Market integration in Qing China and Europe: a reinterpretation

Peter Foldvari, Bas van Leeuwen, and Jieli van Leeuwen-Li

1. Introduction

In the last couple of years there is an increased interest in the working of grain markets not only because it tells us something about the complexity of the economy, but also because well working markets are a necessary condition for economic and institutional development (e.g. Bateman 2011; 2014; Casson et al. 2011). This point has been stressed by the California School, who claims that Europe and Asia only started to diverge economically in the late 18th and early 19th century (e.g. Studer 2008) implying that, up to that point, market performance in Europe and China must have been the same.

Yet, evidence so far is mixed. For example, Li Bozhong (1996) claims the presence of strong market integration in the Yangtze delta. This view is supported by Shiue and Keller (2007) who argue that market integration in the Yangtze is comparable to that of Western Europe. This finding, however, is contradicted by several studies that claim far less impressive market integration at the national level, while they do find integration at the local level (Lillian Li 2007; Isett 2007).

These mixed results demand further investigation. Therefore, in this paper we follow a different strategy for calculating market integration in both Europe and China by looking at it from a cross-section perspective. The Chinese estimates are for what we call the "Greater Yangtze" region (i.e. Shandong, Anhui, Zhejiang, and Jiangsu) between 1736 and 1911. We find an increase in market performance up to the mid-19th century and a deterioration afterwards. Yet, the levels of market performance are considerably lower than hitherto assumed.

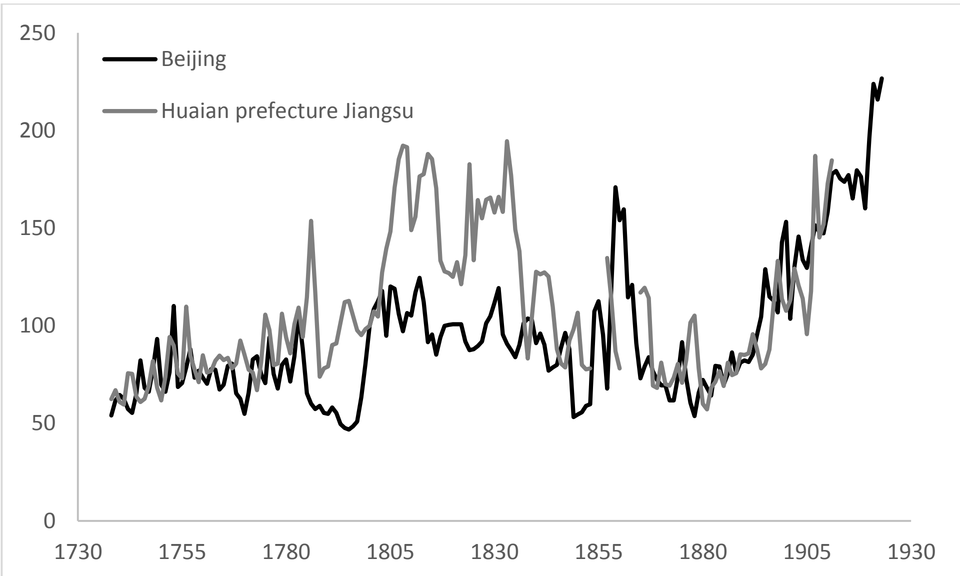
In the next Section we will discuss the price data that are at the heart of most of the existing market integration studies. In Section 3 we will calculate and compare market performance in both Europe and China. We find that market performance remained considerably higher in Europe. Section 4 concludes.

2. Data

In Qing China, a unique dataset is in existence on granaries. These were government initialized system which intended to buy grain in times when grain was abundant and, at a later stage, when there occurred a grain shortage, brought the stored grain again on the market. Of course this is the theoretical notion and there is a large literature reflecting all the changes that this system underwent over the Qing dynasty (e.g. Bin Wong et al. ; see also Ye Ma this workshop).

Detailed price data are thus available for many regions in China at a prefectural level between 1736 and 1911 and they have been used in many studies on market integration (e.g. Shue and Keller 2007). These studies go at great length to show that these data are real market prices, i.e. they reflect the demand and supply factors on the market. Yet, even a casual glimpse at the data suggests otherwise. In Figure 1 we compared the market price of grain in

Figure 1. Index of rice prices (1800=100)



Source: Allen et al. (2009)

Beijing with the granary prices for the 19th century in Huaian prefecture, Jiangsu. We notice a remarkable deviation in price at the start of the 19th century. In addition, average volatility is lower in the granary data compared to the market data. This is, of course, not very surprising giving that granary prices were supposed to reduce price volatility.

The question whether prices are conform market prices is very crucial since most studies use a form of time series modelling to predict market integration. In other words, if prices in two markets move in the same direction over time (cointegration), we argue that market integration is higher. However, if we have two series that are not very volatile, of course their movement (or lack of that) is also the same. Hence, when estimating market integration using cointegration based on series that are underestimating actual volatility will artificially increase market performance.

However, in this study we essentially follow a cross-section-type of approach by using spatial methods. We use two methods. First, we use spatial lags which essentially means that we look if prices in region A are determined by grain prices in other regions. This is calculated over short periods of 10 years, meaning that essentially this method utilizes the cross-section component of the data. Second, we use Moran's I, which is a true spatial correlation statistics. Since both methods focus on the level, rather than the volatility, this removes the need of using series that show the right volatility. Rather, our requirement is that the prices in each prefecture are roughly biased in the same way as compared to actual market prices. This is not an unreasonable assumption given that the function of the granary system was the same everywhere.

Hence, we will also use the granary data between 1736 and 1911 for the "Greater Yangtze Region", i.e. for the prefectures in Anhui, Zhejiang, Jiangsu and Shandong. These were collected data by prefecture from a dataset set up by Wang Yeh-Chien from the First Archives in Beijing and the National Palace Museum in Taipei. We use the data for the „Greater Yangtze Delta", i.e. for prefectures for Anhui, Zhejiang, Jiangsu, and Shandong (a total of 52 series of monthly data between ca. 1736 and 1911). His data, however, has several gaps, which we filled in with information from Institute of Economics (CASS) (2009). We also added additional information weather circumstances from the State Meteorological Society (1981).

3. Analysis of market integration in China utilizing spatial lag

As pointed out in the previous Section, we utilize two different spatial methods to calculate market integration. The first method utilized is a regression-based model, i.e. a spatial lag model. This means that, if markets are integrated, prices in region A will be affected by past prices of other regions. Of course not only prices of other regions affect current prices, but also part events in region A itself. Hence, we use an autoregressive specification and the effect of changes in weather, and the unobservable prefecture- and time-specific effects. We directly include the effect of prices in other provinces by a spatial lag of the dependent variable.

The resulting model is as follows:

$$\ln p_{i,t} = \beta_0 + \sum_{j=1}^{3} \beta_j \ln p_{i,t-j} + \delta S_{i,t} + \sum_{k=2}^{5} \phi_k D_k^{weather} + \eta_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

With $p_{i,t}$ being the price of rice in prefecture i in period t, $S_{i,t}$ is the spatial lag of the log price, $D_k^{weather}$ denotes four dummies capturing the effect of 5 possible weather situations (1= continuous heavy rain, 2=in spring and autumn continuous rain, but no flood, 3=normal, 4=-in some months small drought, 5=drought can last for several months), and $\eta_i, \lambda_t, \varepsilon_{i,t}$ are the prefecture- and period specific effects and a random error. Choosing an autoregressive specification does not only allow for directly capturing the dynamics of price changes, but also makes the above specification immune to spurious regression problems associated with regression on possibly non-stationary variables.

The spatial lag of the dependent variable is defined as follows:

$$S_{i,t} = \sum_{i \neq j} w_j \ln p_{j,t} = \sum_{i \neq j} \frac{\ln p_{i,t}}{d_{i,j}} \quad (2)$$

where w_i is the weight associated with the price of rice in another prefecture, and the weight is the reciprocal of the distance between the centers of prefectures i and j. The distance is estimated by the great circle distance formula with 6371 km assumed for the radius of Earth. A possible source of bias is the changing number of missing observations. In periods when at least a single observation of the rice price is not available equation (2) modifies as follows:

$$\tilde{S}_{i,t} = \sum_{i \neq j} w_j \ln p_{j,t} - \sum_{k=1}^{n_m} w_k \ln p_{k,t} = S_{i,t} - n_m E\left(w_k \ln p_{k,t}\right) \quad (3),$$

where n_m observations are missing. In order to minimize the effect of the changing number of available price information, we introduce cross-term between the number of missing observations and the spatial lag variable.

$$\ln p_{i,t} = \beta_0 + \sum_{j=1}^{3} \beta_j \ln p_{i,t-j} + \delta S_{i,t} + \sum_{k=2}^{5} \phi_k D_k^{weather} + \gamma n_{m,t} S_{i,t} + \eta_i + \lambda_t + \varepsilon_{i,t} \quad (4)$$

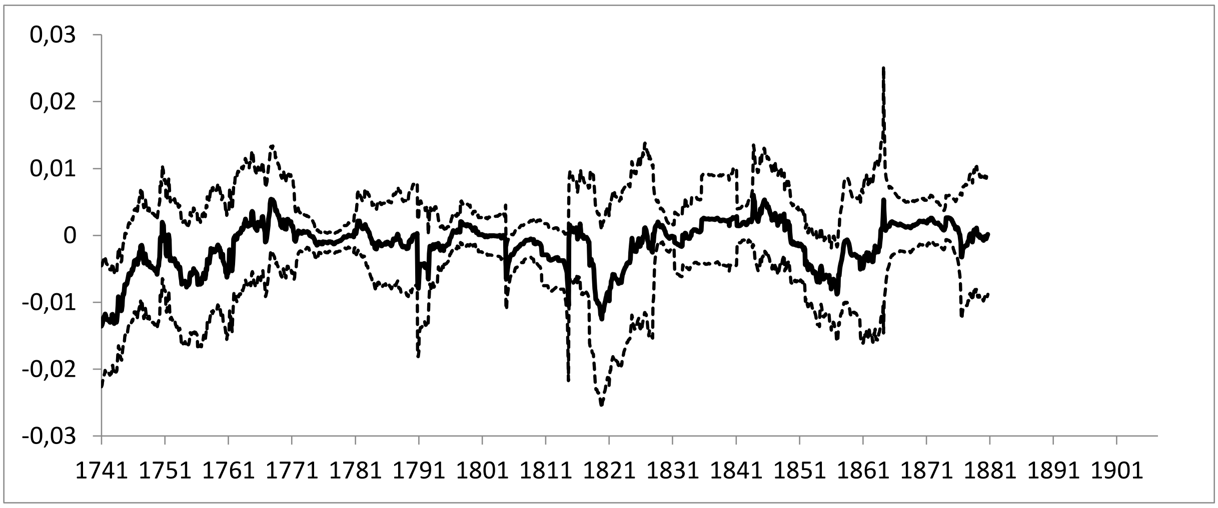
The above specification is however only applicable if $n_{m,t} \neq 1$, since otherwise there would be a perfect multicollinearity in (4). Hence (4) is only used as a cross-check for the effect of omitted price information as a result of missing data until the 1880s.

The spatial lag model discussed so far is a fixed-effect ARX(3) panel specification, where , with the long sample in mind, we cannot assume that the coefficients remain the same over time. For this reason we opt for estimating (1) by an overlapping rolling-window method. The first period we estimate (1) on is between July 1736 and June 1746, exactly 10 year or 120 months. The coefficient is than reported as our estimate for the period in the middle, that is, June 1741. The 120 months period is chosen partly because it is long enough so that the bias in fixed-effect dynamic panels described by (Nickell 1981).

The coefficients for the spatial lag coefficient are reported in Figure 2 (equation 1) and in Figure 3 (with the interaction term in equation 4). While the interaction coefficient in

Figure 2. The spatial lag coefficient from equation (1) (overlapping rolling window, 120 months, 95% conf. intervals)

Figure 3. The spatial lag coefficient from equation (4) (overlapping rolling window, 120 months, 95% conf. intervals)



equation (4) usually yields a statistically significant coefficient, the overall picture in Figure 3 is the same as in Figure 2, hence we can conclude that the missing price information does not have a serious effect on our estimates of the spatial correlation of prices. While occasionally we find significant spikes in Figures 2 and 3, but with the exceptions of the first years of the 20^{th} century, when we find positive, statistically significant coefficients, indicative of some degree of the integration of local grain markets, the evidence rather points at a lack of market integration among the 49 prefectures in the sample.

4. A cross-check: Moran's I in China and Europe

This is quite a shocking result as it goes counter to the finding of Shiue and Keller (2007). Can we cross-check our results? Fortunately, there is an alternative method for calculating the spatial correlation, namely Moran's I. Moran's I statistics is a spatial equivalent of Pearson's linear correlation coefficient and measures the direction and magnitude of spatial relationship among observations of a variable in different places.

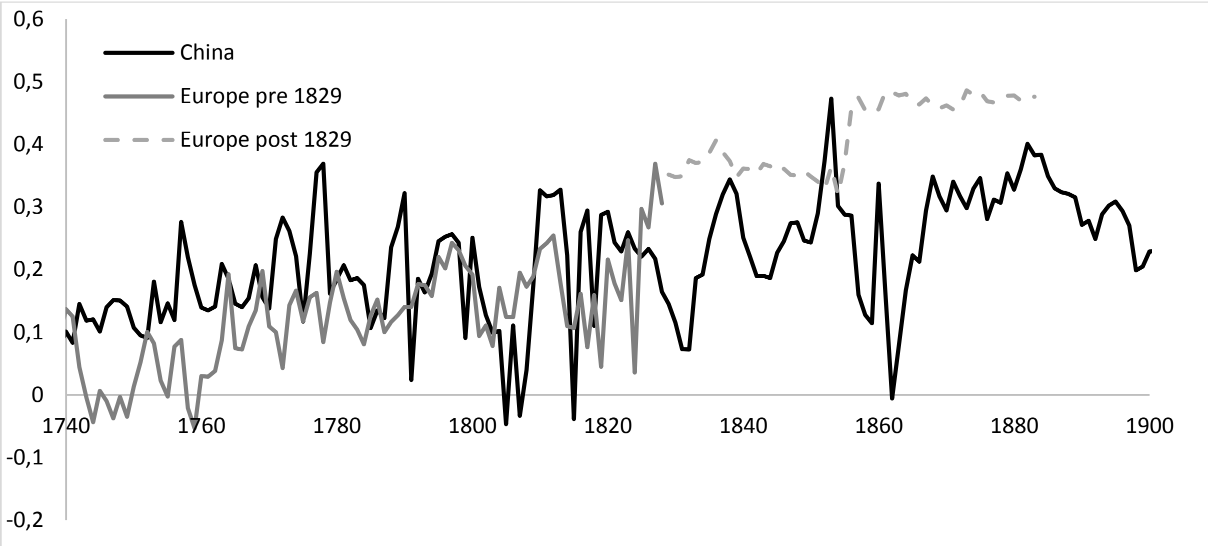
$$I = \frac{N\sum_i \sum_j w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_i \sum_j w_{ij} \sum w_{ij}(x_i - \bar{x})^2} \quad (5)$$

, where i and j denote spatial positions, and w_{ij} is the spatial weight incorporating the effect of distance between i and j, such that $w_{ij} = \frac{1}{d_{ij}}$, where d_{ij} is the distance between position i and j, calculated by the great circle formula.

The measure I is normalized so that its value is between -1 and 1. A negative value refers to dispersion while a positive value indicates spatial concentration. A value 0 is indicative of no spatial relationship. Since the variable x is log grain prices in this paper, the interpretation slightly modifies so that a positive value indicates that the closer two markets are, the more similar grain prices are, while a negative value of I would indicate that prices tend to be more different when two markets are near to each other. Since market integration is tantamount with the regular flow of homogenous goods among different locations, we can expect a positive coefficient.

The results are given in Figure 4 where we aggregated the Chinese data to make them annual and directly comparable to those in Europe. The European data have been taken from the Allen-Unger database. We indeed find that up to ca. 1800 China experienced roughly

Figure 4. Moran's I for spatial integration in China and Europe



comparable levels of market integration as Europe. However, in the 19th century a divergence occurred. The reason why this occurred. Is still food for further research. However, possible suggestions are the decline of the granary system when official started to hold more silver instead of grain. According to Shiue (2004) the main reason for this reversal is that the costs of transport were lower than the cost of storage making it more profitable to buy grain during times of poor harvests. More importantly, perhaps, was the decline of the brokerage system (e.g. Shiue 2014, 350). Initially, this consisted of a hybrid system involving government official as well as guilds to asses prices (i.e. Mann 1987). The local guilds taught inter-regional merchants networks bargaining techniques etc. Yet, neither the government nor the guilds dominated the local markets. Yet, in the course of the 18th/19th century, the role of government became smaller the guilds even took over part of the collection of the brokerage tax. Initially, this seems to have had a positive effect,. Trade tax increased while borage tax decreased and, at the same time, privatization of trade occurred. The problem was, however, that this free market behaviour eroded at the same time the institutional situation of China which was not geared towards economic freedom but rather towards public order (e.g. Huang 1996, 107. As Figures 2 and 3 show, even though the downward trend in market performance only occurred from the 1830s, while a significant break only happened around 1890. This suggest a slow institutional process. More specifically, the rise of privatisation increased the role of large merchant networks. Yet, these networks were based on personal (or family) relationships. Hence, it was difficult to expand them beyond a certain maximum limit. Hence, privatization created an over-expansion of the merchant networks. This was even worsened by a break down in networks during the Taiping rebellion.

5. Conclusion

There is a large discussion about market integration. Some have argued for a good, and even increasing, market integration while author authors have stressed the limitations,. One of the main reasons for this continuing debate is the nature of the data used, i.e. granary data. These data have a high degree of stability over time due to the situation that the government set the prices to a large extent. This implies that, when using cointegration as a standard tool for measuring market integration, you will overestimate this integration.

In this paper we used the spatial correlation as an alternative measure a sit utilizes level differences which are less dependent on volatility over time. Using two methods, the spatial lag and Moran's I, we find that market integration in China is indeed considerably lower than argued by Shiue and Keller (2007) found based on a cointegration analysis. Yet, once comparing to Europe, we find only significant divergence in the 19th century.

References

Bateman, Victoria N. (2014), 'Price volatility and markets in late medieval and early modern Europe,' In: Van der Spek, Van Leeuwen and Van Zanden (eds.), *A History of Market Performance From Ancient Babylonia to the Modern World,* Routledge.

Bateman, Victoria (2011) "The evolution of markets in early modern Europe, 1350–1800: a study of wheat prices," Economic History Review, Vol. 64 (2), 447-471.

Casson, Catherine; Fry, J. M. and Casson, Mark (2011), "*Evolution or revolution? a study of price and wage volatility in England, 1200-1900,"*MPRA Paper No. 31518, posted 13. June 2011

Dobado-Gonzalez, Rafael, Alfredo Garcia-Hiernaux, and David E. Guerrero (2012), 'The integration of grain markets in the eighteenth century: early rise of globalization in the West,' *Journal of Economic History,* Vol. 72 (3), pp. 671-707.

Foldvari, P. and Leeuwen, B. van (2011), 'What can price volatility tell us about market efficiency? Conditional heteroscedasticity in historical commodity price series,' Cliometrica, 5(2): 165-186.

Huang, Ph. C. C. (1996), *Civil Justice in China. Representation and Practice in the Qing*, Stanford: Stanford University Press.

Institute of Economics, Chinese Academy of Social Science (2009), Grain Price Table Between 1821 and 1912, 23 Volumes, Guangxi Normal University Press. (中国社会科学院经济研究所, 清代道光至宣统间粮价表(23册), 广西师范大学出版社2009年1月January, 2009)

Isett, Christopher Mills (2007), *State, Peasant, and Merchant in Qing Manchuria, 1644–1862*, Stanford: Stanford University Press.

Li, Bozhong (1998), *Agricultural Development in Jiangnan, 1620-1850*, New York: St. Martin's Press.

Li, Lillian M. (2007), *Fighting Famine in North China: State, Market, and Environmental Decline, 1690s–1900s*, Stanford: Stanford University Press.

Mann, S. 1987. *Local Merchants and the Chinese Bureaucracy, 1750–1950*, Stanford: Stanford University Press.

Nickell, S. J., 1981. Biases in Dynamic Models with Fixed Effects, Econometrica vol. 49(6): 1417-26.

Shiue, Carol H. (2004), 'Local Granaries and Central Government Disaster Relief: Moral Hazard and Intergovernmental Finance in 18th and 19th Century China', *Journal of Economic History*, 64: 101–25.

Shiue, Carol H., and Wolfgang Keller (2007), 'Markets in China and Europe on the Eve of the Industrial Revolution,' *American Economic Review*, vol. 97(4), pp. 1189-1216.

Shiue, Carol H. (2014), 'The organization and scope of grain markets in Qing China (1644–1911),' In: Van der Spek, Van Leeuwen and Van Zanden (eds.), *A History of Market Performance From Ancient Babylonia to the Modern World*, Routledge.

State Meteorological Society. *Zhongguo jin wubai nian hanlao fenbu tuji* [Collected maps of droughts and floods in China in the past five hundred years]. Beijing: Ditu chuban she, 1981.

Studer, Roman (2008), "India and the Great Divergence: Assessing the Efficiency of Grain Markets in Eighteenth- and Nineteenth-Century India," Journal of Economic History, Vol. 68 (2).

Van der Spek, Van Leeuwen and Van Zanden (2014), *A History of Market Performance From Ancient Babylonia to the Modern World*, Routledge.