735. The price data we employ summarizes the prevailing market prices at the province level. The original source of these data is the *Yongcheng zhupi yuzhi* (Vermillion endorsements and palace memorials of the Yongzheng period). Yongzheng (1723–35) succeeded to the throne upon the death of his father Kangxi (reign 1662–1722), and was the third of ten emperors who ruled during the Qing dynasty (1644–1911). Important procedures, originating with Kangxi, in what was to become a routine reporting system that transmitted data on prices, harvests, and weather reports from locations throughout the empire to the capital in Beijing were developed and expanded upon during Yongzheng's rule.

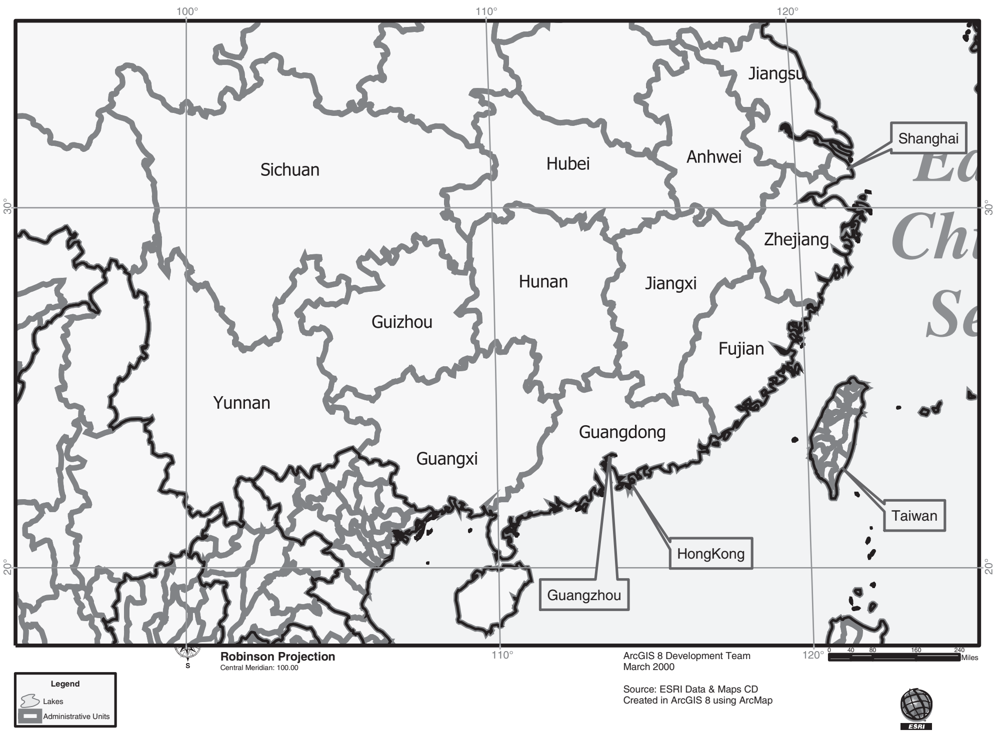

Figure 1. Twelve Chinese Provinces

The creation of the price reports typically began at the county level, where details on crops, harvest predictions, weather, and prevailing prices from the local county market were compiled every ten to 30 days. County officials sent their reports to the next higher authorities, the prefectural level, where the price reports were summarized and sent to the provincial governors. A detailed summary of all these reports was used by the provincial governor to prepare his report (memorial) to the emperor on the conditions in the province. These were part of the more general responsibility of various government officials to provide information about the economic and social conditions of their jurisdiction to the throne.

The agricultural reports submitted from the lower administrative areas of the empire included not only prices of three quality gradations of rice and several major local grains, but also a description of recent weather conditions, the amount of rainfall or snow, and made note of the severity of any floods or droughts. During months of cultivation, current planting conditions or the expected harvest outcome were noted. During post-harvest, information on actual yields was given.

The Qing emperors' interest in price and harvest conditions across the empire can in part be explained as general concerns about the legitimacy of governance from a political and economic point of view, since a severe weather shock could result in food crises and instability. Thus, the harvest, weather, and grain price report system served as a way to monitor food supplies in the empire, and it also served as an early warning system for potential areas of crisis. In addition, rice was an important commodity of consumption for military supplies and for the large number of bureaucrats and officials residing in Beijing. Much of the rice consumed by those in Beijing had to be obtained from other provinces since rice was not an indigenous crop around the northern capital.

Local officials were required to provide accurate information, and punished for failing to do so. To increase the quality and accuracy of the regular reports, a separate system of audits and checks on the regular reports operated through various channels as a dual price reporting system. More importantly, the standardization of the form and content in the reports, and the very practical functions of price information for official purchases of grain suggest that the information contained in the reports is useful and valid.[7]

Chuan and Kraus (1975) report prices at a monthly frequency, albeit not for all provinces and all years. We have aggregated the data to an annual level, which is the same frequency as the data we have for these provinces in the late twentieth century (see below). Table 1 provides an overview of the data. The average of all prices is about 1.2 for the period 1723–35 (columns 1–4), with the by-province mean varying from about 1 in Guizhou to about 1.5 in Zhejiang. Prices are reported in units of *taels* (silver ounces) per *shi* of rice, where one *shi* equals about 103.8 liters. The local prices are used to compute aggregate prices. We obtain the relative size of the provinces in this sample using fiscal land acreage (Wang, 1973), shown in Table 1, at the bottom.[8] Summary statistics on the aggregate price variable are shown in column (2) of Table 1.

Historical records on harvest for a large geographical area are often scarce or non-existent.[9] In the case of China, however, some records on harvest quality exist and are available to us.[10] Often the only information available is an overall assessment of harvest quality for the province as a whole, and there is one value for each harvest cycle.[11] Harvests are not reported in terms of absolute levels of output, but as a percentage of maximal output (100 percent) that could be expected in that province. It is plausible to view these percentages as an indicator of harvest quality. Harvest quality ranges from 50% ("poor harvest") to 100% ('excellent harvest') in the data, and are typically reported by ten-percentage point gradations.[12] Table 1 shows summary statistics on harvest quality in column 3.

Our source for historical weather data are the weather maps in the State Meteorological Administration (1981). These give weather data throughout China for each year for 120 "stations", where about five such stations are located in each province. We use the data for the station in the provincial capital. This is a discrete indicator of the degree of "wetness and aridity", from floods, droughts, monsoons, or rainfall, relative to what is considered normal for that region (denoted by R_{it}). Bad weather ranks are 1 and 5 (severe drought and flood), fair weather ranks are 2 and 4 (limited drought and floods), and good weather is rank 3 (favorable conditions). Our weather variable is defined as $w_{it} = |R_{it} - 3|$, so that higher values of w_{it} indicate worse weather (w_{it} takes on the values 0, 1, and 2). Summary statistics on this variable are shown in Table 1, column 4.

We can be brief in describing the data for our twentieth-century period, as this data has been carefully analyzed in a recent paper by Alwyn Young (Young, 2000).[13] Our sample period is 1986–93, for which we use annual data on the price of rice purchased by commercial establishments in the 12 provinces.[14] Summary statistics, in yuan per 100 kilograms, are given in Table 1, column 5. As our measure of province size, we use the total grain sown areas in each province, averaged in the years 1980 and 1985. From that we compute shares for the 12 provinces in our sample, shown in Table 1, at the bottom. Summary statistics of the aggregate prices based on that are presented in column 6.

Table 1. Summary Statistics

		Period 1723 to 1735				Period 1986 to 1993				
Province	Statistics	(1) Local price	(2) Aggregate price	(3) Harvest quality	(4) Weather	(5) Local price	(6) Aggregate price	(7) Harvest quality	(8) Weather	(9) Weather variab.
Anhwei	mean	1.164	1.228	0.767	0.769	49.688	52.777	0.000	8.813	0.763
	sd	0.092	0.129	0.153	0.725	11.218	12.033	0.132	2.454	0.187
Fujian	mean	1.373	1.219	0.829	1.000	56.113	52.300	0.000	11.701	0.874
	sd	0.250	0.125	0.132	0.707	12.723	11.852	0.034	2.766	0.140
Guangdong	mean	1.217	1.226	0.840	0.692	64.720	51.253	0.000	13.776	0.909
	sd	0.305	0.121	0.107	0.480	18.066	11.290	0.052	3.034	0.193
Guangxi	mean	1.157	1.224	0.827	0.636	56.198	52.176	0.000	10.620	0.894
	sd	0.280	0.126	0.136	0.809	15.613	11.807	0.088	2.281	0.198
Guizhou	mean	0.999	1.223	0.925	0.231	46.058	52.717	0.000	8.714	0.971
	sd	0.194	0.123	0.035	0.599	9.828	11.994	0.073	1.311	0.191
Hubei	mean	1.152	1.229	0.794	0.462	48.841	52.817	0.000	11.833	0.771
	sd	0.128	0.134	0.097	0.877	8.970	12.201	0.036	2.183	0.269
Hunan	mean	1.115	1.230	0.819	0.538	52.274	52.456	0.000	11.661	0.660
	sd	0.144	0.126	0.049	0.776	11.163	11.991	0.035	1.735	0.140
Jiangsu	mean	1.409	1.193	0.790	0.308	51.484	52.564	0.000	9.574	0.786
	sd	0.133	0.113	0.110	0.630	12.524	11.827	0.044	2.943	0.177
Jiangxi	mean	1.157	1.240	0.858	0.231	50.601	52.570	0.000	12.849	0.754
	sd	0.132	0.134	0.086	0.439	11.631	11.927	0.020	1.901	0.158
Sichuan	mean	1.023	1.236	0.733	0.364	52.209	52.483	0.000	7.196	1.133
	sd	0.272	0.124	0.208	0.505	12.878	11.805	0.025	1.469	0.169
Yunnan	mean	1.405	1.221	n/a	0.077	57.258	52.300	0.000	7.523	0.905
	sd	0.159	0.124	n/a	0.277	12.498	11.848	0.031	1.929	0.137
Zhejiang	mean	1.513	1.198	0.875	0.692	45.871	52.869	0.000	12.480	0.635
	sd	0.194	0.115	0.029	0.630	10.970	11.963	0.052	1.245	0.086
Total	mean	1.223	1.222	0.824	0.500	52.459	52.440	0.000	10.562	0.838
	sd	0.244	0.121	0.108	0.671	12.855	11.179	0.057	2.924	0.212
	N	112	156	58	152	93	96	96	96	96

Other Provincial Level Data

Variable	Year(s)	Anhwei	Fujian	Guangdong	Guangxi	Guizhou	Hubei	Hunan	Jiangsu	Jiangxi	Sichuan	Yunnan	Zhejiang
Relative size*	1723–35	0.083	0.030	0.073	0.019	0.006	0.128	0.075	0.153	0.214	0.100	0.020	0.100
Relative size**	1986–93	0.106	0.036	0.086	0.066	0.041	0.093	0.095	0.112	0.066	0.178	0.062	0.060
GDP per capita	1990	1170	1738	2247	1063	803	1527	1227	2318	1137	1106	1222	2167

* Fiscal land acreage, for the year 1753
** Total grain acreage, averaged for 1980 and 1985

Harvest quality in the twentieth-century sample is estimated as the residual from a regression of output on labor and capital in agriculture.[15] As long as other shocks (demand, productivity) are not perfectly correlated with weather shocks, this residual should pick up differences in harvest quality across provinces. Summary statistics for this are shown in column 7 of Table 1. The measure of weather is monthly average rainfall in a year, measured in centimeters, and the weather variability measure is the coefficient of variation of rainfall across months in a given province. Summary statistics on these variables are shown in Table 1, columns 8 and 9, respectively.

To incorporate the geographic dimension in this sample of Chinese provinces, we use the bilateral distances between provinces (measured as the distance between provincial capitals). Finally, the GDP and population figures we employ below to compute income per capita are taken from provincial statistical yearbooks (source: Young, 2000). GDP per capita figures are shown at the bottom of Table 1.

The next section turns to the empirical results.

4. Empirical Results

4.1 Market Integration in the Early Eighteenth Century and Late Twentieth Century

The results for the period 1723 to 1735 are presented in Table 2. These are variants of equation (4) in which the function $\psi(d_{ij})$ is set to 1 for now. In specification (1), the aggregate price coefficient is estimated to be positive. Even though the estimate of 0.530 is not very precise, one can reject the null hypothesis that it is equal to 1 at standard levels (the 95% confidence interval is [0.192, 0.868]). We also note that the aggregate price accounts for only about six percent of the variation in local prices. This suggests the importance of local influences on price.

Table 2. Market Integration in the Years 1723 to 1735

Dependent variable: log local price

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Aggregate price	0.530**	0.488**	0.089	0.476**	0.327
	(0.170)	(0.166)	(0.321)	(0.154)	(0.272)
Weather		0.058**	0.062	0.043*	0.024
		(0.028)	(0.045)	(0.022)	(0.038)
Harvest quality			–0.686**		–0.822**
			(0.285)		(0.212)
Province FEs	No	No	No	Yes	Yes
Hausman test [p-value]				0.55	2.42
				[0.759]	[0.491]
N	112	110	56	110	56
$\bar{R}^2$	0.056	0.093	0.147	n/a	n/a

All regressions include a constant (not reported).
Heteroskedasticity-consistent (Huber-White) standard errors in parentheses for (1)–(3).
Conventional standard errors for random effects specifications (4) and (5).
**(*) means larger than 0 at a 5%(10%) significance level.
Aggregate price defined in eq. (2); weather is |dryness-3|, see section 3.
Harvest quality variable described in section 3.

Consistent with this idea, we find the local weather variable entering significantly in specification (2). The estimate suggests that prices in a moderate drought or flood are on average 5.8% higher than under normal weather conditions, with an additional 5.8% price increase when a severe flood or drought occurs. Next, we consider the harvest quality variable.[16] The results suggest that the quality of the local harvest is a major determinant of local prices: for a harvest improvement from the first to the third sample quartile, the local price is predicted to be lower by about 8%.[17] In addition, the aggregate price is no longer significantly correlated with local prices.

The following two specifications introduce fixed effects for the provinces. Given the relatively low $\overline{R}^2$ of these regressions, there may be important unobserved heterogeneity that these fixed effects can control for. It comes at the cost of giving up any between-province price variation. The Hausman tests indicate that the efficient random effects model can be employed.[18] The coefficient on aggregate price in specification (4) is estimated to be not very different from the value in the comparable specification (2), without fixed effects (0.476 vs. 0.488). At the same time, we note that the fit of the regression increases substantially, indicating that unobserved heterogeneity across provinces plays a major role (this is not reported in Table 2). When the local harvest variable is added, it is significant while aggregate market conditions are no longer significantly correlated with local prices (see (5)). Overall, these results suggest that local factors, in particular harvest quality, are most important in determining prices in the early eighteenth century.

An important issue concerns the interpretation of the results in Table 2, specifically whether the coefficients measure the change in the local price for a given change in any of the right-hand side variables. The weather and harvest quality variables are arguably both random and exogenous, so that the coefficients can be taken as measuring the causal effects. The aggregate price, however, is likely to be in part endogenous, because if there is trade, the price of some province j—which is part of the regressor $\overline{p}_{it}$—may to some extent be influenced by p_{it}, the left-hand side variable of the regression. One way of obtaining true exogenous variation is to instrument for the aggregate price variable, but here we have such instruments only for the eighteenth, but not for the twentieth century.[19]

There is also the question whether estimating the effect of an exogenous change is appropriate in this context. Prices in trade equilibria are necessarily jointly determined, and a possible approach that treats both left- as well as right-hand side price variables explicitly as endogenous would be cointegration. Unfortunately, here the time series length is too short to obtain a powerful cointegration analysis. In other work on eighteenth-century China, we have shown that at least for shorter distances there is cointegration between markets, so that the least-squares estimates are consistent. The reader less interested in comparing eighteenth- and twentieth-century market integration, but more interested in an econometric analysis that explicitly addresses endogeneity issues, is referred to other recent work on eighteenth-century China such as Shiue and Keller (2004) and Keller and Shiue (2007).[20]

Here, we address the possible endogeneity of the aggregate price variable as follows. First, the price in province i is excluded from the computation of the aggregate price in order to avoid a built-in endogeneity between the dependent and an independent variable (see equation (1)). This will eliminate the first-order endogeneity effect. Second, we interpret the coefficient on $\overline{p}_{it}$ as a correlation, not as a causal effect.

Turning to the twentieth century, Table 3 shows the results, comparable to Table 2, of estimating versions of equation (1) above. In specification (1), the aggregate price effect enters with a coefficient of 0.966 and accounts for about three-quarters of the

Table 3. Market Integration and Trade in the Years 1986 to 1993

Dependent variable: log local price						
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Aggregate price	0.966**	0.954**	0.972**	0.971**	0.974**	0.972**
	(0.047)	(0.047)	(0.048)	(0.050)	(0.042)	(0.044)
Aggregate price 1986–89						
Aggregate price 1990–93						
Weather		0.063	0.076*	0.073	0.021	0.054
		(0.043)	(0.044)	(0.047)	(0.045)	(0.047)
Weather variability			0.094*	0.091	0.010	0.065
			(0.052)	(0.053)	(0.044)	(0.050)
Harvest quality				–0.060		–0.095
				(0.321)		(0.210)
Province FEs	No	No	No	No	Yes	Yes
Hausman test [*p*-value]					8.15	9.19
					[0.043]	[0.057]
$\overline{R}^2$	0.756	0.758	0.765	0.762		

All regressions include a constant (not reported).
Heteroskedasticity-consistent (Huber-White) standard errors in parentheses for (1)–(4).
Conventional standard errors for random effects specifications (5) and (6).
**(*) means larger than 0 at a 5% (10%) significance level.
Aggregate price defined in eq. (2); weather is log average annual rainfall.
Weather variability is log coefficient of variation of monthly rainfall.
Harvest quality variable described in section 3.

variation in local prices ($\overline{R}^2 = 0.756$). In addition to greater measurement error in the earlier period, which almost surely plays a role, this suggests that aggregate market conditions do not matter nearly as much in the early eighteenth century as they do in the late twentieth century. The weather variable does not enter significantly (see (2)). It may be that this relationship is nonlinear; including additional higher order terms in the regression though does not change the finding. However, according to (3) if both rainfall and its variability are considered simultaneously, this is associated with higher prices, all else equal. In contrast, the quality of the local harvest has no impact on the local price, according to specification (4). Including any of these additional variables has almost no impact on the coefficient of the aggregate price, which remains around 0.97.

In the remaining two specifications, we include fixed effects for the 12 provinces. With *p*-values of 4.3% and 5.7%, the Hausman tests at the bottom of (5) and (6) indicate that at a 1% level we cannot reject that the random effects model is appropriate.[21] The main consequence of allowing for fixed effects is that there is no longer a significant relation between weather variability and local price. The harvest variable enters with the expected sign (negative) but remains insignificant.

What about economic magnitudes? In specification (3), a 10% increase in local rainfall and rainfall variability is associated with about a 0.8% and 0.9%, respectively, higher local price, and most of this effect appears to be province-specific (the weather variables become insignificant when province fixed effects are included). The coefficient of 0.972 on aggregate price means that a 10% increase in the aggregate price of rice is associated with a price increase of 9.72% in province i, on average. Given the standard error, one cannot reject the null hypothesis that local and aggregate prices move one-for-one. For the modern sample period, then, the source of local price movements seems to be mainly aggregate shocks. This is consistent with a well-integrated grain market.

Overall, these findings suggest that in the late twentieth century, aggregate effects are far more important than local factors, whereas in the early eighteenth century the reverse is true: local factors dominate, and aggregate conditions do not affect local prices significantly. This indicates that a national market did not yet exist in the eighteenth century, but something closer to a nationally integrated market exists today. For the 1720s, this raises the question of what was the scope of China's rice markets at the sub-national level—over what distances do we find evidence for market integration and trade?

To bring this question into sharper focus, we introduce geographic features in the next section.

4.2 The Scope of Markets in Geographic Space

The bilateral distances between provincial capitals in our sample lie between 234 and 1797 km, with a median value of 760 km. In the following, we construct aggregate price measures separately for relatively near and relatively far provinces, based on some threshold distance, $\bar{d}$. To this effect, we define the indicator function $I(d_{ij}, \bar{d})$ which equals 1 if $d_{ij} < \bar{d}$, and 0 otherwise. Analogously, we define another indicator function, $\tilde{I}(d_{ij}, \bar{d})$, which equals 1 if $d_{ij} \geq \bar{d}$, and 0 otherwise; the corresponding aggregate prices are $\bar{p}_{it}^{e,n}$ (superscript "n" for near) and $\bar{p}_{it}^{e,f}$ (superscript "f" for far).[22]

We then consider the following regression:

$$p_{it} = \beta_0 + \beta_n \bar{p}_{it}^{e,n} + \beta_f \bar{p}_{it}^{e,f} + \varepsilon_{it}, \tag{5}$$

where β_n estimates the association of aggregate market conditions with nearby provinces, while β_f is for aggregate market conditions in provinces that are above the threshold distance $\bar{d}$ away. A simple grid search over threshold distances gives 700 km as the value that maximizes the fit of equation (5) for the period 1723–35; we take $\bar{d} = 700$ as our threshold value. Conditional on this distance threshold, Table 4 shows estimation results for both the 1723–35 and 1986–93 samples.

In the early sample period, β_n and β_f are estimated to be 0.578 and about 0, respectively, whereas in the later period the corresponding values are 0.618 and 0.344 (columns 1a and 1b). The changes in the degree of market integration over these 270 years can be gauged in a number of ways. First, if prices in all other provinces go up by 10%, this is associated with a 5–6% higher local price in the eighteenth century, while it is close to the full 10% in the later period; these results confirm the earlier regressions. This move from a correlation of local with aggregate prices from about 0.5 to close to 1.0 points to a substantial increase in the degree of market integration.

Second, for the early eighteenth century, prices in provinces that are more than 700 km away are not correlated with local prices at all: 100% of the aggregate price correlation comes from provinces that lie within 700 km. In contrast, for the late twentieth-century sample, provinces beyond the 700 km distance range contribute about one-third of the total correlation (0.344/(0.344 + 0.618)). Changes in market integration seem to be primarily the result of establishing market linkages over longer distances.

Table 4. The Geographic Scope of Market Integration Over Time

Dependent variable: log local price

	1723 to 1735				*1986 to 1993*			
	(1a)	*(2a)*	*(3a)*	*(4a)*	*(1b)*	*(2b)*	*(3b)*	*(4b)*
Aggregate price—Near	0.578**	0.554**	0.381	0.505**	0.618**	0.608**	0.607**	0.561**
	(0.170)	(0.161)	(0.252)	(0.165)	(0.151)	(0.147)	(0.146)	(0.143)
Aggregate price—Far	0.028	–0.021	–0.123	–0.003	0.344**	0.352**	0.352**	0.402**
	(0.088)	(0.083)	(0.153)	(0.152)	(0.144)	(0.145)	(0.145)	(0.143)
Weather		0.053**	0.065	0.017		0.086**	0.086*	0.045
		(0.025)	(0.042)	(0.037)		(0.042)	(0.045)	(0.047)
Weather variability						0.068	0.067	0.031
						(0.053)	(0.057)	(0.050)
Harvest quality			–0.571**	–0.707**			–0.018	–0.083
			(0.277)	(0.194)			(0.327)	(0.197)
Province FEs	No	No	No	Yes	No	No	No	Yes
Hausman test				5.36				4.27
[*p*-value]				[0.252]				[0.511]
N	110	108	54	54	93	93	93	93
$\overline{R}^2$	0.126	0.150	0.169	n/a	0.751	0.758	0.755	0.879

All regressions include a constant (not reported).
Heteroskedasticity-consistent (Huber-White) standard errors in parentheses for (1a)–(3a) and (1b)–(3b).
Conventional standard errors for the random effects specifications (4a) and (4b).
**(*) means larger than 0 at a 5%(10%) significance level.
Definitions of variables are as in Tables 3 and 4, respectively.

Third, the distinction of near versus far provinces is much more important in the eighteenth than in the twentieth century. This is another indication of the fact that geographic distance matters much less in the later period: comparing the regression fit in Tables 2, 3, and 4, we see that the $\overline{R}^2$ more than doubles upon the separation of near versus far provinces in the early period, whereas the improvement in $\overline{R}^2$ for the later period is tiny if present at all.

The additional regression results presented in Table 4 largely confirm these results. An exception is specification (4a): when near and far aggregate prices are distinguished, using the random effects model we estimate a positive and significant aggregate price effect in the earlier period even conditional on harvest quality. Without the near/far distinction, there was no significant aggregate price effect (see Table 2, specification (5)). The results suggest that local and aggregate factors (with distance of less than 700 km) influence local prices in roughly the same order of magnitude: a 10% increase in this aggregate price is associated with a 5–6% local price increase, while a 10% better harvest is associated with a 6% lower local price, on average.

This modifies our earlier conclusion for the eighteenth century period that all variation in local prices has local sources. We continue to find that prices in provinces that are relatively far away do not matter, but price movements in markets at intermediate distances (up to 700 km) account for about half of the variation in local prices, with local harvest shocks accounting for the other half. For the late twentieth century, the findings are on the whole unchanged, with aggregate effects playing the dominant role.

We have conducted a wide-ranging analysis in order to examine the robustness of these results. In particular, we have confirmed that neither any individual province nor any particular period is responsible for the main results. When we distinguish between groups of provinces based on geographic location, the correlation of local and aggregate price for southern and eastern provinces in the early eighteenth century tends to be somewhat stronger than that in northern and western provinces. In the late twentieth century, the correlation of local with aggregate prices beyond 700 km is stronger for southern than for northern provinces of China.[23] Overall the analysis indicates that our findings are robust.

In the following section, we examine the relationship between the measures of market integration and income.

4.3 Market Access, Trade, and Income

We now turn to the question of whether differences in market access and trade are related to income differences across provinces. The evidence presented above suggests that market integration and trade have increased substantially between the early eighteenth and late twentieth century. At the same time, we know that per capita income in these provinces has risen as well, even if we do not have exact figures for the eighteenth century period. Thus, we observe more trade at the same time as we observe higher incomes. But can we say more than that?

To this end, we examine whether there are differences across provinces in terms of market access and trade at a given point in time. In our framework, this amounts to asking whether the aggregate price is more important in explaining local price variation in some versus in other provinces. While there is not enough data for a powerful regression analysis (roughly eight observations per province in 1986–93), we can aggregate the provinces into groups and then examine how income varies with market integration across groups.

For each of the 12 provinces, we compute their median GDP per capita from the years 1986 to 1993. In the year 1990, GDP per capita ranges from a high of 2318 yuan in Jiangsu (including Shanghai) to 803 yuan in Guizhou. We classify the 12 provinces into three groups with four provinces each, called Low-, Mid-, and High GDP per capita groups, and compute for these three groups our measure of market integration (group median of correlation of local with aggregate price).[24]

The left-hand side of Figure 2 shows the results. There is no major difference in terms of market integration and trade between the “Mid” and “High” provinces, while there is some between the relatively poor and the other provinces (0.91 for “Low”, and 0.96 for “High” incomes). This is consistent with relatively good market integration and trade being a cause of relatively high income. At the same time, the differences across the regions are, with about five percentage points, not very large.

What about the earlier period? As noted above, we do not have good measures of provincial incomes at that time. But we can compare our measures of market integration and trade for the period 1723–35 with the GDP per capita figures for 1986–93. This is shown on the right-hand side of Figure 2. The “Low” income provinces of the late twentieth century had values around 0.35, whereas the “High” income provinces had values around 0.68, with the “Mid” group in between. The analysis above already indicated that all eighteenth-century levels of market integration would lie considerably below the twentieth-century values. Thus, what is new here is that market integration and trade in the 1720s–30s is a good predictor of GDP per capita in the late twentieth century.[25]

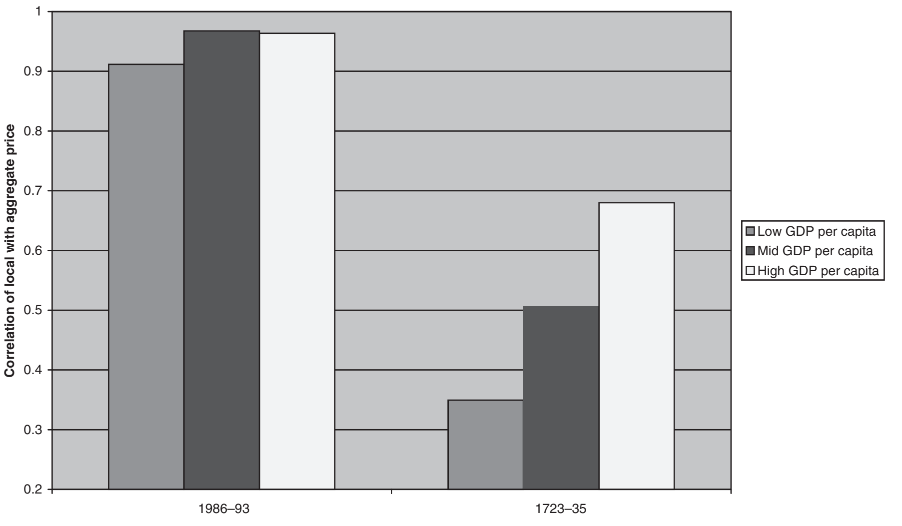

Figure 2. Market Integration, Trade, and Income across China: Now and Then

One implication of this finding is that relying on only a relatively short time horizon to assess the impact of market reform in China may be misleading. Since the inception of the reforms of the 1980s, it may well be that it was in the most market-oriented provinces where per-capita income grew fastest—particularly those provinces along the coast, Guangdong, Zhejiang, Fujian, and Jiangsu including Shanghai—but it does not follow that all the growth effects since reform can be attributed to market reform and trade liberalization. Our analysis shows that today, richer provinces enjoy higher levels of integration and trade than poorer provinces (Figure 2, left). However, the same provinces that are rich today had relatively high levels of market integration and trade already about 270 years ago (Figure 2, right).

This is not to say that market reform has no growth effects, but in the nineteenth and early twentieth centuries, China was strongly affected by war, political instability and foreign incursion. From the end of World War II until 1978, China was a socialist planning economy. Thus, it may well be that the eighteenth century is the most recent time before the 1980s during which the market played the major role as China's allocation mechanism. Seen along these lines, the regional income dynamics in China since 1978 could just mean a return to the cross-province income differences that had existed in China a couple of centuries earlier. If this is the case, it would support the idea that regional economic disparities associated with market integration, trade, and geography are highly persistent. It would also suggest that the impact of reform is overstated.

The following section summarizes our results and contains additional discussion.

5. Discussion

This paper studies market integration and trade in China over almost three centuries. Our findings indicate that in the late twentieth century, although the law of one price does not hold, local and national prices essentially move one-to-one. Compared to historical levels of market integration, contemporary markets are more integrated. But we also find a significant degree of market integration for distances up to about 700 km in early eighteenth-century China.

That there is evidence for a substantial degree of market integration provides additional support for other research that finds significant integration in China. The evidence in this paper pushes this period even earlier, to the early eighteenth century. The finding of significant integration over the eighteenth century in China is also consistent with evidence that finds market integration in China was high and comparable to most of the advanced areas of Western Europe before the turning point of modern growth, and that the divergence of incomes between China and Western Europe emerged rather suddenly in the nineteenth century (e.g., Shiue and Keller, 2004). In contrast, theories of modern growth that suppose a Western European advantage that accumulated early on and very slowly over several centuries prior to the 1730s do not seem to find support in our analysis.

Moreover, when we compare past differences in market integration and trade with today's differences in per capita income, we find that the degree of market integration in the 1720s is a very good predictor of per capita income in the 1990s. This paper does not analyze non-agricultural commodities directly, but considering the extent of structural change that has taken place over 270 years, it is quite stunning to see how well agricultural market integration in the past alone can predict today's income per capita.

The finding that per capita incomes in the late twentieth century can be forecasted by market integration levels about three centuries earlier supports the notion that initial advantages may have major income consequences in the very long run. Put differently, the rate of income convergence among Chinese provinces appears to be rather small, or possibly zero. The finding also suggests that while the 1978 Chinese reforms may have been important for the cross-provincial income distribution that emerged thereafter, it is easy to overestimate the importance of these reforms. What we observe may be less due to trade liberalization and subsidies going to special economic zones to attract foreign direct investment, and more due to the re-emergence of the income distribution across Chinese provinces that had existed a couple of centuries earlier. At a minimum, our results suggest that it is useful to take a very long-term view when assessing the efficacy of economic policy reform.

What do our results say on the relationship between trade and growth? In provinces where there is more trade and better market integration, we observe higher per capita income. This appears to be the case both contemporaneously and over time. These systematic differences in trade and income, however, do not necessarily mean that trade causes growth—an equally plausible explanation is that trade and income are jointly determined. The fact that we find contemporaneously-rich provinces to have relatively high levels of market integration already three centuries earlier may help in determining cause and effect, and it highlights the advantage of taking a long-run view. If the exogenous determinants of market integration three centuries ago are persistent (and waterways and geography generally are), one could—to use econometric language—instrument contemporaneous market integration with past market integration to assess the effect of trade on growth.

Finally, how important are trade and market integration as institutions? If the landlocked province of Guizhou were to trade in all goods and services to the same extent as Guangdong province, would Guizhou attain the per capita income of Guangdong? The answer may be affirmative, but given the persistence of provincial differences over the centuries in the case of China, it is a scenario that seems unlikely. The emergence of a higher level of market integration in Guangdong than in Guizhou, in the eighteenth century just as today, may itself be related to other fundamental differences between these provinces, including but not limited to differences in their physical geography.

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Notes

1. In 1993, these 12 provinces had a population of about 0.7 billion, which, given a world population of 5.4 billion, gives a share of 13%. In the mid eighteenth century, these provinces had a population of about 200 million, which according to the best estimates we have amounted to about 20% of the world population.
2. Such trade can be quite important. In fact, Irwin argues that for the period 1500–2000, intra-continental trade—such as trade within Europe or similar-sized China—was quantitatively more important than inter-continental trade (Irwin, 2003, p. 63). See also Perkins (1969).
3. Our analysis abstracts from international trade, because it was largely prohibited and hardly existed in the case of China in the early eighteenth century. In the late twentieth century, China's international trade plays a greater role; on contemporary China and its international trade, see, e.g., Dinopoulos and Segerstrom (2003), who study the effects of China's accession to the World Trade Organization.
4. In eighteenth-century China, the size of the *per diem* ration of rice determined the distance over which grain trade through porters was feasible. In today's economies, distance often determines shipping times and hence transport costs; see e.g. Hummels (1999). In addition, there are distance-invariant trade costs, such as those related to loading and unloading.
5. There are a number of alternatives to our approach of studying market integration, each emphasizing a somewhat different aspect; these include cointegration techniques (e.g., Shiue and Keller, 2004), threshold autoregression models (e.g., Taylor, 2001; Pippenger, 2004), and spatial econometric techniques (e.g., Keller and Shiue, 2004).
6. Figure 1 shows a late twentieth-century map of China. The provincial boundaries in the early eighteenth century were similar to the twentieth-century boundaries, with small exceptions such as Shanghai, which was a part of Jiangsu and is now independent. Our analysis takes this into account.
7. Chinese records on grain prices date to as early as the Tang Dynasty (618–906). For more details on the origin, functions, purposes, and reliability of the grain price reporting system in the Qing Dynasty, see Wilkinson (1969), Wang (1987), Wang (1989), and Chuan and Kraus (1975).
8. These 12 values s_i give rise to 132 s_{ij} when we drop the own weight ($s_{ii} = 0$, for all i), and rescale so that the sum over all j is equal to 1, for all i.
9. For most European nations, for example, price fluctuations are the only evidence for harvest quality that we have (Persson, 1999). An exception is Clark (2002), who uses harvest records from medieval England.
10. See Chuan and Kraus (1975), and also Gong and Zhang (1983).
11. Typically, there is one harvest cycle per year. In five of the twelve provinces, however, it was possible to harvest twice per year (Fujian, Guangdong, Guangxi, Jiangxi, and Zhejiang). If information on both harvests is available, our annual harvest measure is the average of the two

for these provinces. All dates have been converted from the original lunar system of dating to the solar calendar. See Chuan and Kraus (1975) for details on the timing of harvests, especially p. 99, and pp. 119–66.

12. A 70% harvest is typically recorded as "fair", while 80% and 90% harvest are "fair/good" and "good", respectively.

13. We thank A. Young for posting this data on his website; all the data described in the following comes from this source. The original sources of Young's data are public, including Province Statistical Yearbooks, China Statistical Yearbooks, and China Price Statistics Yearbooks. For more details on the nature and original sources of the data, see Young (2000).

14. This is the price for long-grained nonglutinous rice (Indica rice).

15. The regression of log agricultural output on log labor (employment in primary sector), log capital (power of agricultural machinery), and provincial fixed effects gives an R^2 of about 0.98; we include the fixed effects to obtain a harvest measure relative to what is normal in the province, the measure we have for the eighteenth-century period.

16. This reduces the size of our sample, see Table 2.

17. The first quartile is 78% of the harvest, the third quartile is 90%, and $(0.90 - 0.78) \times -0.686 = -0.082$.

18. The random effects model assumes that there is no correlation between province fixed effects and the regressors, while the deterministic fixed effects (LSDV) model gives consistent estimates even in the presence of a non-zero correlation.

19. For the eighteenth century, local harvest quality may be a good instrument for local price (see Table 2, specification (3)), and we have experimented with a predicted aggregate price based on this first-stage regression. For the twentieth century, however, harvest quality is not correlated with local price (see Table 3, below), ruling out this approach for comparative analysis.

20. We have also considered including a trend or time fixed effects in the specification. This would eliminate common shocks, important if we primarily tried to estimate an exogenous effect. We do not include time fixed effects here because they are less plausible in the context of long-run equilibria between endogenous prices; formal tests for eighteenth-century China are summarized in Shiue and Keller (2004).

21. In any case, the LSDV coefficients are similar to the random effects estimates in Table 3.

22. The "near" aggregate price is defined as $\overline{p}_{it}^{e,n} = \ln\left[\Sigma_{i\neq j,j=1}^{I} s_{ij} I\left(d_{ij}, \overline{d}\right) P_{jt}\right]$, $\forall\ i, t$, and the $\overline{p}_{it}^{e,f}$ variable is analogously defined and based on $\tilde{I}(d_{ij}, \overline{d})$.

23. These results suggest that relatively good waterway access along the coast in China's East and South meant low transport costs for grain trade, which is consistent with the findings in Shiue (2002).

24. This is the aggregate price for distances of less than 700 km in both sample periods.

25. We have also confirmed that there is a significantly positive relationship between market integration in the eighteenth and GDP per capita in the twentieth century using regression analysis.