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Economic Integration of the Chinese Provinces: A Business Cycle Approach

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Abstract

This paper uses correlation of business cycles to gauge the degree of economic integration of the Chinese provinces. The more integrated the provincial economies are, the stronger their correlations should be. Only the correlations between some provinces in eastern China are found to be consistently strong, suggesting that an integrated national economy is yet to be shaped. Secondly, the results imply that treating China as a single entity could be misleading, even at the macro level, especially in understanding China's business cycles. (JEL Classification: E3, O1)

I. Introduction

Since China began its economic reform in the late 1970s, its rapid growth has been characterized by volatile business cycles ⟨Tseng *et al.* [1994]⟩. A fundamental cause of these abrupt business cycles is over administrative decentralization and under economic decentralization ⟨Blejer *et al.* [1991]⟩.

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Economic reform has only partly removed economic power from the hands of the central government to that of the market, but, perhaps, more into the hands of local authorities. The pre-reform larger-sized national command economy has been transformed into a number of smaller-sized local command economies ⟨Jia and Wang [1994]⟩. Without sufficient coordination, particularly in the presence of inter-regional competition, local policies were distant from being consistent with national macroeconomic objectives.

While it is acknowledged that macro instability is associated with fragmentation of the economy, most of the literature continues to treat China as a single entity, when it comes to macro analysis. Differentiation of the business cycles in different regions is rarely noticed. Nonetheless, fragmentation does not necessarily eventuate into idiosyncratic business cycles. Whether this occurs depends on both the symmetry of shocks experienced by regions and the effectiveness of transmission of the shocks between them.

Market integration is a key element of economic integration. It is especially important in the reform era, as the role of the planning system in resource allocation and distribution has largely been taken over by the market. Nevertheless, in the same way as business cycles, market fragmentation between regions is mostly over-looked. The only two noticeable exceptions are the World Bank [1995] and Kumar [1994].[1] Market fragmentation has both micro and macro impacts. From the micro efficiency perspective, it restricts regional economies from the benefits of exploitation of comparative advantages, economies-of-scale, diffusion of technical knowledge and increasing competition. From the macro management perspective, market integration is a major determinant of the effectiveness of transmission of disturbances. This transmission mechanism is especially important once the People's Bank of China (PBC) replaces the credit plan with the interest rate as the major instrument of macro-control.[2] Unless the PBC can apply

1. Also see Yang [1997] for a detail account of coast-interior political and economic relations. One of the conclusions of Yang [1997] is that the coastal area has been increasingly dominating, compared to the interior area. Nevertheless, it should be noted that the duration, frequency and aggregated level of the data used by Yang [1997] is quite different from that of this paper, and its conclusion is referred more to political economic issues.
2. Replacing direct credit controls by indirect instruments that are compatible with market mechanism, such as interest rates, has been advocated by a number of orga-

different interest rates to different regions, interest rates would be symmetric to all regions. If regional markets are not integrated sufficient to equalize idiosyncratic disturbances, then the interest rate instrument would not be adequate to smooth all their business cycles.

For some other China observers, economic/market fragmentation might have far more important implications than micro inefficiency and macro instability. A frequently raised issue is, whether increasing local autonomy and regionalism could result in disintegration, especially after the world witnessed the dissolution of the former Warsaw group of countries in the early 1990s.[3]

Most studies of the fragmentation of the Chinese economy, including those mentioned above, chose a micro approach. They manage to provide detailed and solid analyzes of how institutional arrangements, under decentralization, have led to economic fragmentation. However, there are some problems with this kind of micro approach, in that quantifying institutional and political elements is difficult; those quantifiable items may not be directly comparable; and appropriate weightings between them are barely known. As a consequence, it is difficult to draw an overall picture relating to fragmentation of the Chinese economy. Additionally, all those studies left an important question unanswered: If the Chinese economy is not a united entity, are there any regional economic unions within China?

This paper attempts to bring a completely different framework into the literature. Firstly, it recognizes that, even at the macro level, there may be differences between different regions, and thus disaggregates China into the 22 provinces, 5 autonomous regions and 3 municipals (hereafter all are denoted as 'province' unless specify otherwise). Secondly, instead of examining various micro elements, it estimates the correlation of business cycles between the provinces as a measure of their degree of integration. Theoretically, the correlation of business cycles between different regions depends on, amongst other things, the degree of interdependence of their economies.

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nizations and individuals. For example, the International Monetary Fund ⟨Blejer, Burton *et al.* [1991]⟩, the World Bank [1995], and an economist of the Chinese Ministry of Finance [Ma 1993].

3. For example, see Goodman [1991, 1994], reports cited by Yang [1994:80] and a conclusion of a Pentagon study cited by Huang [1996:2]. These authorities, themselves, however, did not advocate such views regarding dissolution of China.

Empirically, Frankel and Rose [1996] established that trade linkage can enhance the correlation of business cycles between the partner economies. This framework is associated with the optimum currency areas (OCA) paradigm which is widely adopted in the monetary unification literature. Following a common practice in the literature, the correlation of business cycles is measured as that of the shocks experienced by the provinces; shock, in turn, is defined as the stochastic element of some underlying models.

There are several advantages of using this business cycle approach. It provides a comprehensive measure of various factors that attribute to economic fragmentation; the measure is unit free, thus cross country comparison is feasible; and it reveals whether there are any regional groupings of the provincial economies. On the other hand, the approach does have disadvantages. The measure is based on aggregate data. Given limited data, it can not identify how much of the fragmentation is due to 'intrinsic' structural incompatibility of the provinces, and how much to policies or institutional settings. It is also possible that the two provinces are simply hit by symmetric shocks. Then no matter whether they are integrated economically, their business cycles will be correlated. Moreover, the measure does not take into account fiscal integration, which is also an important element of economic integration (*e.g.* Ahmad *et al.* [1995], and Wong *et al.* [1995]). Therefore, the macro approach advocated by this paper should be regarded as a complement, instead of a substitute, to the micro approach.

The rest of this paper is organized as follows. Section II briefly reviews the background of decentralization and fragmentation in the Chinese economy. Section III outlines the theoretic framework underlying the empirical method. Section IV provides the empirical findings, and the final section gives the conclusion.

II. Economic Fragmentation

Economic fragmentation existed in China well before economic reform. Preceding the reform, there had been progressive decentralization of the economy. In particular, following the self-sufficient (*zili gengsheng*) guidance of Mao Zedong, the provinces were required to be economically independent (Zhao [1994]). This policy set the ground for economic fragmentation.

In the late 1970s, after almost three decades of social movements, the central authority urgently needed remedies to cure the damaged economy. To mobilize local enthusiasm in production, the central government decided to conduct the "*fenquan rangli*" policy. The principle was to decentralize administrative power and allow local authorities and enterprises to retain part of their revenues. It is commonly recognized that decentralization was one of the engines behind the fast growth of the Chinese economy in the past two decades. However, this growth was not without costs. Cannon and Zhang [1996] observed that local protectionism became stronger and more widespread in the reform era and that the decentralized power of economic decision-making has not passed fully to enterprises. Local authorities have as much, or even more, control and self-interests over those enterprises. Local authorities are also reluctant to invest in other regions to avoid losing revenues. To protect the local enterprises, import embargoes of substitutes, and export embargoes of production materials, are not uncommon ⟨Goodman [1994]⟩. Barriers exist in the forms of tariffs, quantitative controls, or even physical barricades. In summary, neither capital nor commodities are completely free to move across provincial borders. To a certain extent, the provinces have evolved into 'aristocratic' or 'cellular' economies ⟨Jia and Wang [1994]⟩.

The World Bank [1994] provided comprehensive evidence to quantify the above observations. From 1985 to 1992, China's external exports and imports in local currency grew at 28 and 20 percent per year, respectively, while inter-provincial exports and imports rose only by 6.9 and 4.8 percent per year, respectively. Another closely related study showed that total inter-provincial trade, as percentages of GDP for China in 1985, 1988 to 1992 were 31.6, 23.0, 18.8, 19.1, 16.9 percent, respectively ⟨Kumar [1994]⟩. By comparison, inter-member trade of the European Community (EC), in 1989, was 28.3 percent, and that of the former Soviet Union (FSU), in 1990, was 17.3 percent (27.2 percent if Russia is excluded). China's internal trade was not only smaller than that of the EC and FSU, but also declining across time. That is why Breslin [1995] concluded that, to a certain extent, the Chinese provinces are more open to the outside world than to each others.

Another indicator of the degree of market integration is price divergence. The World Bank [1994] found that, for seven daily consumer goods, the

standard deviations of prices across the provinces in 1991 were all higher than in 1986. On the other hand, that of five production materials fell in general between 1990 and 1992.[4]

On the investment side, the issuing of stocks and bonds is supposed to be an effective means of inter-regional investment. However, as the central authority still considers the stock market to be an experimental financial infrastructure in China, this has not been adopted widely. An examination of the ratios of inter-provincial to total local investment of Guangdong, Shaanxi, Beijing, Liaoning and Shanghai, from 1985 to 1992, show that only in Shanghai did this ratio rise significantly. The ratios of the first three provinces actually fell ⟨World Bank [1994]⟩. These five provinces accounted for about 30 percent of the national investment.

Similar to the use of price differential in gauging commodity mobility, capital return differential can be employed to assess capital mobility. Over the period 1986 to 1990, the variation of profit rates of firms across the provinces increased from 0.19 to 0.66. Further, it was found that inter-provincial investment was induced more by tax concession differential than by any real difference in capital productivity ⟨World Bank [1994]⟩.

Labor is another important factor of production and its mobility naturally reflects the degree of integration of labor markets. Labor mobility differs from that of capital and physical goods, because it is intentionally restricted by the authorities to control the growth of population in city areas. The household registration system (*hukou zhidu*) is a major policy instrument. Under this system, people who want to change registration status are required to obtain permission from the authorities. Before the economic reform, city residences almost completely relied on their affiliated unit (*danwei*) for job replacement, housing, and rationed foods ⟨Yan [1990]⟩. And the counterpart in rural areas was people communes (*renmin gongshe*). The affiliation and registration systems, together, provided an effective means of controlling labor migration. However, as a consequence of the economic reform, the planning system has been giving way to the private market in

4. The seven consumer goods were flour, rice, vegetable oil, apples, white cotton cloth, color TV, resident use coal, and kerosene. The five production materials were steel sheet, copper, coal, cement, and timber.

the provision of foods and jobs. This development has encouraged higher mobility of labor, especially from inland rural to coastal urban areas.

Comprehensive and systematic reports on intra-provincial labor migration are rare. The 1987 interim census revealed that inter-provincial migration accounted for only 20.7 percent of internal migrants ⟨Wakabayashi [1990]⟩. Chinese Labour Statistic has recorded the number of annual inter-provincial migrant workers of state-owned, urban collective-owned, and private ownership units. The numbers of workers of these units as a percentage of total workers, that moved out to other provinces, in 1990 and 1994, were 0.09 and 0.12 percent, respectively. The statistics are also likely to understate the mobility as only registered workers were counted.

To summarize this section, China is an economy where "major elements of economic union including a single currency and a common external tariff are combined with a lack of some basic features of a free trade area, such as the free movement of goods and factors" ⟨World Bank [1994]⟩. Furthermore, even if Chinese provinces are using a single currency, capital is not perfectly mobile, thus China is not quite a currency area either.[5]

III. Theoretical Framework

The theoretical framework of this paper is virtually the 'reverse' of the OCA paradigm. The OCA paradigm suggests that, if the candidate economies satisfy certain criteria, they would be eligible to form a (an optimal) monetary union. The mostly mentioned criteria include, amongst others, labor, capital and commodity mobility ⟨Tower and Willett [1976]; Tavlas [1993]⟩. Underlying all these criteria are two more fundamental elements: flexibility of price and real wage, and symmetry of disturbances. Primarily, most criteria are about how to attenuate the impacts of asymmetric disturbances between the candidate economies, when price and real wages fail to adjust in the short-run. For example, movement of factors and goods from depressed regions to booming regions could reduce unemployment in the former and inflation in the latter. In other words, the more integrated the

5. One of the definitive features of a currency area is free flow of capital. See Cohen [1994] for a discussion of 'the' definition of currency area.

member economies are, the more effective they will be to equalize the impacts of asymmetric disturbances.

A shortcoming of this kind of criteria-counting approach is that it fails to account for the dynamic impacts of monetary unification. As advocators of the European Monetary Union (EMU) have claimed, zero exchange risk and foreign exchange transaction cost would be likely to boost intra-union trade and investment ⟨CEC [1990]⟩. Stronger economic interdependence would lead to more effective transmission of disturbances between the member economies on the one side. Offsetting this, specialization in production could reduce the correlation of industry-specific shocks. The net impact is therefore an empirical question. Frankel and Rose [1996] looked at this dilemma and found international evidence that stronger trade ties lead to a stronger, instead of weaker, correlation of the business cycles between the partner economies. They concluded that OCA is a result of, rather than a prior condition for, monetary unification.

This paper attempts to turn the pitfall of the OCA paradigm into a useful device to gauge the degree of integration of Chinese provinces simply by 'reverting' the theories. Since the PRC was established in 1949, yuan (or *Renminbi*) has been the single legal tender in China. Though the functions of money were largely suppressed in the pre-reform era, it did not preclude the provincial economies from the benefits of zero exchange risk and transaction cost.[6] After almost 50 years, *with respect to the given institutional arrangements,* all endogenous benefits of monetary unification 'should be' largely realized, including correlating business cycles. Therefore, if the provinces have still not fulfilled the correlation criterion, it means that, either the provincial economies are structurally too incompatible to integrate, or there are institutional settings hindering them from becoming fully integrated under a single currency.

However, one should be aware that it is possible that two provinces may have strong economic linkages but asymmetric business cycles. For example, suppose the transmission of an asymmetric disturbance from the source province to the destination province takes half a year. If one uses

6. For a discussion of the function of money in the pre-reform era, see Peebles [1991], Also see Li [1995] for an analysis of monetization of post-reform China.

monthly data to measures the correlation of business cycles, then it may be found that the two provinces are not integrated. On the other hand, if one uses low frequency data, say annual data, then it may average out some shocks and thus blur the measure of correlation. It will also reduce the number of observations and so the accuracy of the measure. In this paper, business cycles are measured in the quarterly unit which is a kind of medium term scenario and to maintain enough number of observations. Given the limitations of the method, the results of this paper should be interpreted with caution, especially those related to economic integration.

In this paper, correlation of business cycles is measured through the shocks, experienced by the provinces; a shock, in turn, is defined as the stochastic element of some underlying models. In a simple dichotomous world, shocks can be categorized into either nominal or real. An example of the former is money supply shock, and an example of the latter is productivity shock. Their transmission channels are different. Presumably nominal shocks can be equalized between regions through flows of liquid assets, and real shocks through flows of physical commodities.

To separate these two kinds of shocks from aggregate data, the Blanchard and Quah [1989] method is employed. If a vector of variables X_t is stationary, it can be represented by a vector moving average representation or structural vector autoregression (VAR):

$$X_t = A(L)u_t,\ E(uu') = I.^{7} \tag{4.1}$$

X_t is a vector of change of real output (Δy_t) and inflation ($\Delta^2 p_t$).[8] u_t is a vector of structural shocks. $A(L)$ is a matrix polynomial of the lag operator. $E(uu') = \mathrm{I}$ represents three imposed normalization and orthogonality condi-

7. A constant and a linear time trend are included in practice to capture the growth rates of individual provinces. The discussion will be invariant to those additional variates.

8. First difference and second difference of output and price are used respectively to satisfy the stationary condition. Moreover it is found that the two elements of X are not cointegrated; if it is the case, an error correction term should be included. The inferences are based on the results of augmented Dickey-Fuller tests. Since those unit root and cointegration tests have become standardized nowadays with the help of computer econometric packages, the test results are omitted.

tions on the variance-covariance matrix of the structural shocks. u_t is not observable, but it can be recovered by estimating a reduced-form VAR of X_t:

$$X_t = B(L)e_t, E(ee') = \Omega \tag{4.2}$$

where e_t is a vector of estimated errors. Comparing (4.1) and (4.2), we have:

$$u_t = A_0^{-1}e_t. \tag{4.3}$$

To convert e_t back to u_t, it is necessary to identify the matrix A_0. In this bivariate system, A_0 has four elements, so it requires at least four restrictions to identify it. The first three restrictions are indeed from the normalization and orthogonality conditions. They can be denoted by:

$$A_0A_0' = \Omega.^9 \tag{4.4}$$

The last restriction imposed by Blanchard and Quah [1989] is that one of the components of u_t, say u_{1t}, has no long-run impact on output (y). Since its long-run impact on output is actually equal to the sum of impacts on the change of output (Δy) from time zero to infinity, the neutrality restriction on u_{1t} can be represented by:

$$\sum_{j=0}^{\infty} a_{11}^j = 0 \tag{4.5}$$

Equation (4.4) and (4.5) can be used to solve for A_0, hence u_t can be recovered. In this paper, u_{1t} is interpreted as a nominal shock, while the other is real shock. This kind of identification rule is definitely somewhat arbitrary. For example, Blanchard and Quah [1989] and Gali [1992], on the other side, interpreted the former as demand shock and the latter as supply shock. The naming of the two shocks itself is irrelevant, but it does reveal the underlying assumptions about the source of the shocks, *e.g.* either from the real or the nominal side. As it is well known that all these identification strategies will break down, if either the impacts of real/supply shocks are transitory, or nominal/demand shocks have permanent impacts on output. Therefore, these identifications should be treated as approximations.

There is a reason why the real-nominal instead of the supply-demand interpretation is adopted. Based on aggregate-demand-aggregate-supply

9. Since $e_t = A_0u_t$, $E(ee') = A_0'E(uu')\,A_0 = A_0'IA_0 = \Omega$.

models, u_{1t} should reduce inflation. However, from the impulse response functions, it is found that u_{1t} increases rather than decreases inflation.[10] This means that it contains a significant amount of demand shock elements which have permanent impacts on output. Therefore, adopting the supply-demand interpretation would be misleading.

Deseasonalized monthly data of industrial output and retail price index are used for the estimation. Since industrial products in general are tradable, and capital and intermediates intensive, they are suitable for measuring capital and commodities mobility. To maximize the degrees of freedom, the VARs of the provinces are estimated with monthly data. Then the estimated structural monthly shocks are aggregated into quarterly shocks to compute correlations. Measuring quarterly correlation is for the convenience of cross country comparison. Uniformly 12 months lag length is used for all the provinces. A 12 months lag is suggested by the Akaike's information criterion (AIC) for the national figures. Only 28 provinces have been tested because the data of Tibet are incomplete, and the data of Hainan is included in that of Guangdong. The testing period is 1990Q2-1995Q4. Excluding lags, the number of net observations is 20 quarters. Data of China are obtained from China Monthly Statistics, various issues; data of other countries are obtained from the International Economic Data Base, Australian National University.

The choice of the starting year is limited by the fact that China has published monthly provincial data since only 1990. It should be noted that the data are corresponding to roughly a complete business cycle in China. In the aftermath of the 1989 political turmoil, economic activities were severely dampened by domestic political uncertainty as well as international condemnation. The economic deadlock was relieved by Deng Xiaoping's southern tour and call for faster growth in 1992. But soon later it eventuated into excess aggregate demand, particularly fixed investment, and consequently high inflation. To restore macro-balance, the authorities restricted investments by state-owned units and tightened bank credits; the growths of fixed investments as well as GDP immediately slowed down during 1993-95 ⟨World Bank [1996]⟩.

While strong macro fluctuation can actually facilitate to measure the cor-

10. The impulse response functions are omitted.

relation of business cycles, the events happened during this particular period may have very asymmetric impacts on different provinces. For example, coastal provinces could be more responsive to Deng's call. Therefore, the findings of this paper should be interpreted with caution. To obtain results of greater generality, it requires data of more cycles, and thus is a possible work in the future.

IV. Estimation of Correlation of Shocks

Table 1 reports the correlations of real shocks. These are mapped into Figure 1. A large group of correlated provinces can be identified: include Liaoning, Jilin, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hunan, Guangdong, Guangxi, Yunnan, Gansu, Ningxia, and, to a lesser degree, Shanxi and Sichuan. In 1994, this group of provinces accounted for 60.7 percent of national industrial output.

Table 2 reports the correlation of nominal shocks. These are mapped into Figure 2. A similar, but smaller and much weaker, group of provinces

Figure 1
Correlation of Real Shocks

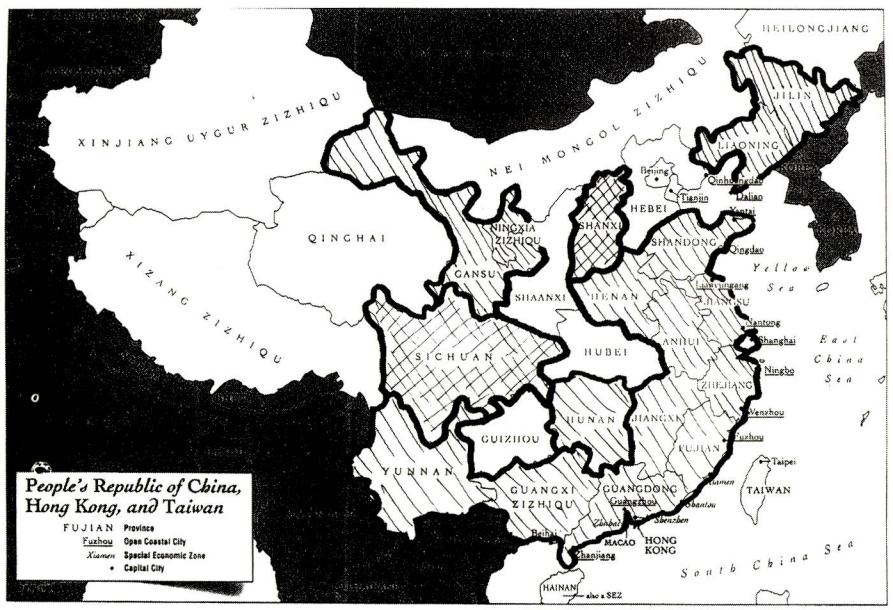


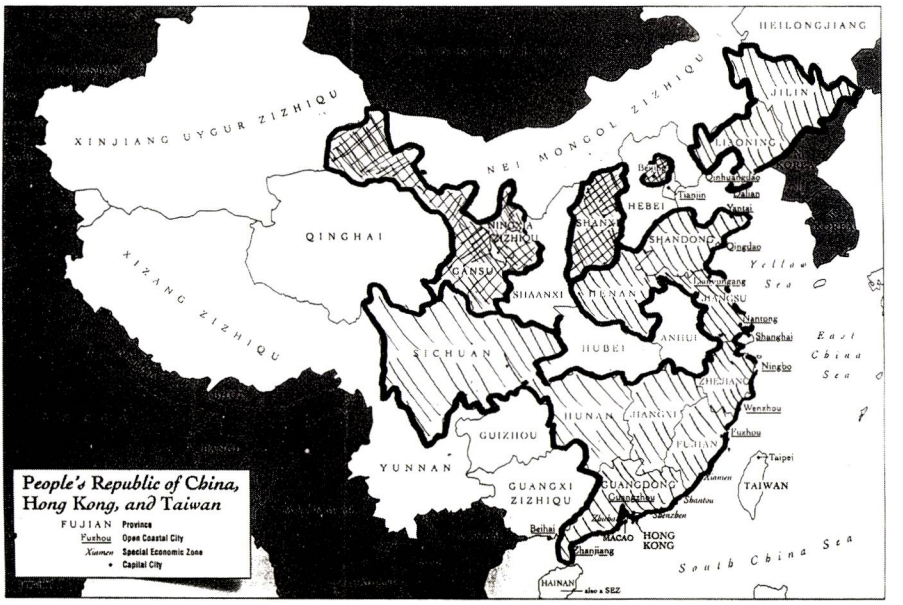
Table 1

Correlation of Real Shocks between Chinese Provinces

	BJ	TJ	HB	SX	IM	LN	JL	HLG	SH	JS	ZJ	AH	FJ	JX	SD	HN	HUB	HUN	GD	GX	SC	GZ	YN	SAX	GS	QH	NX	XJ
Beijing	1.00																											
Tianjin	0.23	1.00																										
Hebei	0.16	-0.29	1.00																									
Shanxi	0.26	-0.01	0.35	1.00																								
Inner Mongolia	-0.60	0.17	-0.21	-0.44	1.00																							
Liaoning	0.55	0.13	0.05	0.54	-0.74	1.00																						
Jilin	0.50	0.39*	-0.23	0.39*	-0.57	0.54	1.00																					
Heilongjiang	-0.59	0.03	-0.11	-0.35	0.73	-0.74	-0.47	1.00																				
Shanghai	0.01	0.21	0.27	0.16	-0.27	0.26	0.14	-0.08	1.00																			
Jiangsu	0.15	0.49	-0.29	0.21	-0.34	0.56	0.50	-0.48	0.40*	1.00																		
Zhejiang	0.38*	0.28	-0.08	0.42*	-0.57	0.67	0.64	-0.63	0.43*	0.72	1.00																	
Anhui	0.19	0.16	-0.19	0.33	-0.55	0.44	0.81	-0.45	0.27	0.57	0.72	1.00																
Fujian	0.42*	0.23	0.10	0.52	-0.71	0.58	0.72	-0.65	0.38*	0.52	0.66	0.75	1.00															
Jiangxi	0.30	0.36	0.09	0.42*	-0.58	0.54	0.59	-0.30	0.53	0.45	0.57	0.54	0.71	1.00														
Shandong	0.31	0.18	-0.27	0.38*	-0.62	0.65	0.64	-0.55	0.39*	0.71	0.64	0.68	0.63	0.63	1.00													
Henan	0.25	0.09	0.05	0.60	-0.56	0.56	0.60	-0.48	0.24	0.45	0.54	0.56	0.64	0.60	0.71	1.00												
Hubei	0.10	-0.14	0.30	0.52	-0.11	-0.05	0.22	-0.02	0.17	-0.04	0.16	0.32	0.31	0.08	0.21	0.41*	1.00											
Hunan	0.42*	0.17	0.30	0.56	-0.67	0.62	0.54	-0.61	0.46	0.57	0.63	0.48	0.69	0.68	0.71	0.78	0.31	1.00										
Guangdong	0.26	0.37*	-0.14	0.37*	-0.51	0.69	0.56	-0.66	0.42*	0.77	0.76	0.60	0.73	0.58	0.71	0.55	-0.01	0.57	1.00									
Guangxi	0.35	0.55	-0.05	0.37*	-0.44	0.70	0.41*	-0.39*	0.57	0.75	0.66	0.36	0.56	0.65	0.53	0.35	-0.11	0.52	0.69	1.00								
Sichuan	0.23	-0.07	0.20	0.51	-0.55	0.65	0.29	-0.59	0.42*	0.43*	0.56	0.34	0.52	0.49	0.64	0.77	0.22	0.82	0.58	0.41*	1.00							
Guizhou	0.20	-0.08	0.37*	0.48	-0.32	0.32	0.09	-0.19	0.41*	0.12	0.40*	0.21	0.29	0.17	0.10	-0.02	0.25	0.12	0.34	0.41*	0.16	1.00						
Yunnan	0.36	0.36	0.01	0.59	-0.53	0.51	0.66	-0.39*	0.34	0.45	0.43*	0.55	0.64	0.66	0.70	0.64	0.24	0.61	0.59	0.53	0.39*	0.20	1.00					
Shaanxi	0.30	0.16	0.01	-0.03	-0.51	0.22	0.28	-0.27	0.44	0.47	0.28	0.43*	0.48	0.39*	0.57	0.14	0.14	0.46	0.34	0.43	0.20	0.21	0.41*	1.00				
Gansu	0.52	0.27	-0.15	0.63	-0.64	0.76	0.72	-0.54	0.05	0.42*	0.58	0.49	0.67	0.60	0.56	0.60	0.13	0.56	0.51	0.61	0.45	0.23	0.55	0.16	1.00			
Qinghai	0.22	0.21	0.13	-0.12	0.05	0.02	0.26	0.01	0.24	0.02	0.23	0.27	0.02	0.10	0.02	0.09	0.21	0.13	-0.16	0.05	0.07	0.03	-0.01	0.05	0.01	1.00		
Ningxia	0.45	-0.13	0.29	0.62	-0.76	0.64	0.40*	-0.53	0.43*	0.41*	0.63	0.51	0.56	0.49	0.65	0.60	0.32	0.74	0.45	0.47	0.69	0.43*	0.55	0.47	0.48	0.06	1.00	
Xinjiang	-0.01	-0.10	0.19	-0.09	0.01	-0.23	-0.35	0.14	0.07	-0.16	-0.14	-0.16	-0.17	-0.11	-0.08	-0.42*	-0.02	-0.14	-0.11	0.00	-0.21	0.48	0.07	0.46	-0.27	-0.09	0.13	1.00

Note: Underline, high-lighted, Italian bold, and asterisk (*) denotes significant at 0.1, 1%, 5% and 10% level respectively. With 20 observations, the corresponding critical values of two-tails tests are ±0.74, ±0.58, ±0.44, and ±0.37 respectively. Testing periods for zero lag is 1990Q2-1995Q1, for 1 lag is 1990Q3-1995Q2 etc., with 20 net observations.

Figure 2
Correlation of Nominal Shocks



emerge. Anhui, Guangxi, Yunnan are excluded, while Beijing is included marginally. Sichuan becomes more significant, while Gansu becomes a marginal case. The core group accounted for 53.4 percent of national industrial output in 1994.

Since the patterns of correlation of real and nominal shocks are different, it is informative to know the relative importance of the two shocks. This can be obtained by decomposing the variance of forecast errors into the contributions of the two shocks respectively. The forecast horizon is 5 years. Instead of estimating those of individual provinces, only that of the whole nation is estimated. The results are reported in Table 3. Nominal shocks account for more than 35 percent of the forecast error of output within a one year horizon, and more than 80 percent of inflation permanently. In other words, nominal shocks are quite important in explaining the fluctuations of both output and inflation, especially in the short run.

For comparison, the correlations between 9 European Community countries (EC-9) across 1986Q1-1993Q3 are estimated. The results are reported in Table 4 and 5. In terms of real shock, less than half of the EC-9 countries

Table 2

Correlation of Nominal Shocks between Chinese Provinces

	BJ	TJ	HB	SX	IM	LN	JL	HLG	SH	JS	ZJ	AH	FJ	JX	SD	HN	HUB	HUN	GD	GX	SC	GZ	YN	SAX	GS	QH	NX	XJ
Beijing	1.00																											
Tianjin	-0.08	1.00																										
Hebei	-0.33	0.35	1.00																									
Shanxi	0.00	0.10	0.27	1.00																								
Inner Mongolia	0.20	0.11	-0.12	***0.45***	1.00																							
Liaoning	***0.58***	0.10	***-0.53***	0.20	0.31	1.00																						
Jilin	***0.48***	0.01	-0.24	0.23	0.04	0.33	1.00																					
Heilongjiang	-0.29	-0.11	0.26	0.20	0.14	-0.21	-0.27	1.00																				
Shanghai	0.07	***0.41***	0.24	0.40*	0.03	0.33	0.15	-0.18	1.00																			
Jiangsu	0.42*	0.11	-0.35	0.38*	0.38*	***0.52***	***0.64***	0.00	-0.11	1.00																		
Zhejiang	***0.56***	-0.03	***-0.49***	0.36	0.21	***0.71***	***0.63***	-0.13	0.32	***0.58***	1.00																	
Anhui	0.23	-0.12	-0.09	-0.04	0.15	0.23	0.29	-0.01	-0.07	0.13	0.31	1.00																
Fujian	0.26	-0.07	-0.25	0.42*	0.12	***0.46***	***0.56***	0.00	***0.50***	0.43*	***0.75***	0.16	1.00															
Jiangxi	***0.44***	-0.17	-0.26	0.19	0.13	0.38*	***0.65***	-0.27	0.00	***0.45***	0.40*	0.37*	0.25	1.00														
Shandong	0.11	-0.01	-0.57	0.28	0.38*	0.48	***0.45***	-0.03	0.19	***0.46***	***0.56***	0.04	***0.57***	0.20	1.00													
Henan	0.40*	-0.07	-0.19	0.08	-0.24	0.25	***0.58***	-0.27	0.27	0.33	***0.55***	0.20	0.42*	***0.48***	0.24	1.00												
Hubei	0.05	-0.10	***0.51***	0.43*	-0.01	-0.04	-0.03	0.12	***0.45***	-0.10	0.10	-0.02	0.29	-0.12	-0.24	0.30	1.00											
Hunan	0.21	-0.12	-0.40*	0.31	0.29	0.39*	***0.56***	0.19	0.05	***0.65***	***0.54***	0.15	***0.74***	0.21	***0.67***	0.18	-0.10	1.00										
Guangdong	***0.57***	0.07	-0.13	0.07	0.15	***0.44***	***0.68***	-0.13	0.20	***0.51***	0.38*	0.31	0.38*	0.40*	0.24	0.20	-0.13	***0.50***	1.00									
Guangxi	-0.09	0.15	0.20	0.22	0.30	-0.16	0.05	0.19	-0.09	0.25	-0.11	-0.18	0.16	-0.21	0.17	-0.32	-0.04	***0.54***	0.17	1.00								
Sichuan	0.29	0.18	***-0.44***	0.16	0.20	0.43*	0.55	-0.33	0.25	0.43*	***0.53***	0.13	***0.47***	***0.59***	***0.56***	***0.62***	-0.20	0.36	0.24	-0.22	1.00							
Guizhou	-0.27	0.21	***0.56***	***0.45***	0.06	-0.33	-0.26	0.19	***0.46***	-0.38*	-0.15	0.01	0.17	-0.14	-0.10	-0.02	0.35	-0.14	-0.26	0.06	0.07	1.00						
Yunnan	***0.45***	-0.25	-0.20	0.03	0.11	0.06	***0.49***	-0.41*	0.15	0.04	0.30	0.18	0.35	0.26	0.13	0.14	0.00	0.31	0.34	0.16	0.15	-0.05	1.00					
Shaanxi	-0.27	0.06	0.26	***0.50***	0.08	-0.07	0.19	0.31	0.05	0.25	0.24	0.24	0.27	-0.10	0.11	0.10	0.36	0.19	-0.19	0.00	-0.01	0.21	-0.04	1.00				
Gansu	0.12	0.08	-0.08	***0.60***	0.39*	0.21	***0.57***	0.04	0.24	***0.61***	***0.54***	-0.19	***0.61***	0.19	0.43*	0.20	0.18	***0.60***	0.25	0.36	0.34	-0.03	0.39*	0.39*	1.00			
Qinghai	0.18	0.12	0.37*	0.21	-0.07	-0.14	0.34	-0.05	0.28	0.03	0.12	0.24	0.19	0.25	-0.10	***0.58***	***0.59***	-0.08	0.01	-0.15	0.21	0.29	0.07	0.22	0.07	1.00		
Ningxia	-0.13	-0.14	-0.11	***0.55***	0.40*	0.16	0.43*	0.08	-0.09	***0.63***	0.31	0.07	0.43*	0.29	***0.47***	0.09	0.12	***0.53***	0.12	0.28	0.26	-0.11	-0.02	***0.53***	***0.58***	0.14	1.00	
Xinjiang	0.16	0.23	0.31	0.18	-0.37*	0.03	0.29	-0.24	***0.50***	-0.05	0.32	0.21	0.34	0.13	-0.08	***0.65***	***0.48***	-0.05	-0.07	-0.15	0.28	0.38*	0.23	0.38*	0.10	***0.62***	-0.08	1.00

Note: Underline, high-lighted, Italian bold, and asterisk (*) denotes significant at 0.1, 1%, 5% and 10% level respectively. With 20 observations, the corresponding critical values of two-tails tests are ±0.74, ±0.58, ±0.44, and ±0.37 respectively. Testing periods for zero lag is 1990Q2-1995Q1, for 1 lag is 1990Q3-1995Q2 etc., with 20 net observations.

Table 3
Variance Decomposition for Output and Inflation Percentage of Variance Due to Nominal Shocks

Period	Proportion of Variance Due to Nominal Shock							
	1 quarter	2 quarters	3 quarters	1 year	1.5 years	2 years	3 years	5 years
Output	75.70	38.70	16.81	35.67	9.25	4.01	0.05	0.08
Inflation	99.60	97.81	90.04	83.14	83.81	79.51	82.72	84.32

Table 4
Correlation of Real Shock of EC-9 Countries

	Germany	France	Italy	Austria	Netherlands	Switzerland	UK	Spain	Greece
Germany	1.00								
France	0.21	1.00							
Italy	0.17	***0.39***	1.00						
Austria	***0.39***	***0.54***	-0.05	1.00					
Netherlands	0.08	***0.58***	-0.14	***0.57***	1.00				
Switzerland	0.03	***0.46***	0.23	***0.37***	***0.50***	1.00			
UK	-0.31*	0.31*	-0.17	0.00	0.16	0.26	1.00		
Spain	0.03	***0.36***	0.20	0.17	0.16	0.22	0.25	1.00	
Greece	-0.10	0.22	0.15	0.08	-0.11	0.08	0.29	0.34*	1.00

Note: Underline, high-lighted, Italian bold, and asterisk (*) denote significance at 0.1, 1, 5, and 10% levels respectively. With 31 observations, the corresponding critical values for two-tails tests are ±0.59, ±0.46, ±0.35, and ±0.30 respectively.

are correlated at a 1 percent level. In terms of nominal shock, most are insignificantly correlated. Whitt [1995] applied the same method on several EC members across a pre German unification period: 1965Q2-1992Q2. He found that in terms of real shock, the correlation between Germany and four other EC members (the UK, France, Italy and the Netherlands) were –0.08, 0.56, 0.46 and 0.40, respectively. While that of nominal shock were –0.32, 0.02, –0.24, and –0.34, respectively. Bayoumi and Eichengreen [1994] used annual data, across the period 1960 to 1990, and evidenced stronger correlations between the EC-9 countries. They also found that the correlation of real shocks between six out of seven US regions ranged from +0.43 to +0.81, and that of nominal shocks ranged from +0.43 to +0.79.

Table 5
Correlation of Nominal Shock of EC-9 Countries

	Germany	France	Italy	Austria	Netherlands	Switzerland	Spain	Greece	UK
Germany	1.00								
France	0.13	1.00							
Italy	0.05	0.04	1.00						
Austria	*0.55*	-0.05	-0.29	1.00					
Netherlands	0.22	0.20	0.17	-0.01	1.00				
Switzerland	0.15	0.09	*0.43*	0.11	-0.01	1.00			
UK	-0.12	0.01	0.08	-0.23	-0.19	0.06	1.00		
Spain	0.14	0.15	-0.01	0.09	0.13	0.15	-0.16	1.00	
Greece	-0.09	0.10	0.12	-0.03	0.11	-0.05	-0.20	*-0.60*	1.00

Note: Underline, high-lighted, Italian bold, and asterisk (*) denote significance at 0.1, 1, 5, and 10% levels respectively. With 31 observations, the corresponding critical values for two-tails tests are ±0.59, ±0.46, ±0.35, and ±0.30 respectively.

In considering the findings of this paper and other studies, no clear conclusion can be drawn about the relative coherence between the Chinese provinces and the EC-9. The result contrasts with the findings of the World Bank [1994], that the EC countries have much stronger trade ties more than that of the Chinese provinces, whereas the US regions seem to be more correlated than these two unions. Nonetheless, the comparison may not be on an equal basis. Bayoumi and Eichengreen [1994] used annual data and grouped the 30 states of the US into only seven regions, some short-term intra-regional asymmetry might be averaged out.

Sensitivity Tests

It is not uncommon that the scaling of business cycles are sensitive to the estimation specification such as simply the number of lag ⟨Hafer and Shee-

11. This method was applied by Cohen and Wyplosz [1989] and Karras [1996] on the EMU. This method itself has various estimation specifications, such as different lag lengths or different growth trends. Since it is for the purpose of illustrating the sensitivity of the VAR results, any plausible specifications which manage to provide altered results would fulfill the purpose. The one we choose here is one of the specifications in Karras [1996].

han [1991]). To ensure the robustness of the results, their sensitivity with respect to lag length, and even to the estimation method, is examined.

Firstly, the exercise is repeated by selecting the lags for individual provinces according to the AIC. It turns out that all lags suggested by the AIC are very short, either one or two months. Compared to the previous 12 lags, it can be considered as an extreme testing case. The correlation patterns become sharper than the case of uniform 12 lags. The correlation of real shocks clearly divides China almost exactly into a western and an eastern sphere, with Heilongjiang and Guangxi at the ends of the diagonal. The only exception is Sichuan which is still correlated to eastern provinces. The correlation patterns of nominal shocks changes even more dramatically. Almost all the provinces are strongly correlated.

Secondly, a different univariate method is use.[11] It is to decompose fluctuations of output and inflation into province-common and specific shocks:

$$x_{it} = w_i + x_{it-1} + \rho_{i2}x_{it-2} + \ldots \rho_{ik}x_{it-k} + c_t + s_{it}, \qquad (4.1)$$

where the subscript i and t denote province and time respectively. x is the rate of change of logarithm output (Δy) or inflation ($\Delta^2 p$); w is the real growth rate; c is province-common shock; s is province-specific shock. The lag terms of x are to capture the persistence of shocks. Three and two lags are used in the output and the inflation regression, respectively.

Common shocks are those that affect all provinces at the same degree; specific shocks are those that affect individual provinces only. The more effective the transmission of shocks across the provinces, the more dominant the common shocks, relative to the specific shocks, will be. The ratio of variances of common to specific inflation shock of the provinces ranges from 12.5 for Inner Mongolia to 1.3 for Beijing. The ratios for 29 provinces are actually above 3.3. The finding is consistent with the nation wide strong correlation of nominal shocks when shorter lags are used in the VAR analysis. On the other hand, that of output shocks ranges from 2.3 for Hebei to 0.2 for Jiangsu. The ratios of only 3 provinces are above 1.0, while that of 12 provinces are below 0.5.

Furthermore, the more effective the transmission between two provinces are, the stronger the correlation of their specific shocks. Since the variance ratios of common to specific output shocks are generally small, the correla-

tion of output specific shocks becomes more important. Two groups of provinces with strong correlation are identified: 1/ Liaoning, Zhejiang, Anhui, Fujian, Jiangxi and Hunan; 2/ Guizhou, Shaanxi, Gansu, Qinghai and Xinjiang. The members of the first group are located in eastern China, while the second group is positioned in western China. Furthermore, these two groups are significantly negatively correlated to each other. In terms of correlation of inflation shock, three groups of integrated provinces can be identified: 1/ Beijing, Tianjin, Shanghai and Guangdong; 2/ Jiangsu, Zhejiang and Anhui; 3/ Hunan, Sichuan and Guangxi. The composition of the first group is tangible, as the members are the most open provinces, in terms of the ratio of external trade to GDP. The second and third group of provinces are close neighbors in eastern and northern China respectively.

Overall, the regional groupings identified both by using shorter lag lengths and by the univariate method are quite different from the previous findings. It means that any conclusions about regional integration would, at the most be suggestive. On the other hand, a small group of provinces which are consistently strongly correlated under most estimation specifications can be identified. This includes Jiangsu, Zhejiang, Anhui, Jiangxi, Fujian, and Hunan. They are close neighbors in eastern China.

V. Concluding Remarks

This paper uses the correlation of business cycles between 28 Chinese provinces to gauge their degree of economic integration. It was found that the shocks experienced by the provinces were not uniformly correlated. Secondly, different estimation specifications suggest different groupings of the provincial economies. However, it was found that several eastern provinces are consistently strongly correlated. Overall, the findings suggest that treating China as a united economy might be misleading not only at the micro level, but also at the macro level, especially in understanding its business cycles. From the perspective of economic integration, it indicates that a single national economy may not yet be shaped. However, it should be aware of the tentative nature of the conclusions about economic integration. The analysis is corresponding to the period of 1990-95 only which features the cycle of recovery in the post-Tiananmen era. In addition, economic inte-

gration is not the single explanation of the correlation of business cycles. Taking these limitations into consideration, a suggestion for future research is to extend the macro business cycle model in terms of both the duration of data and the disaggregation of shocks on the one side, and to examine the possibility of further integration of the macro and micro approaches on the other.

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