# The Evolution of Markets in China and Western Europe on the Eve of Industrialisation[*]

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**Abstract:** We use monthly prefectural data for Southern China (1740-1820) to implement a dynamic version of Shiue and Keller's (2007) seminal analysis of spatial market integration. Our cointegration analysis is carried out for rolling windows of 20 years, rather than their static cross-section, and uncovers a secular decline in market integration across all bilateral distance categories of Southern China. When comparing Chinese prefectures less than 150 km apart with Belgian markets (1765-94) and English counties (1770-1820) in the same distance category, we observe similar degrees of market integration for 1740s China and mid-18th century Belgium and England. While the two European countries maintain stable levels of integration over time, we find substantial decline in China relative to the West, in particular when the analysis is limited to the economically most advanced Lower Yangtze region or the prefectures along the Yangtze River.

**Keywords**: market integration, 18th century, China and Western Europe, cointegration

**JEL classification**: F15, N75, L11, O13

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# 1. Introduction

*"A fundamental problem with the 'striking resemblances' [between East and West] thesis, is that, in trying to establish the relative efficiency of various economies, it tends to compare static cross-sections."*

Peer Vries (2010: 741)

A large literature on the role of markets and development finds that well-performing markets and their supporting institutions were necessary but insufficient to enable some regions to embark on industrialization. Regions with similarly advanced and efficient markets did not undergo industrialization in similar ways. A major focus of analyses has been the Great Divergence between Europe and China from the late 18th century onwards. Advanced parts of Europe began to experience sustained growth as the Industrial Revolution took hold from the late 18th century, while China was to languish for more than another 150 years. Wang (1992), who did pioneering research into grain and land prices in China, argued markets in China in the mid-18th century may well have been more integrated and hence price-efficient than those in Europe, but had fallen well behind by the start of the 19th century. Pomeranz (2000: 16) even went so far as to suggest factor and product markets might have been in advance of Europe in the closing decades of the 18th century. In a seminal empirical contribution, Shiue and Keller (2007; hereafter SK) directly compared the performance of rice markets in South China with selected European wheat markets. Their paper compared the spatial integration of these grain markets using cointegration analysis.[1] They find that "as late as 1780, markets in China were comparable to most of those in Western Europe" (SK: 1190).

The SK paper changed how economic historians and economists viewed the relative performance of early modern Chinese and European grain markets. Cited widely, the SK study was the first rigorous empirical test of the positive views of Chinese economy that had come out of the so-called California School (Wong, 1997; Frank 1998; Pomeranz, 2000, among others). Markets performed well during the 18th century, so the explanation for China falling behind must be sought elsewhere.

Our study extends the SK approach using a dynamic implementation of their cointegration framework. In doing so, we qualify their conclusions. There are three important differences in our implementation of the cointegration framework compared with SK. First, we extend the temporal coverage of the Chinese data from 1742-95 to 1740-1820. Secondly,

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[1] Their use of cointegration analysis anchors the results in a general equilibrium framework of price behaviour and provides some safeguards against spurious correlation and short-term dynamics that otherwise distort the analysis.

we use the full 12-months of prefecture-level price data in our estimations instead of just two monthly data points. Thirdly, enabled by the use of monthly data we deploy a rolling window of analysis to examine dynamic changes over time instead of a static cross section for the entire period. Starting from 1740, we estimate the pairwise coefficients for a 20-year window of 1740-59, shifting the window one year at a time and repeating the analysis until the final window of 1801-20. These innovations are applied to monthly rice prices from 131 Southern Chinese prefectures, and for cross-continental comparison to monthly wheat prices from 20 Belgian cities (1765-94) and 40 English counties (1770-1820). We are thus able to address one of the fundamental criticisms levelled against 'Californians' voiced by Peer Vries (2010) among others and cited at the start of this article.

Our main findings are twofold. First, across all bilateral distance categories we show a progressive decline in the extent of Chinese market integration during the 18th century. Second, comparing the time paths of market integration in China, Belgium and England in the lowest distance category (150km or less), we establish that degrees of Chinese market integration at the start of our sample period in the 1740s were comparable to those around the 1770s in Belgium and England, in particular for the Yangtze River Delta, the economically most advanced region. Contrary to the widely accepted view that market integration was high in 18th century China, our rolling window implementation of the cointegration analysis finds evidence for a substantial decline in China relative to the Western European economies. This is the case for the full Chinese sample as well as Yangtze Delta and Yangtze River prefectures subsamples, respectively. SK's results based on the cross-section for the entire 1742-95 period are strictly speaking not incompatible with this finding of secular decline. In fact, in a static sense we agree the markets were comparable. Our conclusion – and contribution to the literature – is that there had emerged divergent trajectories for market integration between East and West well before the end of the 18th century, which is in stark contrast to SK's conclusion that "grain markets did not perform uniformly better in Western Europe than in China" (1205).

The availability of suitable national price panel data constrains our choice of countries for the cross-continental comparison. Belgium and England were chosen because they have substantial 18th century grain price series for many locations *at a monthly interval* (or even weekly for England), and thus our results below are less likely to be biased due to temporal aggregation[2] than if we had used *annual* price series over longer time horizons (e.g., Allen

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[2] Temporal aggregation of prices biases estimates of convergence and half-lives (Taylor, 2001; Brunt and Cannon, 2014). In the *Returns* data we pick prices for the first week of every month.

and Unger's *Global Commodity Prices Database*). These two economies are suitable benchmarks since they were argued to have experienced relatively high levels of national market integration on the eve of industrialisation (SK; Buyst, Dercon and Van Campenhout, 2006). One might *a priori* suggest that the inclusion of alternative 18th century country series from Central or Southern Europe – if such data were available at monthly frequency for a large number of markets[3] – would be a more suitable benchmark to gauge Chinese market integration. However, this criticism misses a crucial point of our empirical results (established *ex post*), namely that the level of market integration in 1740s-60s China was *very much in line* with that of Belgium and England only one or two decades later.[4] Taking English and Belgian markets as a benchmark for China or the Yangtze Delta region is not excessively ambitious and represents the equivalent level China had readily achieved around the time the Qianlong emperor took to the throne.

We are not the first to suggest China's market integration was in decline during the 18th century, though existing work has primarily focused on single provinces or Skinner (1977) macro-regions (for example Li, 2000, on Zhili; Marks, 1991: 105, on Lingnan). Rawski (1972) suggests local markets were vibrant but that trade was cut off between regions. Her view anticipated Skinner's macro-region studies and echoes Pomeranz' (2000: 22) suggestion of high levels of integration *within* macro-regions but not between, "especially after 1780." Such market segmentation is also emphasised in Cheung (2008: 11), who refers to Chinese rice markets as "sporadically integrated," especially during the second half of the 18th century.

The remainder of this article is structured as follows: Section 2 introduces the datasets, Section 3 sets out the empirical framework, and Section 4 presents the empirical results. In Section 5 we critique the empirical approach adopted here and in SK, pointing to new methods we introduce in a companion paper. Section 6 concludes.

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[3] The work by Bateman (2011) represents the best alternative we could find, bringing together (*inter alia*) monthly wheat price series for 10 European cities (Vienna, Antwerp, Brussels, Toulouse, Cologne, Munich, Ruremonde, Utrecht, Pisa and Siena) covering at least parts of the 18th century. However, these data create only a minimal sample for comparison in the lowest distance category (<150km): with reverse pairs a total of 14 observations, compared with 162, 134, 570, 380 and 614 in the lowest distance category for the Yangtze Delta, Yangtze River prefectures, Southern Chinese prefectures, Belgian cities and English counties, respectively. The second distance category (150-300km) covers only three pairs.

[4] We do not have data for England or Belgium for the 1740s, 50s and most of the 60s, so we cannot establish their levels of market integration during that period. Once we do have data for these countries from the mid-1760s onwards, their average ADF *t*-statistics are in line with those in Southern China during the earlier period.

## 2. Data

For China we use monthly prices for rice spanning 81 years, from 1740 to 1820, in 131 prefectural markets in 11 provinces of South China.[5] SK's sample uses two observations per annum (the second and eighth month) from the same source for the shorter period 1742-95. The imperial grain price reporting system was implemented during the reign of the Kangxi emperor (1662-1723) and became a nation-wide system at the start of the reign of the Qianlong emperor (1736-1795). The market prices were collected at the county-level in local weight and currency, and compiled into prefecture-level summaries of high and low prices for up to 20 commodities,[6] which the provincial governor would send in monthly reports to the emperor in Beijing (Chuan and Kraus, 1975; Wang, 1978, 1992; Marks, 1991). Sources suggest the Qianlong emperor and senior officials scrutinised the reports, querying anomalies, which combined with a system of irregular independent reports, ensured lower-level officials were "on their toes" (Marks, 1991: 69, quote; Chuan and Kraus, 1975; SK Online Appendix). Our sample is longer than SK and includes 10 prefectures in Sichuan province. Our price series has around 100,000 observations; we have on average over 730 time series observations for each prefecture.[7] We follow SK in adopting the unweighted mean of the reported high and low monthly prices in our empirical analysis. In addition to analysing Southern China as a whole we provide results for the Yangtze Delta (Jiangnan) region and prefectures along the Yangtze River. We follow SK's definitions for these spatial groupings. The sample distribution is shown in Figure 1 and in Appendix Table A-1.

We compare markets in South China – and in particular its more advanced parts – with advanced European economies during the late 18th century, employing monthly wheat prices for 20 Belgian markets, 1765-1794 (Vandenbroeke, 1973), and for 40 English counties, 1770-1820 (the *English Corn Returns*, collected by Brunt and Cannon, 2013).

From the middle of the 18th century onward the central government of the Austrian Low Countries (Belgium) implemented a program to closely monitor the fluctuations of local grain prices. Like in China, this effort was intended to organize an efficient food supply and to move away from the past *ad hoc* management of food crises (Buyst et al, 2006). Between

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[5] We use medium grade rice for best coverage with the exception of Zhejiang Province where in the absence of alternatives we select polished early-ripening rice. The data collected by Wang Yeh-chien and collaborators are accessible from the Qing Dynasty Grain Price Database (*Qing dai liangjia ziliao ku*), which is hosted at the Institute of Modern History, Academia Sinica, Taiwan.

[6] Prices were recorded in standard taels (*liang*; ounces of silver) per granary bushel (*cang shi*, about 104 litres).

[7] Our panel is unbalanced because we retain prefectures even where there may be significant missing observations (on average 19% of observations) for some periods. Robustness checks presented below address concerns over the impact of missing observations on our findings.

1765 and 1794, customs officials recorded the prevailing market prices for various agricultural products, which were passed to specialist civil servants who oversaw the data collation process and standardized the reporting units use by city governments.[8] The wheat prices we use are those observed on the first market day of the month for all markets considered (Vandenbroeke, 1973), comprising 20 locations with data available for almost all of the 360 months between 1765 and 1794. These markets were "a representative sample of all large and medium-sized grain markets in the Austrian Low Countries" at the time (Buyst et al, 2006: 188). See Figure 1 and Appendix Table A-2 for the location of markets.

The *English Corn Returns* were compiled and published to monitor grain trade in England, Wales and Scotland as part of the British government efforts to regulate domestic grain prices from the 1690s until 1846 (*Corn Laws*), which sought to smooth prices and insure both consumers and farmers against price fluctuations, and further to keep prices high and thus encourage productive investment in agriculture. Like in the Qing China price series, the *Returns* were intended to provide an accurate picture of grain price movements in the country to enable policy interventions.

In the first 20 years of the *Returns* local Justices of the Peace (JPs) collected prices from between two and six market towns in their jurisdictions and each week sent these to the Treasury in London. The identity of market towns from which these prices were drawn was not stipulated and most likely differed between weekly *Returns* (Brunt and Cannon, 2013, 2014). This reporting process is thus similar to that for Chinese prefectures. From 1789 onwards a system in place for London since 1781 was extended across the nation whereby Inspectors of Corn Returns were appointed in each designated market town to collect sworn records of 'all sales' of domestic produce and to forward averages of these prices to the Receiver of Corn Returns in London on a weekly basis. The identity of the monitored market towns was now fixed and their number by county varied between two in Rutland and 12 in Norfolk. The Treasury-based Receiver then calculated the county averages that were published in the *London Gazette*.[9] From the weekly *Returns* data our analysis adopts the first available county wheat price for each calendar month. The sample composition is illustrated in Figure 1 and listed in the Appendix Table A-3.

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[8] Different cities used different measurement systems, which were converted to a common unit – *Brabantine stuivers* per *razier* from Brussels (49 litres).
[9] The data for the 1770-1820 period are prices per (Winchester) bushel of grain in shillings and pence (transformed into pence for the empirical analysis), representing county average prices. Since the availability of London prices differs from that of the 40 counties we limit our sample to the latter.

Figure 1 – Map
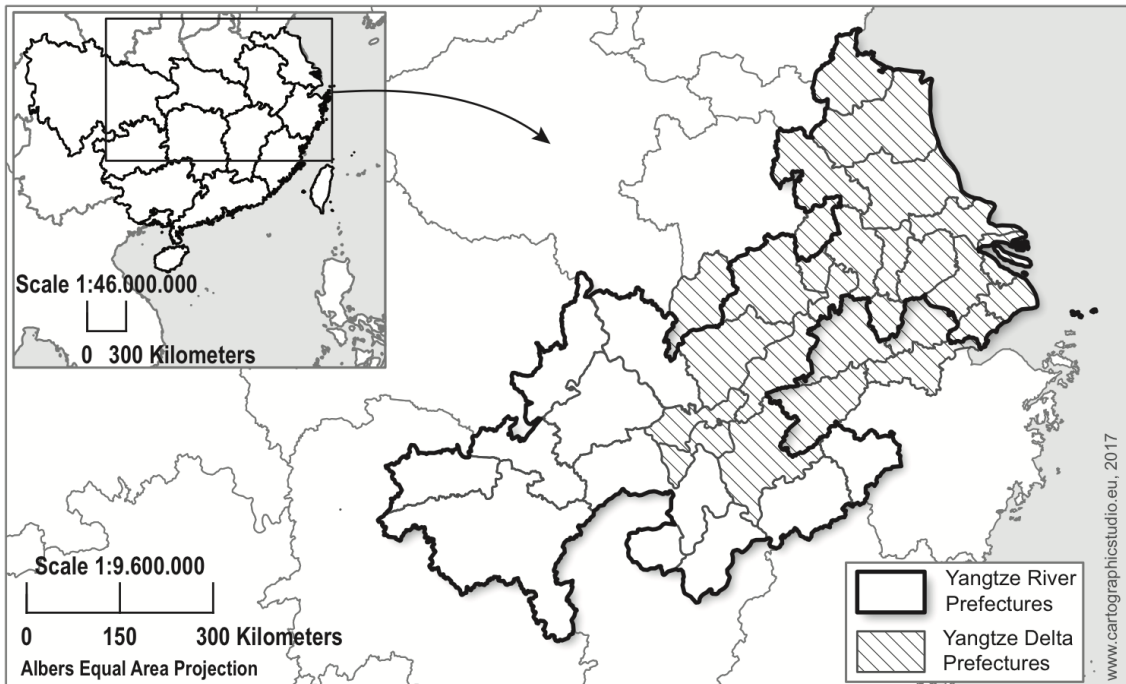


*Notes*: Our Southern Chinese sample comprises 131 prefectures from 11 provinces indicated in the small map inset into the upper panel of this figure. The Yangtze River and Yangtze Delta samples are highlighted in the main map of the upper panel. The lower panel indicates our sample for England and the Austrian Netherlands. The latter does not include cities in the east of the country beyond the Prince-Bishopric of Liège. Upper and lower panels (with the exception of the small inset map for Southern China as a whole) are to the same scale.

Measures of bilateral distance (as the crow flies) for our Chinese sample are computed using data from the China Historical GIS project at Harvard, SK provides distances for the English sample, and distances in the Belgian sample are computed using an internet-based map tool.[10] Distance groups follow the categorisation in SK.

Comparisons between our panel datasets are appropriate given the monthly data frequency, their national market character (no international borders), and the substantial overlap in time and first distance group coverage across the three countries.

### 3. Empirical Framework

The empirical literature on market integration is vast (Fackler and Goodwin, 2001; Federico, 2012), while the metric for measuring market integration is contingent on data availability. An advantage of cointegration analysis used in SK and our study is that it is rooted in a theoretical equilibrium price parity condition where commodity prices are assumed to capture all the relevant information about market performance. The condition for trade between price pairs $P_{it}$ and $P_{jt}$ in locations $i$ and $j$ at time $t$ with iceberg trade cost $z > 1$ is defined as

$$1 \Big/ z(d_{ij}) \leq \left( P_{it} \Big/ P_{jt} \right) \leq z(d_{ij}), \tag{1}$$

where trade costs are represented as a function of bilateral distance $d_{ij}$. Cointegration tests of market integration consider whether over time the price gap between market pairs becomes arbitrarily large (nonstationary process) or not (stationary process). If prices diverge *in the long-run* then arbitrage opportunities remain unexploited, hence the two markets are not integrated. The empirical implementation of this principle proceeds in two steps. First, price pairs are entered into a linear Engle and Granger (1987) cointegrating regression:

$$\ln(P)_{it} = \alpha + \beta \ln(P)_{jt} + \varepsilon_t. \tag{2}$$

Our specification for monthly data includes dummies for each lunar/calendar month (but one) to capture seasonality. We follow SK and add outlier dummies to the Engle-Granger regression in (2), defined to indicate those time periods in which the growth rate of the grain price in $i$ or $j$ exceeds the long-run standard deviation of the respective log levels series. In a second step the residuals $\varepsilon_t$ from equation (2) are investigated in augmented Dickey-Fuller (ADF) regressions (Dickey and Fuller, 1979):

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[10] For simplicity we include *all* city pairs in <150km group even though Nieuwpoort-Namur is 166km apart.

$$\Delta\hat{\varepsilon}_t = \theta\hat{\varepsilon}_{t-1} + \sum_{m=1}^{p} \psi_m \Delta\hat{\varepsilon}_{t-m} + u_t, \qquad (3)$$

where $\theta$ is the parameter of interest. Stronger statistical evidence that $\theta < 0$ implies that price series for $i$ and $j$ are cointegrated, whereas $\theta = 0$ implies a nonstationary residual series and thus permanently diverging prices in $i$ and $j$. Hence, the magnitude of the $t$-statistic associated with $\theta$ serves as a metric for the degree of market integration in the pair of markets.

We follow the practice in SK and estimate (2) and (3) for *all N(N-1) market pairs* in each distance category.[11] The unweighted average of the ADF $t$-statistics is then the measure of the overall degree of market integration. SK argues this empirical approach should be interpreted as studying general patterns in the average ADF $t$-statistics rather than testing sharp hypotheses: computing critical values for ADF tests, which depend on the time series length and deterministic components, is cumbersome given the inclusion of the seasonality and outlier dummies. Our analysis will focus on the relative magnitudes of these $t$-statistics between markets in China (including geographic sub-regions) and Western Europe, as well as their respective evolution over time. The advantage of monthly data compared with the SK approach is that we can employ a rolling window to depict the time-paths of average ADF $t$-statistics and thus capture the *dynamics* of market integration.

The patterns of data availability for the Chinese and Belgian samples create additional challenges for our analysis: the China sample deteriorates towards the end of the 18th century but recovers by 1820, and the Belgium sample drops off markedly in the last 10 sample years.[12] In our benchmark specifications we adopt a rolling window of length 20 years and ignore differential data availability. As a robustness check we vary the length of the rolling window to fix the number of observations in each ADF regression to around 100.[13]

## 4. Empirical Results

The results of our rolling window analysis are reported in Figure 2. The top panel shows the time path of the averaged ADF $t$-statistics from our full sample of 131 Chinese prefectures divided into seven distance categories, following SK. The windows are constructed such that the ADF $t$-ratio in the first year (1740) pertains to the 20-year period of 1740-59, the value in

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[11] We analyse the residuals of the price in $i$ regressed on the price in $j$ and vice versa. We also follow SK in estimating (3) without an intercept.

[12] Critical values are lower (in absolute values) when the number of time series observations is higher, thus making it difficult to compare averaged $t$-ratios across samples of different size.

[13] The rationale for this exercise is as follows: since critical values for cointegration analysis differ by sample size, it is crucial to check whether our findings hold up when we fix the number of observations in each rolling window of analysis to be (roughly) the same.

1741 to the period 1741-60, and so on. This top panel is the dynamic counterpart to SK's cross-sectional averages over the period 1742-95 (semi-annual data; see SK, Figure 4, p.1202). Unsurprisingly, the plots in our top panel confirm the proposition that the degree of market integration decreases with distance: the *t*-ratios are highest (in absolute value) for markets close to each other (<150km) and become smaller for markets further apart. Therefore, our first finding is that this ordering is fairly consistent over time when using monthly data. Our rolling window analysis reveals a significant difference compared with the SK results. We find the degree of market integration declines throughout the second half of the 18th century before picking up again after the turn of the century, albeit never reaching the levels of the 1740s.

To facilitate the comparison of market integration in China, England and Belgium, the lower two panels in Figure 2 report the average ADF statistics for market pairs less than 150km apart. In the middle panel we use a 20-year rolling window, which ignores the varying number of observations across time in the Chinese and Belgian data, while in the bottom panel we vary the window length so as to fix the average number of observations in each window. Keeping the number of observations fixed ensures that the ADF statistics are directly comparable across samples.

The time trend for the full Chinese sample and the regional subsamples confirm the decline in the degree of market integration over the sample period. This process of decline 'peaked' at the turn of the century, in the early years of the reign of the Jiaqing emperor (1795-1820), and thereafter recovered slightly.[14] In both panels English counties maintain a high and relatively stable degree of integration between 1770 and 1820. Belgium's degree of market integration ranks in between that of England and China. However, the difference in specification clearly matters for the Belgian case, where a secular decline in market integration turns into an increase once we make sample sizes constant over time.

Market disintegration is particularly accentuated in the two subsamples for the Yangtze Delta, the most advanced region of China, and its supply route, the Yangzi River prefectures: their levels of integration in the 1740s are close to those in Belgium and England during the second half of the 18th century. Levels of market integration in the two Yangtze samples however deteriorated more substantially than in the rest of the empire, to the extent that beginning from the 1770s they had lower levels of integration in this lowest distance category than Southern China as a whole.

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[14] The early Jiaqing period was marked by large-scale disturbances, which included the White Lotus Uprising (1796-1804) and the Miao Rebellion (1795-1806) both of which disrupted local governance and domestic trade.

## Figure 2 – Market Integration in China and Europe: Rolling Window Analysis
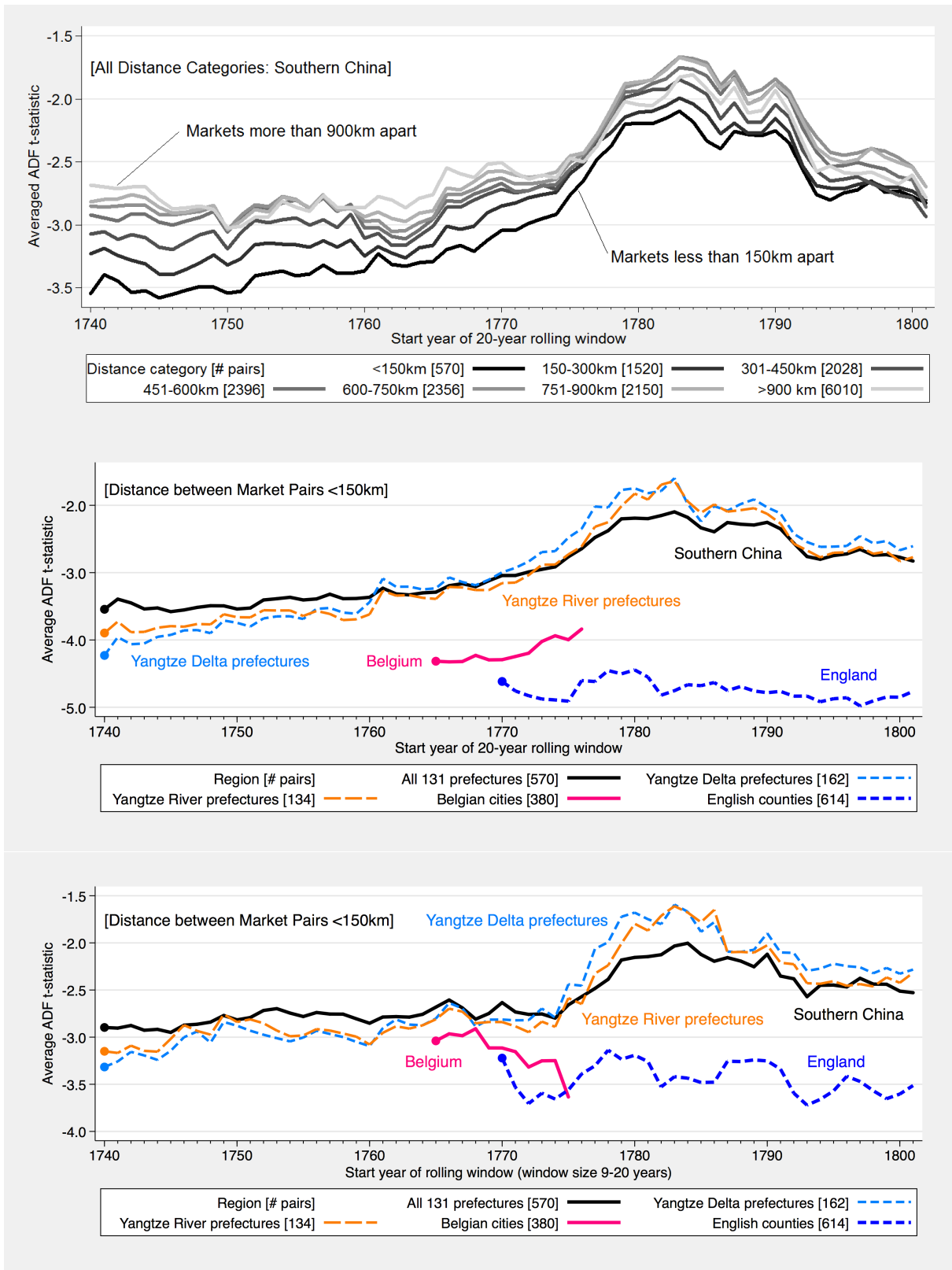


**Notes:** We compare the time paths of mean ADF *t*-statistics for all/three Chinese groupings with results for English counties and Belgian market towns. In the upper and middle panels we fix the rolling window to 20 years, and in the lower panel we fix the number of observations to around 100. In all plots the starting year of the rolling window (whether of length 20 years or not) is indicated along the *x*-axis. In the bottom two plots we highlight the estimate for the first rolling window in each sample, which emphasises the relative parity in terms of average *t*-statistics. See the main text for details.

## 5. Cointegration Analysis for Market Integration: Some Caveats

There are several caveats attached to the use of the cointegration methodology. These apply to the analysis in SK as well as to our own and relate to the assumptions made in the implementation of pairwise Engle-Granger regressions. The first critical assumption is the order of integration of the log price series. Investigating long-run equilibrium relations in an Engle-Granger framework is only sensible – yielding 'super-consistent' estimates, robust to dynamic misspecification and omitted variable bias – if the underlying variable series are integrated of order one. There are two major concerns with this assumption. First, even though it is widely accepted that a 'random walk' process may be a sound empirical *representation* of price behaviour in the long run, from an economic theory standpoint a random walk "seems very implausible, at least for commodities where the weather plays a major role in price fluctuations" (Deaton and Laroque, 1992: 3). Second, in extensive analysis of the time series properties of the rice price series (Bernhofen, et al, 2016, online appendix) we find in prefecture-specific augmented Dickey-Fuller time series unit root tests that 54% of prefectures reject the null of a unit root based on the test with a drift, while in the model without a drift we cannot reject the unit root null in any prefecture series.[15] This suggests that we can judge the rice prices to follow a random walk *if, and only if*, we assume that there was no deterministic trend in the series over time. In Appendix Figure A-1 we plot the median annual rice price for Southern China as a whole and for various sub-regions. All of these series show an *upward trend* over time, in line with historical accounts of grain price inflation during the 18th century (e.g. Wang, 1992; von Glahn, 2016). Thus, the crucial assumption for cointegration analysis of a random walk in the rice price series is conceptually questionable and can only be established in the data if we adopt a specification without a drift term, which contradicts the widely acknowledged inflationary trend over this time period.

The second crucial assumption in adopting pairwise cointegration analysis is the absence of what econometricians call strong cross-section dependence (Chudik, Pesaran and Tosetti, 2011). This is distinct from spatial (or weak) dependence in a simple but profound way: spatial cross-section dependence is subject to distance decay, so that any effect of such dependence is in geographical terms localised and in econometric terms irrelevant for consistent estimation. Strong dependence would arise if we assume away the element of

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[15] Panel unit root tests, which have more 'power' in rejecting the null when it is false, reject the null of a random walk in the Southern Chinese rice price series at all lag-lengths investigated and with any combination of deterministic components included (see Bernhofen, et al, 2016, online appendix).

decay, for instance a 'global' shock with heterogeneous impact across locations.[16] An alternative motivation for this phenomenon from economic theory would argue that studying pairs of prices in isolation ignores the existence of any trade network and general equilibrium effects. The macro panel econometric literature has made cross-section dependence its primary focus over the past decade or so (contributions include Bai and Ng, 2004; Pesaran, 2006; Bai, 2009), adopting a common factor framework to model this dependence. We illustrate the approach with a simple model of price behaviour: for each market $i$ assume

$$\ln(P)_{it} = \rho_i \ln(P)_{i,t-1} + \lambda_i F_t + \varepsilon_{it} \qquad \ln(P)_{i0} = \kappa_i \geq 0,$$

where $P_{it}$ is the price level in market $i$, $F_t$ is the common factor and $\lambda_i$ the associated market-specific parameter (factor loading).[17] The common factor could for instance represent levels of rainfall (from drought to flood) over time, while the factor loading captures the more severe implications for harvest (and hence grain prices) of excessive rainfall in a low-lying location close to a large river, compared with a location on higher ground farther from the riverbed. Consequently, if we estimate a linear regression of price pairs

$$\ln(P)_{it} = \beta_{ij} \ln(P)_{jt} + \alpha_{ij} + e_{ijt} \qquad \forall\, i \neq j,$$

we are faced with an omitted variable bias problem: price pairs may appear to co-move because they are subject to the same excessive rainfall shocks contained in $F_t$, rather than because traders are engaged in price arbitrage between markets through trade. This issue is widely recognised in the literature (Li, 2000: 673; Fackler and Goodwin, 2001: 992f; Shiue, 2002: 1407; Federico, 2012: 481f; Brunt and Cannon, 2014: 115), but to date no general solution for this problem has been suggested.

In a companion paper (Bernhofen, et al., 2016) we provide a novel empirical approach to address these issues. We introduce a theoretical model of grain price behaviour for a pre-modern economy with many locations and estimate convergence regression models incorporating a common factor structure that captures the network characteristic of trade and thus grain prices, as well as the presence of common shocks with heterogeneous impact. One advantage of our empirical implementation is that we are able to formulate a 'sharp' hypothesis test for fragmented versus integrated markets. Our findings are in line with the secular decline in Chinese market integration vis-à-vis Western European economies described above, though we find the seeming 'recovery' during the Jiaqing reign far less pronounced. When we apply statistical tests – based on linear or nonlinear price convergence

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[16] The latter qualification is important: if the global shock had *the same* impact on all locations we could simply transform the panel data into deviations from the cross-section mean and thus wash out the 'common factor.'

[17] Note that price evolution over time can be stationary ($\rho_i < 1$) or nonstationary ($\rho_i = 1$).

(Taylor, 2001) – we conclude that we can no longer reject the null of market fragmentation from the mid-1780s onwards (referring to the end year of a 20-year rolling window). Our analysis further extends to a sample of 80 Northern Chinese prefectures, where we find on average lower levels of market integration than in the South, but the same patterns of secular decline over time.

## 6. Concluding Remarks

Drawing on 18th century monthly grain price data for Southern China, England and Belgium and emphasising the dynamics of integration over time, we were able to reveal novel patterns of market (dis)integration in China compared with the widely accepted view that the level of market integration in China was comparable to Europe. In order to directly compare our findings with the seminal SK paper we follow their lead in using cointegration analysis to evaluate the degree of market integration. They apply cointegration to the cross-section for the entire period 1742-95 of their data for 121 Chinese prefectures. Our contribution is to extend the data period to 1740-1820, include another 10 prefectures, and use the full monthly price data, instead of two monthly points per annum, which enables us to implement the estimation using a rolling window to capture the dynamic trend. We confirm that Chinese and European markets during the first half of the 18th century were comparable in a static cross-sectional perspective, but our approach shows that the trajectories of Chinese and European markets were very different. The level of integration of the Chinese grain markets declined through the second half of the 18th century, in stark contrast with the stable evolution in the two European markets.

Novel methodologies, such as the panel time series convergence regressions applied in our companion paper (Bernhofen et al, 2016), are often viewed with scepticism. We have frequently been asked to 'simply do what Shiue and Keller do.' The present paper answers this call. It addresses the criticism of Vries (2010) and others of comparison between East and West in cross-sections: using the same empirical methodology, the same spatial categorisation and (higher frequency aside) the same data as SK, we show that Southern China achieved very high levels of grain market integration around the 1740s, in line with levels of integration we find for England and Belgium a couple of decades later when data series for these countries commence. While the latter two economies continued to enjoy relatively stable and high levels of integration thereafter, the evolution of markets in China is characterised by secular decline during the 18th century and a small recovery during the

Jiaqing reign. This finding holds for all Southern prefectures as well as subsamples limited to the Jiangnan and Yangtze River prefectures: on the eve of industrialisation, Southern China's markets were *not* on par with those in Western Europe.

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Figure A-1 – Average Annual Rice Price Evolution in Southern China (1740-1820)
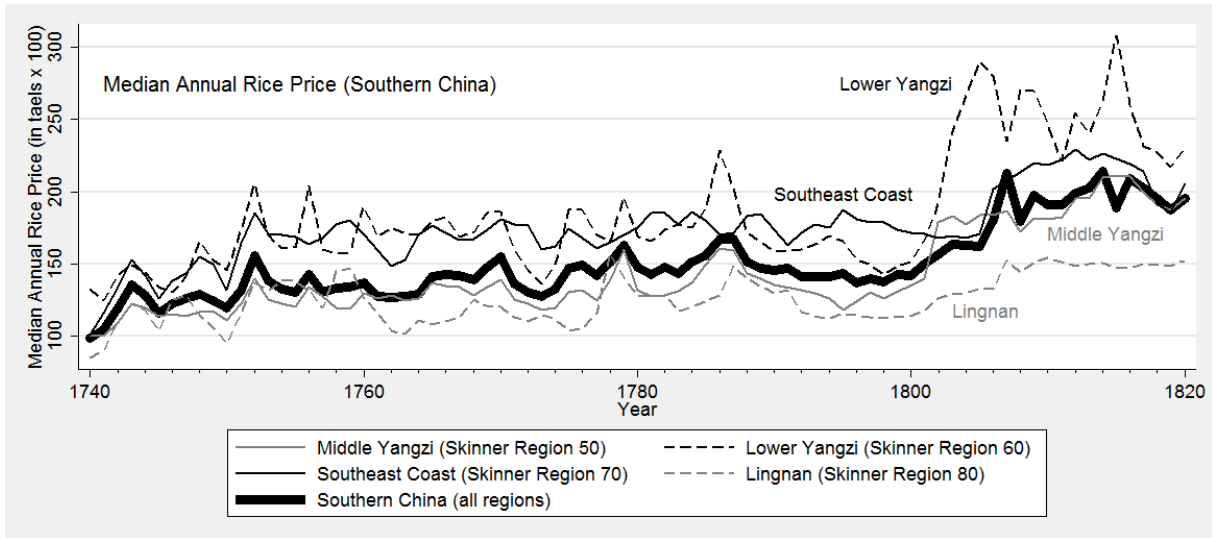


**Note:** We plot the median annual price movement (*taels* x 100) of rice prices across all 131 prefectures in Southern China (thick solid line), along with median prices for selected Skinner (1977) macro-regions.

**A-1: Sample Prefectures in South China (rice prices, 131 prefectures)**

| Province | Prefecture |
|---|---|
| Anhui | Anqing[*#], Chizhou[*#], Chuzhou[*], Fengyang, Guangde[*#], Hezhou[*#], Huizhou[*], Liu'an, Luzhou[*#], Ningguo[*], Sizhou[*#], Taiping[*#], Yingzhou[#]; |
| Fujian | Funing, Jianning, Longyan, Quanzhou, Shaowu, Tingzhou, Xinghua, Yanping, Yongchun, Zhangzhou, Taiwan; |
| Guangdong | Chaozhou, Gaozhou, Guangzhou, Huizhou, Jiayingzhou, Leizhou, Lianzhou, Lianzhou Fu, Luoding, Nanxiong, Qiongzhou, Shaozhou, Zhaoqing; |
| Guizhou | Anshan, Duyun, Guiyang, Liping, Pingyue, Shiqian, Sinan, Sizhou, Dading, Tongren, Xingyi, Zhenyuan, Zunyi; |
| Guangxi | Guilin, Liuzhou, Nanning, Pingle, Qingyuan, Sicheng, Si'en, Taiping Fu, Wuzhou, Xunzhou, Yulin, Zhen'an; |
| Hubei | Anlu, De'an, Hanyang[#], Huangzhou[#], Jingzhou Fu, Shinan, Wuchang[#], Xiangyang, Yichang[#], Yunyang; |
| Hunan | Baoqing, Changde[#], Changsha[#], Chenzhou, Chenzhou Fu, Guiyang, Hengzhou, Jingzhou, Lizhou, Yongshun, Yongzhou, Yuezhou[#], Yuanzhou |
| Jiangsu | Changzhou[*#], Haizhou[*#], Huai'an[*#], Jiangning[*#], Songjiang[*#], Suzhou[*#], Taicang[*#], Tongzhou[*#], Yangzhou[*#], Zhenjiang[*#]; |
| Sichuan | Baoning, Chengdu, Chongqing, Jiading, Kuizhou, Long'an, Ningyuan, Shunqing, Tongchuan, Xuzhou, Yazhou; |
| Zhejiang | Hangzhou*, Huzhou*, Jiaxing*#, Jinhua, Quzhou#, Ningbo, Shaoxing, Taizhou, Wenzhou, Yanzhou |

**Notes**: All prefectures marked * are part of the Yangtze River Delta (Jiangnan) sample and those marked # are part of the Yangtze River sample. Both samples use the sample selection in SK. We exclude the upper Yangtze River prefectures in Sichuan to be comparable with the SK groups.

**A-2: Sample Markets in the Austrian Netherlands (wheat prices, 20 markets)**

| | |
|---|---|
| Antwerp | Lier |
| Ath | Mechelen |
| Binche | Mons (Bergen) |
| Bruges | Namur (Namen) |
| Brussels | Nieuwpoort |
| Charleroi | Oostende |
| Ghent | St. Niklaas |
| Ieper (Ypres) | Tienen |
| Kortrijk | Tournai (Doornik) |
| Leuven | Veurne |

**A-3: Sample Counties in the English Corn Returns (wheat prices, 40 markets)**

| | |
|---|---|
| Bedfordshire | Lincolnshire |
| Berkshire | Middlesex |
| Buckinghamshire | Monmouthshire (Wales) |
| Cambridgeshire | Norfolk |
| Cheshire | Northampton |
| Cornwall | Northumberland |
| Cumberland | Nottingham |
| Derbyshire | Oxford |
| Devon | Rutland |
| Dorsetshire | Salop (Shropshire) |
| Durham | Somerset |
| Essex | Stafford |
| Gloucestershire | Suffolk |
| Hampshire | Surrey |
| Herefordshire | Sussex |
| Hertfordshire | Warwick |
| Huntingdonshire | Westmorland |
| Kent | Wilts |
| Lancashire | Worcester |
| Leicestershire | York |

**Note**: We exclude London from our sample due to differential data availability.