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Spatial panel data analysis with feasible GLS techniques: An application to the Chinese real exchange rate

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ABSTRACT

Recent panel data approaches stress the importance of the location interdependence. Little has been done in the Balassa–Samuelson literature accounting for spatial dependence in the panel data context that allows for spatial autocorrelation. By utilising the recently developed Kapoor et al. (2007) spatial panel feasible GLS methods, we find that the Balassa–Samuelson effect in the Chinese economy during 1985 until 2000 generally does not appear to hold. However, the black market exchange rate tends to be more compatible with the theory.

1. Introduction

The leading principle for most real exchange rate studies, such as those of Balassa (1964) and Samuelson (1964), is that rapid economic growth is associated with real exchange rate appreciation, since the sector productivity growth differential tends to be much higher in fast growing economies. Naturally, the Balassa–Samuelson propositions should be worthy of interest in the case of China, which has been the flagship of the world's fast growing economies. Also, the fact that the Chinese RMB yuan underwent numerous devaluations while growth was respectably high will make our study meaningful in that the relevance of the Balassa–Samuelson theory implies that the rapid growth is attributed to rapid tradable sector productivity growth rather than the export-oriented growth which seems quite likely when an economy begins to open up. Given this, it is intriguing to note that the theory is strongly spatial in its nature in China, in that the nature of growth and real exchange rate variations is not independent of the characteristics of surrounding regions. Table 1 shows a regional breakdown of the GDP growth rates in China in 1993 and 1999. The area of rapid growth is concentrated in coastal areas, which share borders, and the areas with moderate growth are those interior regions.

Fig. 1 shows the bilateral real exchange rates between each region of China and the United States in 1988 and 1993, adjusted to the difference in the GDP deflators of each region and the United States. One important feature of the graph is that a large real depreciation tends to occur in the coastal regions, whereas medium and small rates of real deprecation appear in the central and western regions. The corresponding Moran's I test statistics (see Table 2) reject the null hypothesis that there is no spatial autocorrelation present in the Chinese real exchange rates at 95% level of confidence.

Fig. 2 captures the regional disparity and dependency of the Chinese PPP exchange rates against the U.S. dollar in 1988 and 1993. Again, a cursory inspection of the graph shows that provinces with high levels of PPP exchange rates are geographically concentrated in coastal areas. Such tendency strongly reflects a comparatively lower tradable price structure in these export-oriented regions than in that of the U.S., given that the nominal exchange rates are identical across all Chinese regions. The Moran's I test statistics (see Table 3) tend to confirm such spatial autocorrelations between the Chinese provinces in terms of the relative price of tradable goods.

Given this, our purpose here is to assess the extent to which the real exchange rates for the Chinese provinces have been consistent with the Balassa–Samuelson model incorporating spatial interaction among regions. Since the striking feature during our sample period of 1985 until 2000 in the Chinese economy is the co-existence of both official and black market exchange rates (Phylaktis and Girardin, 2001; Ding, 1998), we use the black market exchange rate as an additional proxy of the true rate throughout our studies. Our empirical work is based on the recently developed spatial panel feasible GLS techniques proposed by Kapoor et al. (2007) on the ground that the generalised moment estimator is computationally feasible when cross-sectional units are large. We find that the purchasing power parity for the tradable goods sector between each individual region of China and the United States does not appear to hold. In addition, a negative relationship between the real exchange rate and relative price (and productivity) differential as implied by the Balassa–

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Table 1
Spatial distribution of GDP growth rate in China in 1993 and 1999.
China Statistical Yearbook (1996, 2000).

Coastal region	1993	1999
Beijing	0.12	0.10
Tianjin	0.12	0.10
Hebei	0.18	0.09
Liaoning	0.15	0.08
Shanghai	0.15	0.10
Jiangsu	0.21	0.10
Zhejiang	0.22	0.10
Fujian	0.25	0.10
Shandong	0.19	0.10
Guangdong	0.22	0.10
Guangxi	0.21	0.08
Hainan	0.21	0.09
Average growth	0.186	0.095
Interior region		
Shanxi	0.12	0.05
Inner Mongolia	0.11	0.08
Jilin	0.13	0.08
Heilongjiang	0.08	0.08
Anhui	0.21	0.08
Jiangxi	0.14	0.08
Henan	0.16	0.08
Hubei	0.14	0.08
Hunan	0.13	0.08
Sichuan	0.14	0.06
Guizhou	0.10	0.08
Yunnan	0.11	0.07
Shaanxi	0.13	0.08
Gansu	0.12	0.08
Qinghai	0.10	0.08
Ningxia	0.10	0.09
Xinjiang	0.10	0.07
Tibet	0.08	0.10
Average growth	0.122	0.078

Samuelson model seems to hold for the black market exchange rate data.

Our study is organised in the following fashion. Section 2 describes the Balassa–Samuelson model that motivates our empirical tests. Section 3 summarises the spatial panel methods proposed by Kapoor et al. (2007), variable constructions and empirical results. Section 4 concludes the paper.

2. The Balassa–Samuelson effect

A fundamental prediction of the Balassa (1964) and Samuelson (1964) model is that in fast growing economies productivity growth in the traded sector is much higher than in the non-traded sector, and this will mean that prices in the non-traded sector will tend to rise more quickly than will be the case for traded goods (Rogoff, 1992). Combining this with the assumption that the prices of tradable goods are equalised across the two countries, the country experiencing relatively high rate of productivity growth in the tradable sector will experience relatively high rate of real appreciation in their currencies (Asea and Corden, 1994).

The starting point for a formal representation of the Balassa–Samuelson model is the linkage between the real exchange rate and relative price of nontradable goods. Suppose that consumers spend a share α of their income on tradable goods (H) and a share (1−α) on nontradable goods (N). The price (P_{jt}) is characterised by the constant-returns-to-scale Cobb–Douglas utility function, which takes the form of:

$$P_{jt} = \left(P^H_{jt}\right)^{\alpha}\left(P^N_{jt}\right)^{1-\alpha} = P^H_{jt}\left(\frac{P^N_{jt}}{P^H_{jt}}\right)^{1-\alpha}, j = 1,\ldots,J, t = 1,\ldots,T. \quad (1)$$

One can then use Eq. (1) to show that the real exchange rate (RER_{jt}) can be expressed as follows:

$$RER_{jt} = \frac{XR_{jt}P^{*}_{jt}}{P_{jt}} = XR_{jt}\frac{P^{H^*}_{jt}}{P^H_{jt}}\frac{\left(\frac{P^{N^*}_{jt}}{P^{H^*}_{jt}}\right)^{1-\alpha^*}}{\left(\frac{P^N_{jt}}{P^H_{jt}}\right)^{1-\alpha}}, \quad (2)$$

where XR_{jt} denotes the nominal exchange rate; an asterisk represents the foreign country.

Assuming now that the weighting factor for the foreign tradable goods (H*) is the same as the weighting factor for the domestic tradable goods (H) (that is, $\alpha = \alpha^*$), it follows that the natural logarithms of the real exchange rate can be expressed in the following alternative form:

$$\ln RER_{jt} = \left(\ln XR_{jt} + \ln P^{H^*}_{jt} - \ln P^H_{jt}\right) + (1-\alpha)\left[\left(\ln P^{N^*}_{jt} - \ln P^{H^*}_{jt}\right) - \left(\ln P^N_{jt} - lnP^H_{jt}\right)\right]. \quad (3)$$

As we previously noted that the Balassa–Samuelson predictions assume that the purchasing power parity holds for tradable goods, it

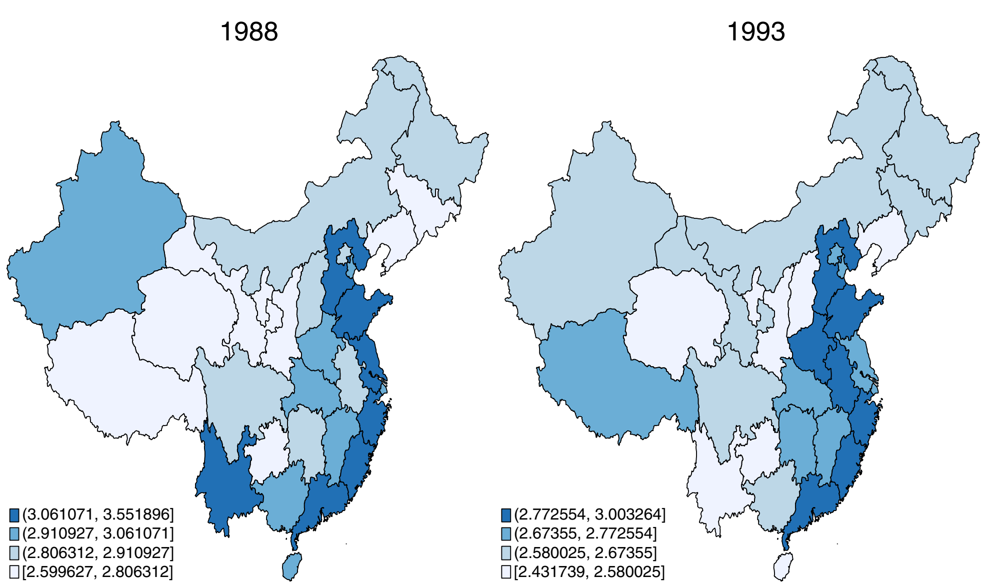

Fig. 1. Spatial distribution of the Chinese real exchange rates (2000 prices).
International Financial Statistics (IFS), China Statistical Yearbook (1990, 1996, 2001).