China's Internal Borders: Evidence from the Business Cycle Correlations across Chinese Cities

Ying Fang, Li Qi, and Zhongjian Lin

Abstract

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KEYWORDS: Border effect, Market integration, Business cycle correlation

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JEL classification: O18; F15; R12

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1. Introduction

During the rise of free-market ideology in the past few decades, many countries underwent reforms toward privatization and shifted from a planned scheme to a market mode. Different countries followed diverse approaches to direct their economic transition. For example, Russia brought a "sudden death" approach to the central-planned economy, while China relied on gradual reforms to move toward a market system. Regardless of the approach taken, economists often measure the degree of market integration to assess the success of these tremendous transformations. If the shift to a market mode is successful and indeed market forces prevail in the end, then one would expect to see a strong degree of market integration. For example, Berkowitz and DeJong (2001, 2002, and 2003) found that after radical price reforms, Russian's domestic market integration improved between 1994 and 1999. However, this trend was reversed later. Interestingly, they also found a significant negative relationship between domestic market integration and openness to international trade.

The case of China, another large economy in transition, is very different. Instead of employing the "sudden death" approach, China started with gradual experimentation on issues like price reforms. During this process, the central government gave local (provincial) governments unprecedented authority to manage local economies. Montinola, Qian, and Weingast (1996) named this Chinese approach market-preserving federalism. Many argue that the competition among Chinese provinces in this federalism

framework is the key to China's success in moving toward a market system. However, the type of organizations that helped propel the move toward markets can also hinder the function of market forces, eventually becoming a roadblock to market development. Lyons (1985) argued that Chinese administrative organizations seemed to have created "a cellular economy" in which provincial governments not only have independent rights to distribute administrative and economic resources but also have tremendous influence over the business environment. As reforms deepened, local protectionism emerged as well.

Russia's case indicates that the trend of market integration in the free-market economic transition is not unidirectional. Does China also exhibit the same characteristics, even though China's approach has been different? Given China's administrative organization, have reforms improved the degree of market integration? Is the force of the market stronger than the barriers resulting from local protectionism? Recent academic studies did not reach a consensus. Some found that market fragmentation has worsened as reforms deepened (Young 2000; Poncet 2003 and 2005). Others agree that although market segmentation still exists in China, the trend toward market integration is nevertheless improving (Tang 1998; Xu 2002; Naughton 2003; Bai, Du, Tao and Tong 2004; Fan and Wei 2006; Holz 2009; and Qi 2009, among others).

This paper uses the new approach of border effect to examine the dynamic trend of market integration in China. Borders are generally defined either as boundaries between different administrative units such as provinces or as the geographic borders of different countries. Since our study focuses on domestic market integration, we use the term "borders" in the sense of boundaries of the administrative units (provinces). The

border effect not only affects trade volumes between various regions (countries) (McCallum 1995), but also manifests in the correlations of business cycles between regions (countries). In general, strong border effects lead to a low correlation of business cycles in different regions (thus indicating a lower degree of market integration in these regions). For example, Clark and Wincoop (2001) examined correlations of output (or employment) to measure business synchronization within the U.S. and among European countries. They discovered that the within-country correlations of business cycles are much higher than the inter-country correlations among European countries, thus demonstrating lower market integration as a result of the border effect in Europe.

This paper uses the methodology developed by Clark and Wincoop (2001) to measure the border effect among the different provinces within China, and investigates specific factors that affect the magnitude of border effects. We calculate the pair-wise GDP growth rate correlation coefficients among 204 Chinese cities, and obtain the weighted averages of these correlation coefficients of cities *within* a province as well as those of cities *across* provincial borders.

We define the difference between these two correlations as the overall border effect across Chinese provinces. This approach has several advantages. First, it allows us to report the *dynamic trend* of border effect in different time periods, unlike previous studies that can draw only a binary conclusion (i.e., integrated vs. not integrated). Second, some existing studies attempting to measure integration based on the law of one price had to use CPI indexes as opposed to prices on specific commodities due to lack of data. But the use of CPI does not truly embody the principle of the law of one price.

Finally, our approach allows us to decompose the overall border effect we defined in order to pin down the specific causes of market segmentation (or the lack of correlations in business cycles). The mere presence of segmentation does not automatically indicate local protectionism. Besides local protectionism, other geographic and economic factors can also affect business synchronizations between various regions.

In this study, we use a regression model in which the independent variable is the correlation between the GDP growth rates of two cities, and the explanatory variables are a series of economic and geographic factors that may affect this correlation between cities (such as the geographic distance between cities and the size of each city). Further, we include factors that could affect trade volumes between provinces: the differences in the industrial structure between two cities, the differences in each city's ratio of fiscal expenditure to GDP, the differences in the amount of FDI each city receives, etc. By controlling these factors that decompose the business cycle synchronization between cities, the residual border effect is an estimate of the magnitude of segmentation due to barriers set by local government policies, i.e., the administrative border effect.

We find that the inter-provincial administrative border effect first rose and then gradually declined in the period between 1991 and 2007. Further, the increase of this type of border effect coincided with the introduction of the Tax Sharing System reform, which started in 1994. This border effect declined steadily in recent years as the tax reform was fully instituted. Our analysis shows that China's reform path (under market-preserving federalism) did not create a persistent provincial "administrative border effect" that debilitated market forces. In fact, we discover that other economic factors that

decrease market integration are just as strong (or even stronger in some cases) as the administrative border effect.

Section 2 of this paper introduces the measurement of border effect in China and describes the trend of overall border effect in the period between 1990 and 2007. We focus our discussion on the provincial border effect as well as the regional border effect among the three regions of East, Middle, and West. Section 3 provides an analysis of factors that affect the overall border effect, and presents a regression model that decomposes the business cycle correlations (overall border effect) to estimate the magnitude of segmentation caused by economic and geographic factors as well as by local government behavior. Section 4 presents our conclusions.

2. Border Effect within China

We take the historical GDP data on 204 Chinese cities for the period of 1990–2007 (from volumes of China Urban Statistical Yearbook and China Economic Information Network) and then convert nominal GDP growth rates to real terms using CPI data for the same time period. After taking the natural log of these real GDP growth rates, we apply the Hodrick-Prescott filter to remove any long-term trends from these growth rates. Our data covers 30 out of 31 provinces and municipal cities in China (the only exception being Tibet). Table 1 shows the number of cities included in our data set for each province.

We calculated pair-wise correlation coefficients of the real GDP growth rates between two cities. This generated 20706 correlation coefficients, among which 902 are

correlations between two cities that are located within the same province; the remaining 19804 correlation coefficients are between cities that are located in different provinces.

We define the overall border effect dummy variable as 1 if two cities are located in the same province, and 0 if they are not. The overall border effect is represented as the estimated coefficient in the regression below:

Eq. (1): $$\text{Corr}_{ij} = \alpha_{ij} + \beta_{ij}\text{Border}_{ij} + \varepsilon_{ij}$$

where Corr_{ij} is the correlation coefficient of the real GDP growth rates between city *i* and city *j*, Border_{ij} is the border effect dummy variable, and β_{ij} is the overall border effect.

Table 2 demonstrates the growth correlations between cities located in the same province (i.e. intra-provincial correlation) as well as cities located in different provinces (inter-provincial correlation), and the magnitude of the estimated overall border effect in various time periods. We also plot the results in Figure 1 to show the trend of these coefficients.

(Insert Table 2 and Figure 1 here.)

The average intra-provincial correlation is .18 for the period of 1991 to 2007, while the inter-provincial correlation is .11. Thus the overall border effect for this period is .07. We then separate our sample into two periods, 1991–1998 and 1999–2007, because in general 1998 marked the beginning of further deepened market reforms in China. In the early period of 1991–1998, the estimated overall border effect is .07, but segmentation seems to increase to .11 for the later time period.

The simple averages do not reflect the relative importance of each city in China's economy. We calculate the ratio of a city's GDP to the overall combined GDP figure of

all 204 cities in our data set, and use that ratio to weight the correlation coefficients among cities. Table 3 and Figure 2 illustrate the weighted average results.

(Insert Table 3 and Figure 2 here.)

The overall border effect with the weighted average approach comes to be .08 for the whole sample period (from 1991 to 2007), while the overall border effect in both sub-periods is approximately .10, contrary to the increasing trend for the later period, shown by the simple average approach. In order to describe the dynamic trend of both simple average and weighted average border effect within China, we calculate the overall border effect with a rolling window of 10 years starting from 1991. The results are presented in Table 4 and Table 5.

(Insert Table 4 and Table 5 here.)

Both tables show a trend of increasing segmentation in China, especially in the two most recent rolling windows. Figures 1 and 2 also demonstrate the same trend.

In addition to inter-provincial overall border effect, we also examine the inter-regional overall border effect among the Eastern, Middle, and Western regions.[1] Most of the Eastern provinces in China are located on the coast. We performed the same correlation tests on the GDP growth rates between every pair of two cities, among which 7723 are intra-regional correlations (i.e. East to East, West to West, and Middle to Middle), and 12983 are inter-regional correlations. Table 6 shows that the average intra-regional correlation in the period of 1991 to 2007 is .13, while the average inter-regional correlation is .1. Therefore, the regional border effect is .03.

[1] The Eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi and Hainan. The Middle region includes Shanxi, Inner Mongolia, Jilin, Xiangsu, Anhui, Jiangxi, Henan, Hubei and Hunan. The Western region includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.

We further divide the sample into two sub-periods: before 1998 and after 1998. We find that the overall border effect in the period between 1991 and 1998 is .06. Interestingly, however, the border effect basically disappears in the later period (1999 to 2007), dropping to -.01 and becoming statistically insignificant as well. The weighted average results of regional overall border effect demonstrate the same trend; Table 7 shows a rather high border effect (.11) from 1991 to 1998, but the border effect becomes statistically insignificant in the later period, decreasing to -.03. Tables 8 and 9 as well as Figures 3 and 4 present the dynamic trend of the regional overall border effect using the same "rolling window" methods used for Figures 1 and 2. Readers can see the declining trend of regional border effect in these figures. In fact, in the last two windows (1997 to 2006, and 1998 to 2007), the regional border effect becomes close to zero or negative (and also turns out to be statistically insignificant).

Overall, we find that the inter-provincial border effect increases with time and has seemed to accelerate in recent years, thus indicating that market segmentation has risen as reforms deepened. On the contrary, the inter-regional border effect has been decreasing, and nearly disappeared in recent years. The declining trend in the inter-regional border effect may not be surprising. In 2000, China started a policy to "Develop the West." This policy significantly boosted infrastructure investment in underdeveloped areas, injecting large amounts of government funds. This development policy also aimed to attract large amounts of private capital to China's interior provinces. Such efforts have helped close the gap of economic growth between the Eastern region and the Middle and West regions, which will increase the inter-regional correlation. Moreover, the regional distinction is more of a geographic concept. It has no connection to the administrative or

jurisdictional boundaries. Interestingly enough, however, among provinces—which do have independent rights to administer and distribute resources—the overall border effect (segmentation) has increased steadily as economic reforms deepened in China. What, then, contributes to the increase in the overall provincial border effect?

3. Decomposing the Market Segmentation: Factors that Affect the Border Effect

Business cycle theories (Wynne and Koo 2000; Frankel and Rose 1998) attribute the correlation of two areas' economic growth mainly to the trade volumes between the two areas. Therefore, all factors that affect trade across borders would be manifested directly or indirectly in the border effect. For this reason, we cannot interpret the magnitude of the overall border effect described in Section 2 as the segmentation caused by local protectionism, as we have not controlled for the other factors that also affect the overall border effect.

Trade theory and literature generally holds that the volume of trade between cities is affected by both the geographic distance between the cities as well as the size of the cities (McCallum 1995; Helliwell 1996; Clark and Wincoop 2001; Anderson and Wincoop 2003; Okubo 2004, among others). We used Google Earth to obtain the longitude and latitude of each city and then calculated the distance between any two cities with the following formula:

Eq. (2):

$$distnce = 6378.7 * \left(\right) \left(\arccos\left[\sin\left(\frac{latitue_i * \pi}{180} \right) * \sin\left(\frac{latitute_j * \pi}{180} \right) + \cos\left(\frac{latitude_i * \pi}{180} \right) * \cos\left(\frac{latitute_j * \pi}{180} \right) * \cos\left(\frac{longitude_j * \pi}{180} - \frac{longitude_j * \pi}{180} \right) \right] \right)$$

where *distance* is the geographic distance between city *i* and city *j*. The unit of *distance* is kilometers. $longitude_i$, $latitude_i$, $longitude_j$,and $latitude_j$ represent each city *i* and *j*'s

longitude and latitude. Our data set yields 18336 pairs[2] of city-distance measures. We use the definition proposed by Clark and Wincoop (2001) to calculate the size of cities, i.e., the natural log of the sum of the population in each pair of cities.

In addition to distance and city size, we also control other factors that could potentially affect the correlation of real GDP growth rates between any two cities. These include: 1) the differences in the industrial structure between two cities; 2) the differences in fiscal expenditure; and 3) the differences in the amount of FDI each city receives.

We adopt the Absolute Value Index developed by Krugman (1991) to measure the industrial structure differences between any two cities. S_{in} (where n = 1, 2, or 3) represents the ratio of the output by the first (or second or tertiary) industry to total output in city i. The Absolute Value Index that describes the industrial structure difference between city i and city j is:

Eq. (3): $$AVI_{ij} = \left|S_{i1} - S_{j1}\right| + \left|S_{i2} - S_{j2}\right| + \left|S_{i3} - S_{j3}\right|$$

Controlling for the industrial structure difference is important as different industries will react differently when there is a common fiscal shock or a common monetary policy shock. On the other hand, one can also argue that the causal effect can run both ways between market integration and the geographic distribution of first, second, and tertiary industries. For example, under the condition of economies of scale and the agglomeration effect, market integration could lead to specialization, which will then affect industry structure. In order to control for this potential issue, we use the average values of the industrial structural difference indexes to reduce the endogeneity in our regression.

[2] This comes from 192 cities in our data set. Although we had economic data on 204 cities, only 192 of them yielded complete data.

We use the standard deviations of the differences between the ratios of a city's fiscal expenditure to its GDP to measure the differences in fiscal expenditure. We define F_{it} as the ratio of city *i*'s fiscal expenditure to its GDP where *t* represents years. Thus, the difference between the fiscal expenditure between city *i* and city *j* is the standard deviation of ($F_{it} - F_{jt}$) where *t*= 1, 2,…T…. Other things being equal, the difference between two cities' fiscal expenditure will lower the correlation of real GDP growth rates between these two cities.

We calculate the differences in the amount of FDI each city receives with a similar approach as the one adopted for the fiscal expenditure differences. Instead of using the ratio of fiscal expenditure to GDP, we use the ratio of FDI to GDP. Attracting more FDI helps accelerate economic growth in a region. Therefore, higher differences in FDI are likely to create a lower correlation of economic growth between cities.

Our regression model is:

Eq. (4):

$$corr_{ij} = \alpha + \beta_{ij}^{1} Border_{ij} + \beta_{ij}^{2} Ln(dis\tan ce) + \beta_{ij}^{3} Size(Population) + \beta_{ij}^{4} Industrail + \beta_{ij}^{5} Fiscal + \beta_{ij}^{6} FDI + \varepsilon_{ij}$$

where

$Corr_{ij}$ is the correlation of the real GDP growth rates between two cities;

$Border_{ij}$ is the dummy variable to indicate whether the pair of cities are within the same province;

Ln(Distance) is the natural log of the distance between two cities;

Size (Population) is the size of a city;

Industrial is the difference in the industrial structure of two cities;

Fiscal is the difference in fiscal expenditure between two cities; and

FDI is the difference in the amount of FDI two cities receive.

After controlling these economic and geographical factors in the regression, the coefficient of the variable $Border_{ij}$ will approximately reflect the market segmentation due to local protective administrative policies (i.e., the administrative border effect as opposed to the "overall" border effect calculated in Section 2).

Table 10 presents the regression results. The estimate for the administrative border effect between 1991 and 2007 is .05 and statistically significant. In the two sub-sample periods, this border effect is .04 for the early period (1991 to 1998) and increases to .06 in the later period (1999 to 2007). Thus local protectionism (built upon local administrative powers) seems to worsen as the economic reforms deepen, resulting in higher market fragmentation.

We further analyze the dynamic patterns of the administrative border effect using samples under "rolling windows." Actually, we find that it first increased but then declined gradually, starting in the window of 1995 to 2004. Our estimates for the administrative border effects of 10-year rolling window are:

.034 for the period of 1991 to 2000

.038 for the period of 1992 to 2001

.052 for the period of 1993 to 2002

.097 for the period of 1994 to 2003

.090 for the period of 1995 to 2004

.06 for the period of 1996 to 2005

.05 for the period of 1997 to 2006

.05 for the period of 1998 to 2007

After a dramatic increase between the periods from (1993 to 2002) and (1994 to 2003), the administrative border effect dropped significantly in the last ten years in the data set, to about .05. This trend is presented in Figure 4. All estimates for this border effect are positive and statistically significant in our analysis. Interestingly, we find that the timing of the initial rapid increase of this kind of border effect coincides with the beginning of the tax reforms (Tax Sharing System – TSS) introduced in 1994. Prior to the TSS, the fiscal contracting system (*caizheng chengbao zhi*) was used, under which local governments held more authority and control. They had great incentives to collect tax revenues and develop local economies, and obtained an increased share of fiscal resources because the most important contracts of shared revenue between central and local governments were fixed in nominal terms, thus also giving local governments the incentives to conceal their revenue capacities.

The new system, TSS, fundamentally changed how central and local governments share revenues. Most taxes were assigned to either the central or local governments. The motivation for introducing TSS stemmed largely from the central government's concern about its fiscal decline. In that regard, a major goal of the new TSS system was to restore the center's control and strength. The changes introduced by TSS met with resistance from the provinces, who feared losing local revenues. In turn, the center offered to return part of the shared revenues to ensure that provincial revenues would not drop below 1993 levels. The resistance subsided, and the system finally gained prominence after 1996, which again coincides with the declining administrative border effect in our regression results.

Our analysis shows that China's reform path (under market-preserving federalism) did not create a persistent provincial administrative border effect that debilitated market forces. Indeed, the local governments practiced stronger protectionist policies in some periods, but it was mostly in reaction to a major nationwide tax reform. The protectionism under the current economic system and organization of administrative powers eventually yielded to the stronger market forces. Table 10 also shows that the inter-provincial administrative border effect did exist to a degree, affecting market integration, but the magnitude of other economic and geographic factors that decrease market integration is just as strong (if not stronger in some cases) as the administrative border effect.

Table 10 also shows that most of the control variables not only turn out to be statistically significant, but also have the expected signs predicted by theories. For example, differences in industrial structure, fiscal expenditure, and FDI all affect the correlation of economic growth among cities. The first two factors (industrial structural diversity and fiscal expenditure difference) negatively impact the correlation, indicating that higher differences reduce the correlation between cities. However, it is intriguing that more differences in FDI actually have a positive impact on the growth correlation, although such an impact diminishes as we approach more recent years.

Table 11 decomposes the inter-regional segmentation to estimate border effect with similar controls on geographic and economic variables. The regression model is:

Eq. (5):

$$corr_{ij} = \alpha + \beta_{ij}^{1} Border_{ij} + \beta_{ij}^{2} Ln(dis\tan ce) + \beta_{ij}^{3} Size(Population) + \beta_{ij}^{4} Industrail + \beta_{ij}^{5} Fiscal + \beta_{ij}^{6} FDI + \varepsilon_{ij}$$

where the dummy variable $Border_{ij}$ takes on the value 1 if two cities are located in the same region, and 0 if they are not. Using sample data with the "rolling window" of ten years, we find that the inter-regional administrative border effect has been declining steadily from the first year included in the data, even becoming negative during the periods of 1997 to 2006 and 1998 to 2007. Figure 6 plots the estimates of regional border effect. Moreover, the inter-regional administrative border effects are not statistically significant either, showing that there is essentially no inter-regional border effect in China.

4. Conclusion

We measure the correlations between two cities' real GDP growth rates (a measure of business cycle correlations) to capture the degree of segmentation across China's provincial and regional borders. This type of segmentation can be caused by local protectionism as well as other economic and geographic factors that affect business cycle correlations between two cities. After controlling these other factors, we are able to pin down the border effect that is due to local protectionism: administrative border effect. We find that the inter-provincial administrative border effect first rose and then gradually declined between 1991 and 2007. Further, its increase coincided with the introduction of the Tax Sharing System reform, which started in 1994. However, the situation of segmentation related to administrative border effect has improved steadily in recent years, once the tax reform was fully instituted. Our analysis shows that China's reform path (under market-preserving federalism) did not create a persistent provincial "administrative border effect" that debilitated market forces. Compared with the inter-

provincial border effect in China, the inter-regional border effect has declined continuously and virtually disappeared in recent years. These findings contribute to our understanding of the impact of China's reform policies on market integration.

Reference

Anderson, J. E., and E. Van Wincoop, 2003. Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review* 93(1), 170–192.

Bai, Chongen, Yingjuan Du, Zhigang Tao, and Sarah Tong, 2004. Protectionism and Regional Specialization: Evidence from China's Industries. *Journal of International Economics* 63(2), 397–417.

Berkowitz, D., and D. N. DeJong, 2001. The Evolving Pattern of Internal Market Integration in Russia. *Economics of Transition* 9(1), 87–104.

Berkowitz, D., and D. N. DeJong, 2002. Accounting for Post-Soviet Russia's Growth. *Regional Science and Urban Economics* 32(2), 221–239.

Berkowitz, D., and D. N. DeJong, 2003. Integration: An Empirical Assessment of Russia *Journal of Urban Economics* 53, 541–559.

Clark, T. E. and E. Van Wincoop, 2001. Borders and Business Cycles. *Journal of International Economics* 55, 59–85.

Fan, C. and X. Wei, 2006. The Law of One Price: Evidence from the Transitional Economy of China. *Review of Economics and Statistics* 88(4), 682–697.

Frankel, J. A. and A. K. Rose, 1998. The Endogeneity of the Optimum Currency Area Criteria. *Economic Journal* 108, 1009–1025.

Helliwell, J. F., 1996. Do National Borders Matter? *Canadian Journal of Economics* 26(3), 507–522.

Hodrick, R., and E. C. Prescott, 1997. Postwar U.S. Business Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking* 29(1), 1–16.

Holz, Carsten, 2009. No Razor's Edge: Reexamining Alwyn Young's Evidence for Increasing Interprovincial Trade Barriers in China. *Review of Economics and Statistics 91(3),* 599–616.

Krugman, P., 1991. *Geography and Trade*. MIT Press, Cambridge.

Lyons, Thomas P., 1985. China's Cellular Economy: A Test of the Fragmentation Hypothesis. *Journal of Comparative Economics* 9(2), 125–144.

Montinola, Gabriella, Yingyi Qian, and Barry R. Weingast, 1995. Federalism, Chinese Style: The Political Basis for Economic Success in China. *World Politics* 48(1), 50–81.

McCallum, J. 1995. National Borders Matter: Canada-US Regional Trade Patterns. *American Economic Review* 85(3), 615–623.

Naughton, B., 2003. How Much Can Regional Integration Do To Unify China's Markets? in Hope, N., D. Yang, and M. Li (Eds.). *How Far Across the River? Chinese Policy Reform at Millennium* (pp. 204–232), Stanford: Stanford University Press.

Okubo, Toshihiro, 2004. The Border Effect in the Japanese Market: A Gravity Model Analysis. *Journal of Japanese International Economics* 18, 1–11.

Poncet, S., 2003. Measuring Chinese Domestic and International Integration. *China Economic Review* 14, 1–21.

Poncet, S., 2005. A Fragmented China: Measure and Determinants of China's Domestic Market Disintegration. *Review of International Economics* 13(3), 409–430.

Qi, L. 2009. Capital Flows and Domestic Market Integration in China. *Journal of Chinese Economic and Business Studies, forthcoming.*

Qian, Yingyi, and Barry R. Weingast, 1996. China's Transition to Markets: Market-Preserving Federalism, Chinese Style. *Journal of Policy Reform* 1, 149-85.

Tang, K. K., 1998. Economic Integration of the Chinese Provinces: A Business Cycle Approach. *Journal of Economic Integration* 13, 549-570.

Wynne, M., and J. Koo, 2000. Business Cycles under Monetary Union: A Comparison of the EU and US. *Economica* 67, 347-374.

Xu，X., 2002. Have the Chinese Provinces Become Integrated Under Reform? *China Economic Review* 13, 116-133.

Young, A., 2000. The Razor's Edge: Distortions and Incremental Reform in the People's Republic of China. *Quarterly Journal of Economics* 115(4), 1091-1135.

Tables:

Table 1 Number of Cities Included in Our Data Set (by Province)

Province	# of Cities Included		Province	# of Cities Included		Province	# of Cities Included	
	for GDP Growth Rates	for regressions on Decomposing Segmentation (in Section 3)		for GDP Growth Rates	for regressions on Decomposing Segmentation (in Section 3)		for GDP Growth Rates	for regressions on Decomposing Segmentation (in Section 3)
Beijing	1	1	Zhejiang	9	9	Hainan	2	2
Tianjin	1	1	Anhui	11	11	Sichuan	12	12
Hebei	9	9	Fujian	8	8	Chongqing	1	1
Shanxi	6	6	Jiangxi	6	6	Guizhou	3	2
Inner Mongolia	4	4	Shandong	14	14	Yunnan	2	1
Liangning	13	13	Henan	14	13	Shannxi	7	7
Jilin	6	6	Hubei	8	8	Gansu	5	3
Heilongjiang	10	10	Hunan	11	10	Ningxia	2	2
Shanghai	1	1	Guangdong	15	15	Qinghai	1	1
Jiangsu	13	11	Guangxi	7	5	Xinjiang	2	1

Table 2: Simple Average Real GDP Growth Rates Correlation Coefficients of Cities Located in the Same Province (intra-provincial correlation) vs. Cities Located in Different Provinces (inter-provincial correlation)

Time Period	intra-provincial correlation	inter-provincial correlation	Estimated Overall Provincial Border effect β_{ij}
1991-2007	0.18***	0.11***	0.07***
1991-1998	0.24***	0.17***	0.07***
1999-2007	0.17***	0.06***	0.11***

Note: *** denotes 1% significance level.

Table 3 Weighted Average Real GDP Growth Rates Correlation Coefficients of Cities Located in the Same Province (intra-provincial correlation) vs. Cities Located in Different Provinces (inter-provincial correlation)

Time Period	intra-provincial correlation	inter-provincial correlation	Estimated Overall Provincial Border effect β_{ij}
1991-2007	0.21	0.14	0.08
1991-1998	0.35	0.24	0.10
1999-2007	0.13	0.03	0.10

Table 4 Simple Average Real GDP Growth Rates Correlation Coefficients of Cities Located in the Same Province (intra-provincial correlation) vs. Cities Located in Different Provinces (inter-provincial correlation) – Rolling Window of 10 Years

Time Period	intra-provincial correlation	inter-provincial correlation	Estimated Overall Regional Border effect β_{ij}
1991-2000	0.22	0.15	0.07
1992-2001	0.21	0.15	0.06
1993-2002	0.19	0.12	0.07
1994-2003	0.15	0.07	0.09
1995-2004	0.19	0.11	0.08
1996-2005	0.16	0.07	0.08
1997-2006	0.16	0.06	0.09
1998-2007	0.17	0.07	0.10

Note: All data presented in this table are 1% statistically significant.

Table 5 Weighted Average Real GDP Growth Rates Correlation Coefficients of Cities Located in the Same Province (intra-provincial correlation) vs. Cities Located in Different Provinces (inter-provincial correlation) – Rolling Window of 10 Years

Time Period	intra-provincial correlation	inter-provincial correlation	Estimated Overall Provincial Border effect β_{ij}
1991-2000	0.27	0.20	0.08
1992-2001	0.26	0.18	0.08
1993-2002	0.21	0.15	0.06
1994-2003	0.18	0.08	0.10
1995-2004	0.21	0.11	0.11
1996-2005	0.17	0.07	0.10
1997-2006	0.13	0.02	0.10
1998-2007	0.14	0.03	0.11

Table 6: Simple Average Real GDP Growth Rates Correlation: Intra-regional vs. Inter-regional

Time Period	intra-regional correlation	inter-regional correlation	Estimated Overall Regional Border Effect β_{ij}
1991-2007	0.13***	0.10***	0.03***
1991-1998	0.21***	0.15***	0.06***
1999-2007	0.06***	0.07***	-0.01

Note: *** denotes 1% significance level, ** denotes 5% significant level and * denotes 10% significance level.

Table 7 Weighted Average Real GDP Growth Rates Correlation: Intra-regional vs. Inter-regional

Time Period	intra-regional correlation	inter-regional correlation	Estimated Overall Regional Border Effect βij
1991-2007	0.21	0.15	0.06
1991-1998	0.33	0.22	0.11
1999-2007	0.02	0.05	-0.03

Table 8: Simple Average Real GDP Growth Rates Correlation: Intra-regional vs. Inter-regional – Rolling Window o 10 Years

Time Period	intra-regional correlation	inter-regional correlation	Estimated Overall Regional Border Effect βij
1991-2000	0.18***	0.14***	0.05***
1992-2001	0.17***	0.14***	0.04***
1993-2002	0.14***	0.10***	0.04***
1994-2003	0.08***	0.06***	0.02***
1995-2004	0.12***	0.10***	0.02***
1996-2005	0.09***	0.07***	0.01***
1997-2006	0.07***	0.07***	0.00
1998-2007	0.07***	0.07***	0.00

Note: *** denotes 1% significance level, ** denotes 5% significant level and * denotes 10% significance level.

Table 9 Weighted Average Real GDP Growth Rates Correlation: Intra-regional vs. Inter-regional – Rolling Window o 10 Years

Time Period	intra-regional correlation	inter-regional correlation	Estimated Regional Border Effect β_{ij}
1991-2000	0.29	0.22	0.08
1992-2001	0.28	0.21	0.07
1993-2002	0.24	0.17	0.07
1994-2003	0.14	0.10	0.04
1995-2004	0.17	0.12	0.04
1996-2005	0.07	0.05	0.02
1997-2006	0.02	0.05	-0.03
1998-2007	0.02	0.05	-0.02

Table 10 Regression Results on Decomposing Correlation Coefficients – Provincial Border Effects

Sample Period	Border	Distance	Size(Population)	Production	Fiscal	FDI
1991-2007	0.05***	-0.01***	0.00	0.00***	-0.83***	0.15***
1991-1998	0.04**	-0.02***	0.02***	0.00***	-0.37***	0.34***
1999-2007	0.06***	-0.02***	-0.02***	0***	-0.03	0.06
1991-2000	0.03**	-0.02***	0.01	0***	-0.51***	0.27***
1992-2001	0.04**	-0.02***	0	0***	-0.68***	0.26***
1993-2002	0.05***	-0.01***	0.01	0	-1.08***	0.19***
1994-2003	0.10***	0	0	0**	-0.85***	0.07
1995-2004	0.09***	0	0	0***	-0.88***	-0.05
1996-2005	0.06***	-0.02***	0	0**	-0.85***	0.10**
1997-2006	0.05***	-0.02***	-0.02***	0***	-0.76***	0
1998-2007	0.05***	-0.03***	-0.02***	0***	-0.36**	0

Note: *** denotes 1% significance level, ** denotes 5% significant level and * denotes 10% significance level.

Table 11 Regression Results on Decomposing Correlation Coefficients – Regional Border Effects

Sample Period	Border	Distance	Size(Population)	Production	Fiscal	FDI
1991-2007	0.03***	-0.02***	0.00	-0.00***	-0.82***	0.15***
1991-1998	0.05***	-0.02***	0.02***	-0.00***	-0.38***	0.33***
1999-2007	-0.01**	-0.04***	-0.02***	-0.00***	-0.04	0.06
1991-2000	0.04***	-0.02***	0.01	-0.00***	-0.51***	0.25***
1992-2001	0.04***	-0.02***	0.00	-0.00***	-0.68***	0.25***
1993-2002	0.04***	-0.02***	0.01	-0.00	-1.07***	0.18***
1994-2003	0.02***	-0.01**	0.00	-0.00**	-0.82***	0.07
1995-2004	0.02***	-0.01**	-0.00	-0.00***	-0.86***	-0.05
1996-2005	0.01**	-0.02***	-0.00	-0.00**	-0.83**	0.10**
1997-2006	-0.01	-0.03***	-0.02***	-0.00***	-0.74***	0.00
1998-2007	-0.01	-0.04***	-0.02***	-0.00***	-0.35**	0.01

Note: *** denotes 1% significance level, ** denotes 5% significant level and * denotes 10% significance level.