Optimum Currency Area for Mainland China and Hong Kong? Variance and Shocks Decomposition Tests

Shu-ki TSANG
Economics Department
Hong Kong Baptist University
Kowloon Tong
Hong Kong

Tel: 852 3411 7544/7548
Fax: 852 3411 5580
Email: sktsang@hkbu.edu.hk
Internet: http://www.hkbu.edu.hk/~sktsang

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Abstract

After the political unification of Hong Kong with China, Hong Kong is supposed to function as a separate economic entity under the framework of "one country, two systems". However, the increasingly close ties between the two economies, particularly in recent years, have raised the possibility of full economic integration despite political constraints, and even of monetary union as the Chinese currency progresses towards full convertibility. This paper employs the theory of optimum currency area (OCA) and adopts the variance analysis as well as an improved version of principal decomposition technique to test whether Mainland China and Hong Kong constitute an OCA. The historical results presented in this paper are very sceptical of a positive answer. The empirical findings based on disaggregated data show some signs of nominal and real convergence only between Hong Kong and parts of Eastern China, driven by trade. This seems to be consistent with the actual trajectory of economic integration. However, all other results, even those based on higher frequency price data, point to a lack of evidence that Hong Kong and Mainland China as a whole as yet constitute an OCA.

JEL classification numbers: F15, F33, F36.

1. Introduction

The foreign exchange system in China has been changing at a remarkable pace in the reform period, particularly since 1994. Current account convertibility for the Chinese currency, the Renminbi (RMB), was formally achieved on 1 December 1996, when the country's central bank, the People's Bank of China, accepted Article VIII of the Articles of Agreement of the International Monetary Fund (Tsang, 1997). Economists are now arguing about the possibility and desirability of full convertibility within the next decade.

As the Renminbi (RMB) moves towards the state of full convertibility, an issue worthy of serious attention is the fate of the currency of Hong Kong---the Hong Kong dollar (HK$). After a decade and a half of British colonial rule, Hong Kong became a special administrative region (SAR) under Chinese sovereignty on 1 July 1997 within a constitutional framework of "one country, two systems", which guarantees a high degree of autonomy for the SAR. Hong Kong is now supposed to enjoy fiscal independence, continue to issue its own currency (the HK$), and be responsible for all matters except (1) national defense, and (2) diplomacy, which are under the jurisdiction of Mainland China. These arrangements are sanctified by the Joint Declaration between China and Great Britain in 1984 and the Basic Law promulgated by China in 1990.

In any case, since China launched her economic reform and open policy in the late 1970s, the economic linkages with Mainland China and Hong Kong have been rapidly strengthening through apparently phenomenal trade and capital flows. Hong Kong as an international port now handles half of China's (and 80% of Guangdong's) external trade. It has provided nearly 60% of "foreign capital" which has been crucial for the Chinese economic take-off. On the other hand, Chinese economic influence in Hong Kong is also increasing rapidly (Tsang, 2002), particularly after the signing of CEPA (Closer Economic Partnership Agreement) in July 2003. China is now the biggest investor in Hong Kong and many of its shares are listed in Hong Kong and can be traded. There are a lot of companies called red chips rather than blue chips because they have communist backing. China Mobile, for example, is the largest and takes about 15 per cent of the total stock market capitalisation in Hong Kong.

The World Bank (1996) also notes that "the proximity of Hong Kong makes China's capital account rather porous. So it is quite probable that capital flows between the two economies (through the neighbouring province of Guangdong) respond to interest rate differentials (adjusted for the expected movements in the exchange rate). It is interesting to note that Chinese official interest rates have loosely followed interest rates in Hong Kong, with China's interest rates higher several percentage points in recent years (figure 3.2)." That may be regarded as an indication of financial integration in formation.

To many, the political unification will only further cement the economic ties. The big question is therefore: Are two separate currencies (the RMB and the HK$) really necessary, particularly when the RMB becomes fully convertible, some time in the future?

This paper investigates the issue by looking at whether the widely acclaimed economic integration between Mainland China and Hong Kong has progressed to a stage that monetary unification is justified. This would involve mainly empirical analysis of the situation so far. It employs the theory of optimum currency area (OCA) and adopts the technique of variance analysis and develops an improved version of principal decomposition tests to determine whether Mainland China and Hong Kong constitute an OCA as yet.

A proviso is warranted right from the start. This is ***not*** a paper on whether monetary union is desirable for Hong Kong and Mainland China (on that, see, for example Tsang 2002). It is an empirical investigation on the stage of nominal and real "convergence" between the two economies. Disaggregated and regional data in China are difficult to find, particularly beyond the annual series. In this regard, I have been able to make use of some data commissioned by and available at the Hong Kong Institute for Monetary Research (HKIMR). Methodologically, I have to compromise at several points given the short time series. Because of these limitations, which few could surmount, my research strategy is designed to the use of a relatively wide range of variables (as many as I could obtain and employ with justifications) and combinations to draw any conclusions. In other words, I opt for breadth to compensate for the inevitable constraints of depth. More in-depth probe into specific variables must await the availability of much-wanted high frequency and other relevant data.

2. The Theory of Optimum Currency Area and Reported Tests

In the analysis of the justification or otherwise for the system of "one country, two currencies" for Hong Kong and China, it is natural for us to go into the theory of optimum currency area (OCA) as pioneered by Mundell (1961) and extended by McKinnon (1963) and others, which is the dominant framework for the economics of monetary union. The push towards a common currency for Europe has prompted a new generation of models and analyses (e.g. Tavlas, 1993). Traditional optimal currency literature identified factor mobility (Mundell, 1961), trade integration (McKinnon, 1963), and regional production diversification (Kenen, 1969) as the major criteria to determine the desirability of a common currency area. Recent literature points to the variance of the real exchange rates (Vaubel, 1976), monetary integration (von Hagen and Neumann, 1994) and fiscal integration (Kenen, 1969; Eichengreen, 1992) as crucial factors that characterize an optimal currency area. For recent theoretical and empirical contributions, see Mélitz (1995, 1996) and Artis, Kohler and Mélitz (1998).

Since China launched its reform in 1978, the economy has undergone a rapid process of monetization (Yi, 1994). However, there are still doubts as to whether the country has fully emerged from the constraints of planning and bureaucratic intervention, which would be serious obstacles to a full-scale financial liberalization and the possibility of a freely convertible Renminbi. Monetary union with Hong Kong, which is regularly elected as one of the "freest" economies in the world, would then not be plausible. In the light of these considerations, the key questions that I attempt to answer in this paper are: (a) Is China itself an OCA? (b) Do China and Hong Kong constitute an OCA? (c) Do eastern China, the most open of the Chinese regions, together with Hong Kong form an OCA?

Artis, Kohler and Mélitz (1998) investigated the issue of OCAs in the worldwide context. China and Hong Kong were included as two of the regions in their sample. Based on the trade criterion, they concluded that China and Hong Kong are an OCA or part of the Asian and Oceanian OCA. Nervertheless, our paper looks at the issue of OCA from both trade and other different criteria and can therefore be compared with their findings. It is interesting to check if their results are robust to criteria other than trade. Incidentally, in an IMF working paper, Liang (1999), testing the generalized PPP hypothesis, reaches a negative conclusion. This is also consistent with the findings of Ma and Tsang (2002), which return a resounding "no" to the question whether China and Hong Kong constitute an OCA up to 1994.

After the political unification of Hong Kong with Mainland China in 1997, Hong Kong is supposed to function as a separate economic entity under the framework of "one country, two systems". However, the increasingly close ties between the two economies, particularly in the post-transition years, have raised the possibility of full economic integration despite political constraints, and even of monetary union as the Chinese currency progresses towards full convertibility. This paper employs the theory of optimum currency area (OCA) and adopts the techniques of variance test and principal decomposition to determine whether Mainland China and Hong Kong constitute an OCA as yet.

3. Econometric Methodology

In the existing literature, various methods can be used to test the OCA hypothesis, ranging from simple statistical tests to co-integration and VAR tests. Constraints in terms of Chinese regional data, short and low in frequency, dictate the "choice" of the techniques used here. Two are employed: (1) the variance test, and (2) principal decomposition analysis.

Variance approach

This approach looks at the variance of some key variables (Mundell, 1961; Vaubel, 1976)). In the recent context, Eichengreen (1992) looks at the minimum, maximum and standard deviations of the real exchange rates of European Community members against Germany. De Grauwe and Vanhaverbeke (1993) focus on the standard deviations of regional growth and unemployment rates. Most variables such as GDP and investment growth rates can be applied by conventional variance analysis.

A number of researchers e.g., von Hagen and Neumann (1994) favour the use of the real exchange rates among different regions. Since the more variable the real exchange rate is, the more adjustment would fall on domestic prices and wages under a fixed exchange rate regime. If there are nominal rigidities, the burden would be shifted to output and employment changes. One way to deal with the case of the real exchange rates among regions in China and Hong Kong is to follow the treatment formalized by von Hagen and Neumann (1994), which Ma and Tsang (2002) adopted as follows.

The real exchange rate (RER) between a mainland Chinese region i and Hong Kong is

$$Q_{it} = P_t + s_t - p_{it} \qquad (1)$$

where P_t is the logarithm of Hong Kong's CPI, s_t is the logarithmic nominal exchange rate of RMB/HK$, p_{it} is the logarithm of Chinese region i's CPI. The real exchange rate between two Mainland Chinese regions i and j as

$$q_{jit} = p_{jt} - p_{it} \qquad (2)$$

as the nominal exchange rate between the latter two is by definition one.

To derive the unexpected component of variables Q_{it} and q_{jit}, we perform the following regressions:

$$Q_{it} = \alpha_0 + \Sigma_k\, \alpha_k Q_{i,t-k} + U_{it} \qquad (3)$$

$$q_{jit} = \alpha_0 + \Sigma_k\, \alpha_k q_{ji,t-k} + u_{jit} \qquad (4)$$

Let these residuals, U_{it} and u_{jit}, be called RER shocks. The conditional standard deviations (STD) of these chocks and average over the Chinese regions are computed to yield the measures of conditional RER variance.

$$V = \Sigma^{M}_{i=1} STD(U_{it})/M \quad (5)$$

$$v_j = \Sigma^{M}_{i=1} STD(u_{jit})/M \quad (6)$$

where M is the number of Chinese regions covered in the regressions.

Then compare v_j (j=1,..M) to see if China is an OCA. However, in the case of China and Hong Kong, we need to construct an aggregate measure for China and then check it against the measure of Hong Kong. One way is to construct an average RER variance of China is to have:

$$v = (1/N)\Sigma_i \Sigma_j STD(u_{jit}) \quad (7)$$

where N=1+2+3+..+M=Z, which is the total number of u_{jit} of Mainland Chinese regions. Then V and v are compared to determine if China and Hong Kong together constitute an OCA.

However, such an approach is susceptible to criticism of bias in results and interpretation (Lafrance and St-Amant, 1999, pp.9-10). A key point is to distinguish between nominal and real shocks. The former tends to disappear as a source of specific shocks in a monetary union. To control for it, the VAR method proposed by Lastrapes (1992) can be used. However, price stickiness in Mainland China, together with rigidity in the nominal exchange rate, might artificially suppress RER volatility and lead to difficulties in interpretation. Given the soft peg in China since 1994 and linked exchange rate in Hong Kong since late 1983 and the different degrees of price flexibility over time and across regions, I have decided not to use real exchange rates in this paper.

Shocks decomposition approach

This approach applies principal components analysis to decompose the common shocks to an economic variable in different regions into symmetric and asymmetric shocks. This is complementary to the von Hagen and Neumann's (1994) individual shock approach. One example of this approach can be found in Caporale (1993), which Ma and Tsang (2002) adopted with an improvement. I adapt such an approach in this paper with some modifications in details.

To generate estimates of the shocks or innovations to a set of economies, one can use the following vector auto-regression (VAR):

$$y_t = \gamma + \beta . y_{t-1} + u_t \qquad (8)$$

where y_t is a vector of values for an important economic variable, say GDP or CPI, over M different economies or regions, γ represents a vector of constants, β is coefficient matrices, and u_t is vector of disturbance terms. Unfortunately, in the case of China and Hong Kong, I fail to apply VAR, and to resort to AR.

The estimated u_t's can then be subjected to principal components analysis after they are normalized so that their expected value equal to 0 and their variance equals 1. Let us call the normalized value e_t. The normalised eigenvectors, f_1, ... f_M, of the correlation matrix of the e_t's is called the loading factors. The squares of the factor loadings show the weight applied to each component in expressing each series as a function of the components. Hence the square of f_{ij}, which is the i-th element of f_j, represents the percentage of the variance of region i's variable explained by j-th principal component included in the model. Hence the square of f_{ij}, which is the i-th element of f_j, represents the percentages of the variance of region i's variable explained by j-th principal component included in the model:

$$e_{it} = f_{i1} p_{1t} + f_{i2} p_{2t} + \ldots\ldots + f_{iM} p_{Mt} \qquad (9)$$

These squares show the percentages of the fluctuation of the economic variable that can be explained by "common shocks", i.e. the "principal components", or shocks that have economy-wide effects.

One can improve upon the above principal components approach of Caporale (1993) by decomposing the total variance of common shocks into positive (symmetric) and negative (asymmetric) contributions, as Ma and Tsang (2002) do. If the symmetric contribution outweighs the asymmetric contribution for a particular economy or region, it would constitute as a piece of evidence that the economy would derive net benefit by being a member of the wider community, say an OCA. As the eigenvectors, or the loading factors, are normalised so that $\Sigma_{j1} f_{ij}^2=1$ for any given region i, the calculated symmetric and asymmetric shocks for each region are also normalised. The decomposition into symmetric shocks for region i is given as follows:

$$\sum_{j\in\{j\,|\,f_{ij}\geq 0\}} f_{ij}^{2} \qquad (10)$$

whilst that of the asymmetric shocks is given as:

$$\sum_{j\in\{j\,|\,f_{ij}<0\}} f_{ij}^{2} \qquad (11)$$

As the total shocks are normalised to one, it implies that although we cannot compare the shocks *across* regions, we can compare them *within* each region and assess each particular region if it is beneficial to stay with a common currency area.

The interpretation of the results is, however, a tricky question. The mainstream view (Caporale 1993; Hagen and Neumann, 1994) is that if the symmetric contributions outweigh the asymmetric contributions for a particular economy in a region, it would constitute evidence that the economy would derive net benefit by being a member of the region, i.e. the region has the potential to form an OCA. If asymmetric contributions of common shocks predominate, an OCA would then be regarded as undesirable because different regions should use independent monetary policy to handle the shocks.

However, such conventional wisdom (based on Mundell, 1961) may be subject to challenge, none other than by Mundell himself (1973a, b). As McKinnon (2001) explains, even heterogeneous economies could share the risks from asymmetric shocks within an OCA. The key is a capital market with enough depth and sufficient diversification in assets and liabilities, or mechanisms of fiscal transfers to smooth the shocks (Tsang, 2002). How can one reconcile the conventional view with this contrarian view of the "mature" Mundell and McKinnon (for an effort, see Ching and Devereux, 2000)? Obviously, risk sharing also requires cross-border policy coordination, which is no easy task. Other economic, as well as political and social factors may also come into play.

In the absence of risk-sharing mechanisms between Hong Kong and Chinese regions as a historical fact, I have chosen to use the Mundell (1961) criteria in the empirical tests.

4. Empirical evidence for Chinese regions and Hong Kong

Empirical tests

In our case of investigating the monetary affinity between Hong Kong and China, I am constrained in my choice of variables for empirical tests by data availability as well as the institutional peculiarities of the Chinese and Hong Kong economies. Hong Kong has adopted a fixed exchange system since late 1983 (the "link" which pegs the Hong Kong dollar to the US dollar at the rate of 7.80), but her prospect as a door step to a rising China has led to domestic inflation (Tsang, 1996). China, on the other hand, has gone through various stages in exchange rate manipulation and liberalization (Tsang, 1994; and Tsang, 1997) during the reform process, as price reforms have proceeded at an uneven pace. So the favourite variable, the real exchange rate, cannot be used in our analyses unless high-frequency data for the 1990s are found, as indicated above.

Given the data limitations I mentioned at the beginning, I have been able to obtain five sets of disaggregated variables in our empirical tests which span the period of 1978 to 1999 or 2000:

(1) GDP;

(2) Fixed asset investments;

(3) Export trade

(4) Monetary variables: deposits and loans

(5) Prices: consumer price indexes (CPI's) and stock prices.

This already represents a big improvement over Ma and Tsang (2002), where low frequency data of a more limited set (of only national income, GDP, investment, prices, and exchange rates) stop at 1994-1995. The inclusion of GDP growth and inflation hardly needs explanation. Export trade figures are employed to compare with the findings of Artis, Kohler and Mélitz (1998). In terms of monetary flows, the World Bank has suggested that "China's official interest rates have loosely followed interest rates in Hong Kong, with the China's interest rates higher by several percentage points in recent years..." (World Bank, 1996, p.30). This may point to some fund movements that seek interest gains, despite the rather strict control on the capital account on the Chinese side. Alternatively, it could simply means that the Chinese government wants to stabilize its currency against the US dollar, to which the HK dollar is pegged. As Hong Kong's interest rates broadly follow those of the US, China has actually been following the HK interest rates. In any case, I bring in deposit and loan growth rates in our tests. The Data appendix gives details about the data sets.

I look at all the 31 regions as well as the 12 coastal regions in Eastern China. For the quantity variables, I aggregate them first to find out the average, and then compare each region as well as the average with Hong Kong. High frequency data for consumer prices and stock prices are available in the 1990s. They can give us a feeling on the more recent trends in the integration process. Due the dearth of high frequency data, I can apply only the variance test to all the 31 regions of China for annual data, but not the principal decomposition test. Only when I limit the tests to the 12 regions of Eastern China can I apply both tests. With higher frequency price data, I can apply both tests. For the principal components exercise, I tried to employ genuine VAR shocks without success because of data limitations, except for the series of stock prices. “Pseudo-VAR” shocks are used instead (variable intercepts, constant slopes.) To make amends, I adopt the seemingly unrelated regression (SUR) method to capture correlations.

Results using GDP data

In Table 1, I report the results of the variance test on real GDP growth of regions in China over the period of 1979 to 1999. Real growth in Chinese regions seemed relatively dispersed. So Mainland China might not be an OCA. Although the deviation of Hong Kong's standard deviation is lower than two thirds of the Chinese regions, it means little if the Mainland itself is not an OCA.

Table 2 reports the results for the eastern 12 coastal regions, which supposedly have the closest economic relationship with Hong Kong. The variance test produces a positive result: Eastern China might be an OCA and Hong Kong could be part of it (Hong Kong's divergence is only 6.3%, the third lowest). The findings of the shocks decomposition exercise however throw doubts on this claim, as Eastern China itself might not be an OCA, although Hong Kong seems to have reacted to shocks symmetrically with five of the regions.

[Tables 1 and 2 here]

Results on investment data

Tables 3 does not look good, with six of the Chinese regions registering divergence of standard deviation of over 50%, slightly better than the tally of seven in Table 1. Table 4 shows the results of both the variance and principal components analyses for Eastern China and Hong Kong. Whether Eastern China is an OCA or not, Hong Kong does not seem to be part of it.

[Tables 3 and 4 here]

Results using trade and monetary data

Then I investigate the data on export trade and money and credit. In terms of trade, Tables 5 provides a very poor picture. Table 6, concentrating on Eastern China, is the most positive so far, particularly as the principal decomposition exercise is concerned. Seven out of ten in the Eastern regions, together with Hong Kong, react in the same fashion to external shocks. This result is a kind of partial support to the findings of Artis, Kohler and Mélitz (1998).

[Tables 5 and 6 here]

Regarding deposit growth and loan growth, the picture is much worse. As Tables 7 to 10 testify, outrageous divergence in standard deviations appear whether in the whole of Mainland or just the eastern part of it in the variance tests. And only four or five eastern regions react symmetrically with Hong Kong.

[Tables 7 to 10 here]

Consumer prices

Table 11 shows that in the years 1985-1999, some nominal convergence in Mainland China appeared to emerge when none of the CPI divergence of the regions from the national average exceeded 50%. Hong Kong barely failed that criterion.

[Table 11 here]

Results based on high frequency data in the 1990s

All our tests of OCA so far have been based on annual data series analyses from 1978 onwards. Critics will argue that the integration process actually picked up speed significantly only in the 1990s. To address this well taken concern, I have looked for high frequency data. Unfortunately, as explained in the Data Appendix, I could only locate disaggregated data on consumer prices and stocks with frequency high than the annual ones. One would have wanted to have output statistics, but they are simply unavailable.

In terms of consumer prices, the monthly data set from January 1994 and December 2000 is used. As shown in Table 12, Mainland China seems to constitute an OCA under both the variance test (with most divergence less than 10%) and the principal components exercise (the latter with two-thirds reacting symmetrically), if nominal convergence is a defining condition. Hong Kong, however, appears to be an outsider of a Chinese OCA on account of both tests.

[Table 12 here]

Table 13, on the other hand, indicates a sign of nominal convergence if we concentrate on those regions in Eastern China which have close economic ties with Hong Kong in terms of trade and investment (all except Hebei and Liaoning), as eight out of eleven regions (including Hong Kong) react symmetrically to price shocks.

[Table 13 here]

Regarding stock prices in the three stock exchanges in the Mainland and Hong Kong, there is simply no nominal convergence in sight, as Table 14 testifies.

[Table 14 here]

5. Conclusion

Extending the OCA criteria beyond trade flow, I have reached a different conclusion from that of Artis, Kohler and Mélitz (1998). The results presented in this paper point to a picture which is very sceptical of a positive answer. The empirical findings based on disaggregated historical data show some signs of real and nominal convergence (GDP and inflation) only between Hong Kong and some parts of Eastern China, driven by trade. This seems to be consistent with the actual trajectory of economic integration, which is not detected in Liang (1999) and Ma and Tsang (2002). However, all other results, even those based on higher frequency price data, fail to provide evidence that Hong Kong and the Mainland as whole as yet constitute an OCA.

Data Appendix

This appendix summarizes how the data for the variance and principal components analyses are compiled.

China has 27 provinces and four municipalities under central control (Beijing, Tianjin Shanghai and Chongqing), making up a total of 31 regions. But data for some provinces or municipalities are too short or sporadic to be of any use. I report in each table about the exact number of regions used.

The 31 regions are separated into three big blocs: east, central and west, in accordance with China's own planning classification: (1) Eastern (coastal) China: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi and Hainan; (2) Central China: Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan; (3) West China: Sichuan, Chongqing, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang. The eastern bloc is a more developed region than other blocs.

GDP and investment data. Regional data are obtained from State Statistical Bureau (1990; 2000) and various recent issues of the statistical yearbooks of China. Volume indexes for GDP are available, which are used to deflate both nominal GDP and fixed asset investment. As to Hong Kong, the earliest GDP statistics date back to 1961, and can be found in Census and Statistics Department, *Annual Digest of Statistics*, various issues.

Trade and monetary data. Regional data on trade, deposits and loans are provided by a consultancy firm commissioned by the Hong Kong Institute for Monetary Research (HKIMR).

Consumer and stock prices. Monthly regional consumer price data in China from January 1994 onwards are available from *CEIC*, whose data base the HKIMR subscribes to. Stock prices for the two exchanges (for A shares) in both Shanghai and Shenzhen as well as the Hang Seng Index in Hong Kong are downloaded from *DataStream.*

Table 1

Variance analysis of annual real GDP growth of 31 regions of Mainland China and Hong Kong: 1979 to 1999

	standard deviation (STD)	%
Beijing	0.0401	(+17.4)
Tianjin	0.0427	(+24.9)
Hebei	0.0441	(+28.9)
Shanxi	0.0491	(+43.5)
Inner Mongolia	0.0406	(+18.9)
Liaoning	0.0467	(+36.6)
Jilin	0.0544	(+59.2)
Heilongjiang	0.0227	(-33.7)
Shanghai	0.0379	(+10.9)
Jiangsu	0.0543	(+58.8)
Zhejiang	0.0585	(+71.2)
Anhui	0.0636	(+86.1)
Fujian	0.0533	(+56.0)
Jianxi	0.0410	(+19.9)
Shandong	0.0449	(+31.3)
Henan	0.0493	(+44.3)
Hubei	0.0461	(+34.8)
Hunan	0.0270	(-21.1)
Guangdong	0.0474	(+38.6)
Guangxi	0.0436	(+27.4)
Hainan		
Chongging	0.0861	(+151.6)
Sichuan	0.0289	(-15.6)
Guizhou	0.0368	(+7.6)
Yunnan	0.0344	(+0.7)
Tibet	0.0882	(+158.0)
Shaanxi	0.0437	(+27.8)
Gansu	0.0498	(+45.6)
Qinghai	0.0554	(+61.9)
Ningxia	0.0362	(+5.8)
Xinjiang	0.0290	(-15.1)
Average of Mainaland China	0.0342	
Hong Kong	0.0420	(+22.9)

Notes: The figure in parentheses represents the percentage divergence of the standard deviation from the average of 30 regions of Mainland China. Due to data problems, Hainan is not included in the analysis.

Table 2

Variance and decomposition analyses of annual real GDP growth of 12 coastal regions of Mainland China: 1979 to 1999

	standard deviation (STD)	%	shocks decomposition: symmetric	asymmetric	total
Beijing	0.0401	(+1.4)	97.8	2.2	100.0
Tianjin	0.0427	(+8.1)	98.5	1.5	100.0
Hebei	0.0441	(+11.5)	44.6	55.4	100.0
Liaoning	0.0467	(+18.2)	91.6	8.4	100.0
Shanghai	0.0379	(-4.0)	99.7	0.3	100.0
Jiangsu	0.0543	(+37.4)	2.9	97.1	100.0
Zhejiang	0.0585	(+48.1)	1.9	98.1	100.0
Fujian	0.0533	(+34.9)	2.1	97.9	100.0
Shandong	0.0449	(+13.6)	8.1	91.9	100.0
Guangdong	0.0474	(+19.9)	1.1	98.9	100.0
Guangxi	0.0436	(+10.2)	82.6	17.4	100.0
Hainan					
Average of coastal regions of China	0.0395				
Hong Kong	0.0420	(+6.3)	94.3	5.7	100.0

Notes: The figure in parentheses represents the percentage divergence of the standard deviation from the average of 11 eastern (coastal) regions of Mainland China. Due to data problems, Hainan is not included in these analyses.

Table 3
Variance analysis of annual real investment growth of 31 regions of Mainland China and Hong Kong: 1979 to 1999

	Standard deviation	%
Beijing	0.16648	(+24.8)
Tianjin	0.12174	(-8.8)
Hebei	0.16375	(+22.7)
Shanxi	0.17735	(+32.9)
Inner Mongolia		
Liaoning	0.14703	(+10.2)
Jilin	0.17070	(+27.9)
Heilongjiang	0.10305	(-22.8)
Shanghai	0.18822	(+41.1)
Jiangsu	0.20897	(+56.9)
Zhejiang	0.19266	(+44.4)
Anhui	0.28677	(+114.9)
Fujian	0.15320	(+14.8)
Jiangxi	0.13677	(+2.5)
Shandong	0.15916	(+19.3)
Henan	0.11921	(-10.7)
Hubei	0.18229	(+36.6)
Hunan	0.14796	(+10.9)
Guangdong	0.22671	(+69.9)
Guangxi	0.26631	(+99.6)
Hainan	0.29062	(+117.8)
Chongqing		
Sichuan	0.17220	(+29.0)
Guizhou	0.12375	(-7.3)
Yunnan	0.17706	(+32.7)
Tibet	0.34789	(+160.7)
Shaanxi	0.14541	(+9.0)
Gansu	0.12432	(-6.8)
Qinghai	0.15245	(+14.2)
Ningxia	0.18495	(+38.6)
Xinjiang	0.11687	(-12.4)
Mainland CHINA	0.13344	
Hong Kong	0.08602	(-35.5)

Notes: The figure in brackets represents the percentage divergence of the standard deviation from China's national average (excluding HK). Due to data problems, Inner Mongolia and Chongqing are not included in this analysis.

Table 4

Annual real investment growth rates of 12 coastal regions of Mainland China and Hong Kong over 1979 to 1999

	Standard deviation	**Shocks decomposition:**		
	%	Symmetric	asymmetric	total
Beijing	0.16648(+15.3)	46.27	53.73	100.00
Tianjin	0.12174(-15.7)	1.34	98.66	100.00
Hebei	0.16375(+13.4)	1.00	99.00	100.00
Liaoning	0.14703(+1.8)	32.99	67.02	100.00
Shanghai	0.18822(+30.3)	63.86	36.14	100.00
Jiangsu	0.20897(+44.7)	63.66	36.34	100.00
Zhejiang	0.19266(+33.4)	92.61	7.39	100.00
Fujian	0.15320(+6.1)	69.82	30.18	100.00
Shandong	0.15916(+10.2)	40.88	59.12	100.00
Guangdong	0.22671(+57.0)	94.99	5.01	100.00
Guangxi	0.26631(+84.4)	37.57	62.43	100.00
Hainan	0.29060(+101.2)	94.60	5.40	100.00
Hong Kong	0.08602(-40.4)	2.96	97.04	100.00
Coastal regions of China (excluding Hong Kong)	0.14444			

Notes: The figure in brackets represents the percentage divergence of the standard deviation from Eastern China's average.

Table 5

Variance analysis of annual nominal export growth of 31 regions of Mainland China and Hong Kong: 1983 to 1998

	Standard deviation	%
Beijing	0.13842	(+27.4)
Tianjin	0.13633	(+25.5)
Hebei	0.20657	(+90.1)
Shanxi	1.18755	(+992.8)
Inner Mongolia	0.22639	(+108.3)
Liaoning	0.16386	(+50.8)
Jilin	0.25248	(+132.3)
Heilongjiang	0.18618	(+71.3)
Shanghai	0.08459	(-22.2)
Jiangsu	0.11472	(+5.6)
Zhejiang	0.08750	(-19.5)
Anhui	0.16444	(+51.3)
Fujian	0.24014	(+121.0)
Jiangxi	0.17279	(+59.0)
Shandong	0.15033	(+38.3)
Henan	0.17915	(+64.9)
Hubei	0.11128	(+2.4)
Hunan	0.12635	(+16.3)
Guangdong	0.32497	(+199.1)
Guangxi		
Hainan		
Chongqing		
Sichuan	0.26635	(+145.1)
Guizhou	0.21799	(+100.6)
Yunnan	0.22738	(+109.2)
Tibet		
Shaanxi	0.24761	(+127.9)
Gansu	0.20186	(+85.8)
Qinghai	0.17847	(+64.2)
Ningxia	0.25605	(+135.6)
Xinjiang	0.19811	(+82.3)
Hong Kong	0.13156	(+21.1)
Mainland China	0.10867	

Notes: The figure in brackets represents the percentage divergence of the standard deviation from China's national average (excluding HK). Due to data problems, Guangxi, Hainan, Chongqing and Tibet are not included in this analysis.

Table 6

Annual nominal export growth rates of 12 coastal regions of Mainland China and Hong Kong over 1983 to 1998

	Standard deviation %	**Shocks decomposition** Symmetric	asymmetric	total
Beijing	0.13842(+13.3)	81.14	18.86	100.00
Tianjin	0.13633(+11.6)	88.45	11.55	100.00
Hebei	0.20657(+69.1)	87.93	12.07	100.00
Liaoning	0.16386(+34.1)	99.65	0.35	100.00
Shanghai	0.08459(-30.8)	95.16	4.84	100.00
Jiangsu	0.11472(-6.1)	69.09	30.91	100.00
Zhejiang	0.08750(-28.4)	10.65	89.35	100.00
Fujian	0.24014(+96.6)	2.01	97.99	100.00
Shandong	0.15033(+23.0)	99.56	0.44	100.00
Guangdong	0.32497(+166.0)	3.53	96.47	100.00
Guangxi				
Hainan				
Hong Kong	0.13156(+7.7)	73.14	26.86	100.00
Coastal regions of China (excluding HK)	0.12218			

Notes: The figure in brackets represents the percentage divergence of the standard deviation from Eastern China's average. Due to data unavailability, Guangxi and Hainan are not included in the analyses.

Table 7

Variance analysis of annual nominal deposit growth of 31 regions of Mainland China and Hong Kong: 1981 to 1998

	Standard deviation	%
Beijing	0.09422	(+45.0)
Tianjin	0.08457	(+30.2)
Hebei	0.07333	(+12.9)
Shanxi	0.07895	(+21.5)
Inner Mongolia	0.06715	(+3.4)
Liaoning	0.05087	(-21.7)
Jilin	0.06819	(+5.0)
Heilongjiang	0.12369	(+90.4)
Shanghai	0.21921	(+237.4)
Jiangsu	0.10654	(+64.0)
Zhejiang	0.06824	(+5.0)
Anhui	0.13664	(+110.3)
Fujian	0.14816	(+128.0)
Jiangxi	0.06589	(+1.4)
Shandong	0.09051	(+39.3)
Henan	0.12327	(+89.7)
Hubei	0.10794	(+66.1)
Hunan	0.08863	(+36.4)
Guangdong	0.14264	(+119.5)
Guangxi	0.10835	(+66.8)
Hainan	0.51986	(+700.1)
Chongqing		
Sichuan		
Guizhou	0.08105	(+24.7)
Yunnan	0.08087	(+24.5)
Tibet	0.16766	(+158.0)
Shaanxi	0.08323	(+28.1)
Gansu	0.10602	(+63.2)
Qinghai	0.05211	(-19.8)
Ningxia	0.09245	(+42.3)
Xinjiang	0.07332	(+12.8)
Mainland CHINA	0.06497	
Hong Kong	0.07183	(+10.6)

Notes: The figure in brackets represents the percentage divergence of the standard deviation from China's national average (excluding HK. Due to data unavailability, Chongqing and Sichuan are not included in this analysis.

Table 8

Annual nominal deposit growth rates of 12 coastal regions of Mainland China and Hong Kong over 1981 to 1998

	Standard deviation %	Shocks decomposition Symmetric	asymmetric	total
Beijing	0.09422(+22.5)	82.12	17.88	100.00
Tianjin	0.08457(+9.9)	77.19	22.81	100.00
Hebei	0.07333(-4.7)	90.86	9.14	100.00
Liaoning	0.05087(-33.9)	86.43	13.57	100.00
Shanghai	0.21921(+185.0)	6.49	93.51	100.00
Jiangsu	0.10654(+38.5)	8.85	91.15	100.00
Zhejiang	0.06824(-11.3)	40.17	59.83	100.00
Fujian	0.14816(+92.6)	2.50	97.50	100.00
Shandong	0.09051(+17.7)	0.80	99.20	100.00
Guangdong	0.14264(+85.4)	6.13	93.87	100.00
Guangxi	0.10835(+40.9)	23.90	76.10	100.00
Hainan	0.51986(+575.8)	35.74	64.26	100.00
Hong Kong	0.07183(-6.6)	99.61	0.39	100.00
Coastal regions of China (excluding Hong Kong)	0.07692			

Notes: The figure in brackets represents the percentage divergence of the standard deviation from Eastern China's average.

Table 9
Variance analysis of annual nominal loan growth of 31 regions of Mainland China and Hong Kong: 1981 to 1998

	Standard deviation	%
Beijing	0.11301	(+187.8)
Tianjin	0.07105	(+81.0)
Hebei	0.05984	(+52.4)
Shanxi	0.09966	(+153.8)
Inner Mongolia	0.08165	(+108.0)
Liaoning	0.05743	(+46.3)
Jilin	0.10348	(+163.6)
Heilongjiang	0.06625	(+68.7)
Shanghai	0.10087	(+156.9)
Jiangsu	0.08703	(+121.7)
Zhejiang	0.07915	(+101.6)
Anhui	0.06211	(+58.2)
Fujian	0.07832	(+99.5)
Jiangxi	0.05081	(+29.4)
Shandong	0.05321	(+35.5)
Henan	0.10693	(+172.3)
Hubei	0.06338	(+61.4)
Hunan	0.06489	(+65.3)
Guangdong	0.12592	(+200.7)
Guangxi	0.11026	(+180.8)
Hainan	0.59466	(+1414.5)
Chongqing		
Sichuan		
Guizhou	0.08858	(+125.6)
Yunnan	0.09820	(+150.1)
Tibet	0.30701	(+681.9)
Shaanxi	0.08679	(+121.1)
Gansu	0.08235	(+109.7)
Qinghai	0.19194	(+388.8)
Ningxia	0.12985	(+230.7)
Xinjiang	0.07993	(+103.6)
Mainland CHINA	0.03926	
Hong Kong	0.10294	(+162.2)

Notes: The figure in brackets represents the percentage divergence of the standard deviation from China's national average (excluding HK). Due to data unavailability, Chongqing and Sichuan are not included in this analysis.

Table 10

Annual nominal loan growth of 12 coastal regions of Mainland China and Hong Kong over 1981 to 1998

	Standard deviation	%	Shocks decomposition: Symmetric	asymmetric	total
Beijing	0.11301	(+102.9)	19.44	80.56	100.00
Tianjin	0.07105	(+27.6)	97.96	2.04	100.00
Hebei	0.05984	(+7.5)	60.02	39.98	100.00
Liaoning	0.05743	(+3.1)	79.05	20.95	100.00
Shanghai	0.10087	(+81.2)	88.72	11.28	100.00
Jiangsu	0.08703	(+56.3)	81.87	18.13	100.00
Zhejiang	0.07915	(+42.1)	18.28	81.72	100.00
Fujian	0.07832	(+40.7)	11.37	88.63	100.00
Shandong	0.05321	(-4.4)	33.98	66.02	100.00
Guangdong	0.12592	(+126.1)	0.19	99.81	100.00
Guangxi	0.11026	(+98.0)	36.59	63.41	100.00
Hainan	0.59466	(+967.9)	4.77	95.23	100.00
Hong Kong	0.10294	(+84.9)	91.36	8.64	100.00
coastal regions of China (excluding HK)	0.05568				

Notes: The figure in brackets represents the percentage divergence of the standard deviation from Eastern China's average.

Table 11
Variance analysis of annual consumer inflation rates of 31 regions of Mainland China: 1985-1999

	Standard deviation	%
Beijing	7.20183	(-7.6)
Tianjin	7.14495	(-8.3)
Hebei	7.59895	(-2.5)
Shanxi	8.12294	(+4.2)
Inner Mongolia	7.23054	(-7.2)
Liaoning	7.58141	(-2.7)
Jilin	6.88741	(-11.6)
Heilongjiang	6.73242	(-13.6)
Shanghai	7.41358	(-4.9)
Jiangsu	8.09019	(+3.8)
Zhejiang	8.43098	(+8.2)
Anhui	8.09748	(+3.9)
Fujian	9.01376	(+15.7)
Jiangxi	8.43222	(+8.2)
Shandong	7.28668	(-6.5)
Henan	8.41227	(+8.0)
Hubei	8.21113	(+5.4)
Hunan	8.69503	(+11.6)
Guangdong	10.19353	(+30.8)
Guangxi	9.64259	(+23.7)
Hainan	10.97083	(+40.8)
Chongqing		
Sichuan	8.11725	(+4.2)
Guizhou	7.97265	(+2.3)
Yunnan	7.77936	(-0.2)
Tibet		
Shaanxi	8.20216	(+5.3)
Gansu	7.92466	(+1.7)
Qinghai		
Ningxia	6.89820	(-11.5)
Xinjiang	7.47776	(-4.0)
Mainland CHINA	7.79257	
Hong Kong	3.86385	(-50.4)

Notes: The figure in brackets represents the percentage divergence of the standard deviation from China's national average (excluding HK). Due to data problems, Chongqing, Tibet and Qinghai are not included in this analysis.

Table 12

Variance and principal components analyses of monthly CPI changes of 31 regions of Mainland China and Hong Kong: Jan. 1994 to Oct. 2001

	Standard deviation %	Shocks decomposition		
		Symmetric	asymmetric	total
Beijing	8.32052(-9.3)	51.94	48.06	100.00
Tianjin	8.91273(-2.8)	44.21	55.79	100.00
Hebei	8.69736(-5.1)	88.92	11.08	100.00
Shanxi	9.56989(+4.4)	57.15	42.85	100.00
Inner Mongolia	8.68264(-5.3)	62.49	37.51	100.00
Liaoning	9.15874(-0.1)	21.34	78.66	100.00
Jilin	8.22365(-10.3)	15.91	84.09	100.00
Heilongjiang	8.87036(-3.2)	57.11	42.89	100.00
Shanghai	9.02286.(-1.6)	35.91	64.09	100.00
Jiangsu	8.74842(-4.6)	37.90	62.10	100.00
Zhejiang	9.11258(-0.6)	58.06	41.94	100.00
Anhui	9.73434(+6.2)	26.91	73.09	100.00
Fujian	9.48341(+3.4)	66.62	33.38	100.00
Jiangxi	10.0499(+9.6)	70.02	29.98	100.00
Shandong	9.02014(-1.6)	33.50	66.50	100.00
Henan	10.0221(+9.3)	62.86	37.14	100.00
Hubei	10.3391(+12.8)	44.39	55.61	100.00
Hunan	9.79174(+6.8)	84.40	15.60	100.00
Guangdong	8.32534(-9.2)	64.90	35.10	100.00
Guangxi	10.6994(+16.7)	66.88	33.12	100.00
Hainan	10.0771(+9.9)	37.59	62.41	100.00
Chongqing				
Sichuan	9.45067(+3.1)	77.76	22.24	100.00
Guizhou	9.53190(+4.0)	69.75	30.25	100.00
Yunnan	8.78699(-4.2)	53.01	46.99	100.00
Tibet				
Shaanxi	10.4115(+13.5)	75.92	24.08	100.00
Gansu	9.77560(+6.6)	65.77	34.74	100.00
Qinghai	8.45225(-7.8)	62.26	37.74	100.00
Ningxia	9.10428(-0.7)	66.63	33.37	100.00
Xinjiang	10.2664(+12.0)	58.34	41.66	100.00
Mainland CHINA	9.16951			
Hong Kong	4.76923(-48.0)	40.26	59.74	100.00

Notes: The figure in brackets represents the percentage divergence of the standard deviation from China's national average (excluding HK). Due to data unavailability, Chongqing and Tibet are not included in the analyses.

Table 13

Monthly consumer price inflation of 10 coastal regions of
Mainland China and Hong Kong from Jan 1994 to October 2001

	Shocks decomposition:		
	Symmetric	asymmetric	total
Beijing	78.90	21.10	100.00
Tianjin	66.09	33.91	100.00
Hebei			
Liaoning			
Shanghai	56.66	43.34	100.00
Jiangsu	77.55	22.45	100.00
Zhejiang	77.68	22.32	100.00
Fujian	33.33	66.67	100.00
Shandong	84.58	15.42	100.00
Guangdong	87.91	12.09	100.00
Guangxi	46.23	53.76	100.00
Hainan	21.32	78.68	100.00
Hong Kong	98.81	1.19	100.00

Notes: Hebei and Liaoning are left out based on the observation that there has been little trade and investment between these two provinces and Hong Kong.

Table 14
Variance and principal components analyses of daily changes in stock prices in Mainland China and Hong Kong: 1992 to 2000

	Standard deviation	%	Shocks decomposition: Symmetric	asymmetric	total
Shanghai A	0.029995	(+5.8)	87.01	12.99	100.00
Shenzhen A	0.026692	(-5.8)	100.00	0.00	100.00
Average of the above 2	0.0283435				
Hang Seng	0. 018471	(-34.8)	0.73	99.27	100.00

Notes: VAR shocks are generated by SUR method. Each equation has five lags.

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