HONG KONG MONETARY AUTHORITY

Research Memorandum 11/2006
September 2006

HONG KONG'S ECONOMIC INTEGRATION AND BUSINESS CYCLE SYNCHRONISATION WITH MAINLAND CHINA AND THE US

Key Points:

- *While Hong Kong's monetary policy is effectively tied to the US, its real economy has been experiencing increased integration with the Mainland through trade, Foreign Direct Investment (FDI), tourism, and increasingly financial flows.*

- *Co-movements of business cycles in Hong Kong and the Mainland have increased steadily since the 1990s. Although its co-movements with the US dipped in the late 1990s, there has been a significant increase in the synchronisation of business cycles among these three economies since 2000.*

- *This finding naturally raises a question as to what factors drive the co-movements of business cycles among the three economies. Our structural vector auto-regression analysis suggests that over the medium to long run, about 60% and 45% of variations in output and prices in Hong Kong respectively can be explained by US shocks, while the impact of Mainland shocks mostly concentrates on Hong Kong's price movements. It is estimated that Mainland shocks explain over one-third of Hong Kong's price developments.*

- *Using a methodology to distinguish between the effects of common US shocks and idiosyncratic domestic shocks, we find little correlation between the business cycles in Hong Kong and the Mainland in the absence of the common US influences, whereas the influence of the US shocks on these two economies leads to a high degree of synchronisation. In other words, the business cycle co-movements of Hong Kong and the Mainland are largely due to the common influence of economic conditions in the Unites States and possibly their US dollar pegged exchange rate system.*

- *The lack of similarity of domestic shocks between Hong Kong and the Mainland can be mostly attributed to their continuing structural differences and stage of economic development. Since the similarity of shocks is the most important factor for the choice of exchange rate regime, it follows that the Linked Exchange Rate system based on the US dollar would continue to be desirable in the foreseeable future.*

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I. INTRODUCTION

While Hong Kong's monetary policy is effectively tied to the US, its real economy is increasingly linked to the Mainland economy through trade, FDI, tourism, and financial markets. As an entrepôt and an international financial centre, Hong Kong intermediates a lion's share of Mainland's external trade, provides significant flows of foreign direct investment, and acts as the largest overseas fund raising centre for Mainland companies. Hong Kong has also become a favourite tourist destination of Mainland visitors, whose spending in Hong Kong was equivalent to 5% of Hong Kong's private consumption expenditure in 2004. Anecdotal evidence suggests that the pace of economic integration between Hong Kong and the Mainland has accelerated greatly since the return of Hong Kong to the Chinese sovereignty in 1997. It is widely expected that the pace of economic integration will increase further as the Mainland moves to make its exchange rate more flexible and its capital account more open.

Closer economic integration with the Mainland has naturally raised a question as to whether the business cycles in the two economics have become more synchronised. According to the Optimal Currency Area (OCA) theory first developed by Mundell (1961), the degree of business cycle synchronisation between two economies may have important implications for the optimal monetary arrangement between them. The OCA theory suggests that an intra-area fixed exchange rate or a common currency is the most appropriate for a group of economies that are closely integrated through the product, factor, and labour markets that have similar degree of business cycle synchronisation and are subject to common economic shocks. If the business cycles are similar and shocks are common, then a coordination of monetary policies is desirable, with a common currency as the ultimate form of policy coordination. However, if shocks are predominantly country-specific or idiosyncratic, then the ability to conduct independent monetary and fiscal policy becomes more important in helping an economy adjust to such shocks.[1]

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[1] The early OCA literature is not concerned with the possibility that the OCA criteria and the decision to form an OCA can be an endogenous process. Frankel and Rose (1998) demonstrate that as a group of countries adopts a common currency their markets may become increasingly integrated, thus resulting to increased business cycle synchronization and more symmetrical transmissions of economic shocks.

This paper assesses quantitatively the current state of business cycle synchronisation between Hong Kong and the Mainland. Because the US economy continues to be one of the most important trading partners of and investors in Hong Kong and, more importantly, because Hong Kong shares a common monetary policy with the US since 1983 when Hong Kong adopted the Linked Exchange Rate System (LERS), it is useful to compare business cycle synchronisation between Hong Kong and the Mainland with that between Hong Kong and the US. The paper attempts to achieve three objectives: First, it provides a quantitative assessment on economic and financial integration among these three economies by constructing a number of indicators for key aspects of economic integration. Secondly, the paper provides an updated assessment on the current status of business cycle synchronisation between Hong Kong and the Mainland and between Hong Kong and the US. Thirdly, the paper examines to what extent Hong Kong's output and price developments are affected by shocks from the Mainland and the US economy and whether the business cycle co-movements with the Mainland are driven by some common shocks.

The empirical findings of the paper suggest that economic integration between Hong Kong and the Mainland, relative to that of the US, has intensified, especially through the real economy channels such as trade, FDI, and cross-border consumption. In addition, the degree of business cycle synchronisation in recent years between Hong Kong and the Mainland has also increased significantly, following a trough in the 1990s. Hong Kong's business cycle synchronisation with the Mainland has been quite high in recent years; but its synchronisation with the US has been even higher. Given that the US is one of the most important markets for both the Mainland and Hong Kong, it is possible that Hong Kong's high business cycle correlation with both economies in recent period has been driven mainly by the US economy. Our findings confirm this observation.

In terms of transmission of economic shocks, we find that in the short run, Hong Kong's output and price changes are mostly affected by domestic shocks. However, Hong Kong is predominantly affected by US shocks in the medium and long run, while the Mainland shocks have become a prominent force affecting Hong Kong's price developments, in addition to the US's and Hong Kong's own price shocks.

The rest of the paper proceeds as follows. Section II assesses the degree of economic and financial integration between the three economies using a number of key indicators based on economic theory. Section III assesses the degree of business cycle co-movements between these economies over time. Section IV examines how output and price shocks are transmitted across these three economies and to what extent Hong Kong's economic shocks can be explained by those from the Mainland and the US. Section V discusses policy implications and concludes.

II. Economic Integration among Hong Kong, the Mainland, and the US

Economic integration was affected by both real-economy and financial-market channels. The real-economy channel refers to economic linkages through bilateral trade, FDI, and tourism. The financial channel was mostly affected by capital flows and policy interest rates. This section quantifies the degree of economic integration achieved so far by constructing a selective set of indicators on some key aspects of real economy and financial integration.

Trade integration

Trade generally promotes economic integration. It is well documented that intra-industry trade based on economies of scale, rather than comparative advantages, will allow economies to specialise in the same sectors and thus lead to increased similarities between trading partners, which in turn help promote business cycle synchronisation. On the other hand, inter-industry trade often leads to specialisation in different industries, thus leading to less co-movement of sectors and less business cycle synchronisation.

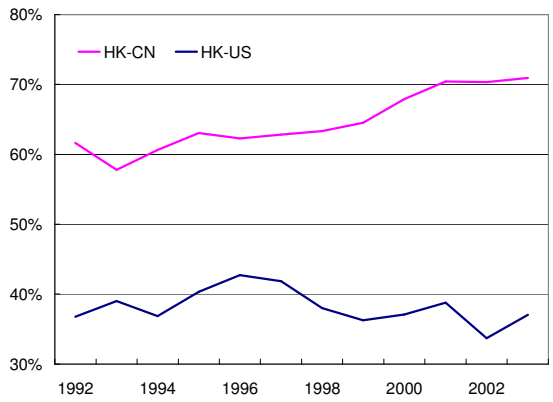
Following Shin and Wang (2004), the intra-industry trade index ($IIT_{ij,t}$) can be defined as follows:

$$IIT_{ij,t} = 1 - \frac{\sum_k | X^k_{ij,t} - M^k_{ij,t} |}{\sum_k (X^k_{ij,t} + M^k_{ij,t})} \qquad (1)$$

where subscripts i and j denote pairs of economies; X and M represent exports and imports; and k denotes an industry sector measured by the one-digit Standard International Trade Classification code. If an industry sector between Hong Kong and the Mainland exports and imports nearly equal amount of similar products, the numerator of equation (1) will be close to zero. As a result, the IIT index will be close to 1, suggesting a high degree of intra-industry trade. If the IIT index is close to zero, it implies a low level of intra-industry trade.

Chart 1 presents our calculated intra-industry trade indexes between Hong Kong and the Mainland and between Hong Kong and the US using total trade data. Intra-industry trade between Hong Kong and the Mainland has been gradually increasing from around 60% to over 70% over the past 12 years, suggesting that Hong Kong has a similar trade structure with the Mainland. On the other hand, intra-industry trade intensity between Hong Kong and the US remained fairly stable within the range of 35% to 45%, suggesting the trading pattern has not changed much over time. In fact, the level of intra-industry trade between Hong Kong and the Mainland is comparable with that among the EU economies.

Chart 1: Intra-industry trade index



Sources: CEIC, CS&D, OECD, and staff estimates

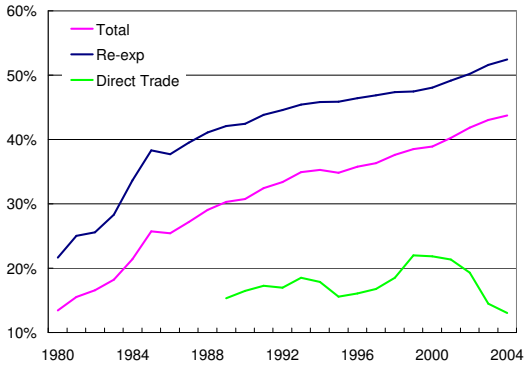
Another trade integration measure often used is the trade intensity index. This index is similar to a bilateral trade share measure, but it controls for the relative size of an economy in the world trade. It is therefore a better measure than the simple bilateral trade shares. Following Frankel and Rose (1998), Kose, Prasad, and Terrones (2003) and Otto *et al* (2001), the trade intensity index is defined in equation (2). In general, a high measure indicates a high degree of trade intensity between two economies.

$$Trade_{HKj,t} = \frac{X_{HKj,t} + M_{HKj,t}}{X_{HKworld,t} + M_{HKworld,t}} \quad (2)$$

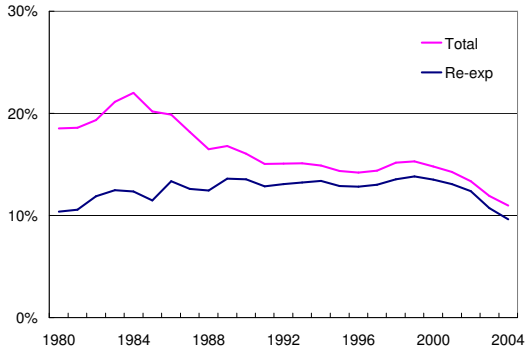
Chart 2A indicates that the importance of Mainland trade in Hong Kong's total trade has increased significantly, rising from less than 15% in the early 1980s to close to 50% in 2004. We also observe the same pattern for re-exports. This suggests that Hong Kong has gained its importance as an intermediary between Mainland exports and the world markets since the Mainland decentralised its foreign trade regime in the 1980s. However, Hong Kong's direct trade with the Mainland for domestic consumption has remained at around 15% on average. Chart 2B shows that Hong Kong's bilateral trade with the US as a ratio in Hong Kong's total trade has declined by half from around 20% in the early 1980s to only 10% in 2004, largely reflecting the transfer of the manufacturing capacity to the Mainland. Overall, the trade intensity index presented in Chart 2 suggests that the Mainland accounts for increasingly larger shares in Hong Kong's trade, while Hong Kong's trade intensity with the US appears to have declined over time.

Chart 2: Trade intensity index

A. Hong Kong and the Mainland



B. Hong Kong and the US



Sources: CEIC, IFS, and staff estimates.

FDI exposure

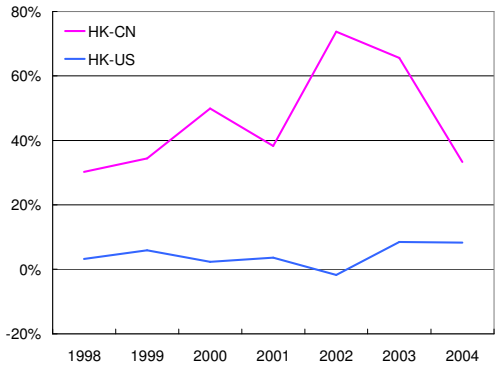
FDI is another measure of integration in the real economy. Analogous to the trade measures, the FDI share measures bilateral direct investment (both inward, $FDI\_In_{ij,t}$, and outward, $FDI\_Out_{ij,t}$,) as a share of total inward and outward FDI (represented by $FDI\_In_{iworld,t}$ and $FDI\_Out_{iworld,,t}$, respectively) of Hong Kong.

$$FDISH_{ij,t} = \frac{FDI\_In_{ij,t} + FDI\_Out_{ij,t}}{FDI\_In_{iworld,t} + FDI\_Out_{iworld,t}} \qquad (3)$$

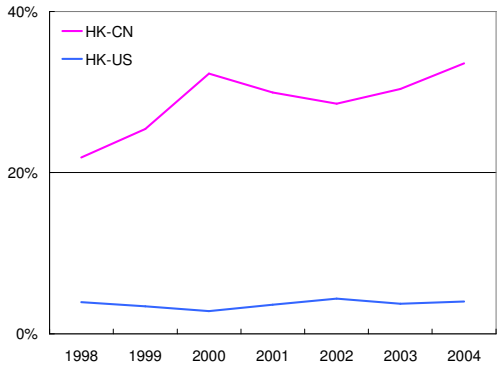
Chart 3 presents Hong Kong's FDI exposure on both a flow and a stock basis. Chart 3A shows that Hong Kong's FDI exposure to the Mainland by flow statistics has more than doubled from around 30% in 1998 to 66% in 2003 before it fell back to close to 30% in 2004, suggesting Hong Kong firms have taken up investment opportunities on the Mainland by directing the majority of their outward FDI to the Mainland. On the other hand, the FDI exposure of Hong Kong in the US remained negligible until 2002 before increasing to 10% in 2004. Chart 3B suggests that Hong Kong's FDI exposure to the Mainland measured by FDI stock has increased steadily from 22% in 1998 to 30% in 2003 while its exposure to the US has remained low and relatively flat at around 3%, largely because the US is one of the world's largest FDI recipients and investors.

Chart 3: FDI exposure

A. FDI flow



B. FDI stock



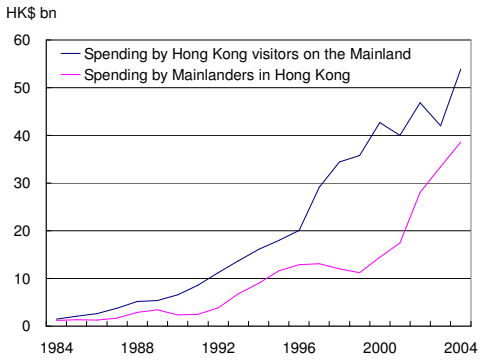
Note: The negative share in 2002 in Chart 5A reflects a net outflow of FDI from Hong Kong to the US.
Sources: CEIC, National Source ACTUAL, and staff estimates.

Tourism related cross-border consumption

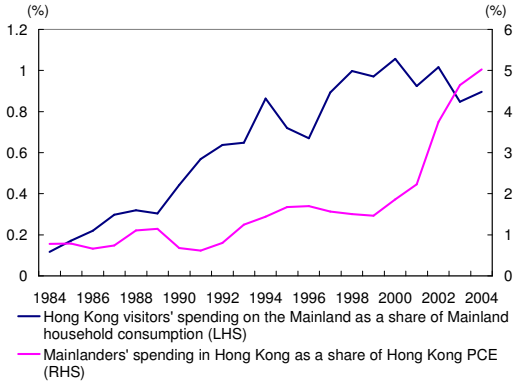
Associated with the rising cross-border tourism between Hong Kong and the Mainland, cross-border consumption has gone through a period of rapid expansion. A study by Ho *et al* (2006) shows that visitors from both sides of the border spend much more than they did 20 years ago and Hong Kong visitors to the Mainland spend more than their Mainland counterparts in aggregate (Chart 4A). Chart 4B shows Mainland visitors' spending in Hong Kong as a share of Hong Kong's private consumption expenditure has risen particularly fast in recent years, from around 1.5% in 1999 to 5% in 2004. Meanwhile, the spending of Hong Kong residents on the Mainland as a share of its household consumption has also increased steadily, from less than 0.2% two decades ago to around 1% in recent years. The growth rate of cross-border consumption has been quite rapid as the share of private consumption of each economy has risen by five times over the past two decades. In particular, the spending of Mainland visitors in Hong Kong jumped sharply after 2000, reflecting the substantial policy shift to relax travel restrictions on Mainland visitors to Hong Kong.

Chart 4: Cross border consumption

A. Consumption



B. Consumption share



Sources: Ho, *et al*., (2006)

Money market integration

In this section, we examine three aspects of money market integration: US dollar and renminbi deposits as ratios of total foreign currency deposits in Hong Kong, Hong Kong dollar demand on the Mainland, and correlation of benchmark policy rates.

Chart 5A presents the ratios of US dollar and renminbi deposits as a share of total foreign currency deposits in Hong Kong. The US dollar deposits stayed at around 70% in 2004, suggesting the dominant role of the US dollar in total foreign currency deposits in Hong Kong. However, US dollar position has experienced a sharp swing. It dropped by more than half from 85% in the mid 1980s to 40% in the early 1990s before returning to the current level. As banks in Hong Kong were allowed to take the renminbi deposits only recently, the absolute scale of renminbi deposit as a ratio to total foreign currency is still relatively small. However, the rate of growth of the renminbi deposits has been rapid, in part reflecting the expectation of the renminbi appreciation.

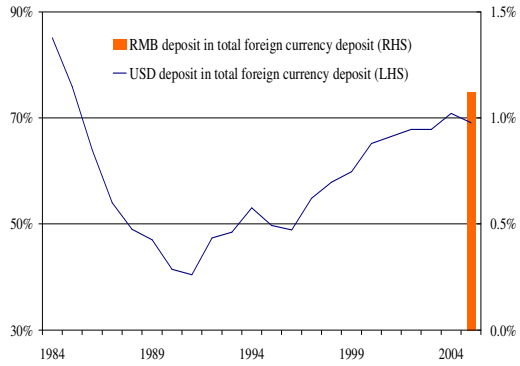
Chart 5B shows the estimated Hong Kong dollar currency holdings by the Mainland residents (Ho, *et al*., 2006). The estimates suggest that Hong Kong dollars held by Mainland residents as a proportion of total Hong Kong dollars in circulation has risen dramatically from 5% in 1990 to close to 60% in 2004.

We next examine the correlation of monetary policy rates. We choose one-year benchmark lending rate for the Mainland, one-year HIBOR (Hong Kong Interbank Offer Rate) for Hong Kong, and the federal fund rate for the US. Chart 5C depicts correlation coefficients of monthly data for each year between 1991 and 2005. Indeed, notwithstanding some abnormal behaviour during the Asian financial crises in 1997-98, the high correlation of the policy rates between Hong Kong and the US is not surprising. This largely reflects Hong Kong's LERS, which links the Hong Kong dollar to the US dollar. As expected, there appears to be little similarity in the behaviour of the policy rates between Hong Kong and the Mainland, suggesting Mainland monetary policy is mainly driven by its own domestic factors. Although the policy rates of Hong Kong and the Mainland are hardly correlated, the monetary conditions indices of these two economies, which is weighted by real interest rate, real effective exchange rate, and money stock, have shared a relatively high correlation since the 1990s (Chart 5D).[2]

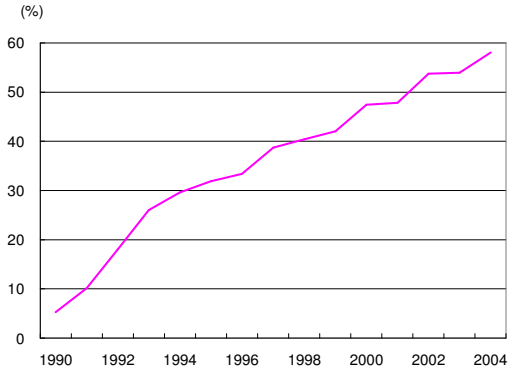
[2] This is indeed mainly due to the movements of the real effective exchange rate (REER) of both economies because of their de-facto peg to the US dollar (until July 2005 in the Mainland's case). Hong Kong's monetary condition index is a weighted sum of Hong Kong dollar REER, renminbi REER, and real interest rate and the Mainland's monetary condition index is a weighted sum of its REER and real lending rate.

Chart 5: Money market integration

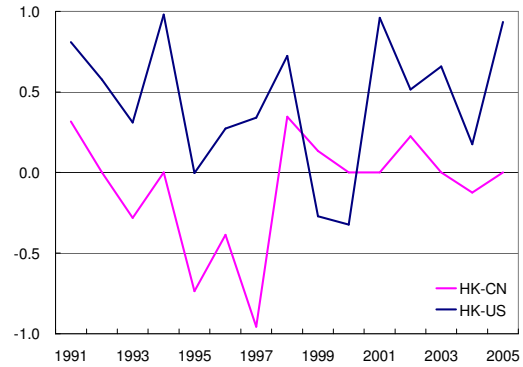
A. Foreign currency deposit ratios in HK



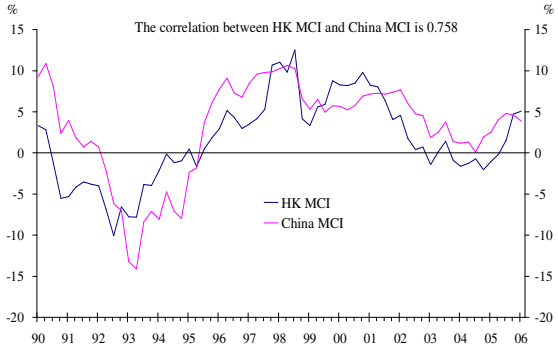
B. HKD currency holding by Mainlanders/ Total HKD currency



C. Correlation of interest rates



D. Evolution of monetary conditions indices



Sources: CEIC, Data Stream, Ho et al. (2006), and staff estimates.

Stock market integration

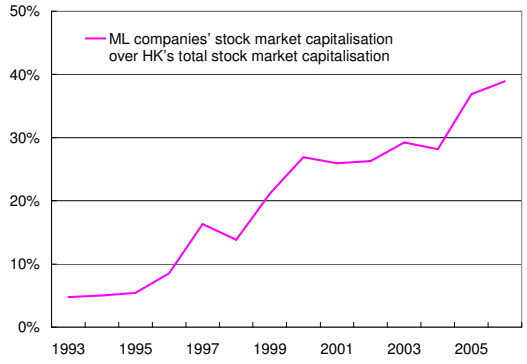
Mainland firms began raising capital in Hong Kong's stock market in 1987. Largely because of Mainland firms' fund-raising activities, the Hong Kong Stock Exchange has become the third largest market in initial public offering in the world. Chart 6A indicates the weight of capitalisation of Mainland companies in the total Hong Kong Stock Exchange capitalisation. This weight has increased by almost eight folds from 5% in 1993 to close to 40% in 2005.

We also looked at correlations of stock market indices in these three economies. The US Dow Jones Industrial Index, Hang Seng Index, and Shanghai Stock Exchange Composite Index are used (Chart 6B). In terms of co-movements of the indices, Hong Kong's stock market is

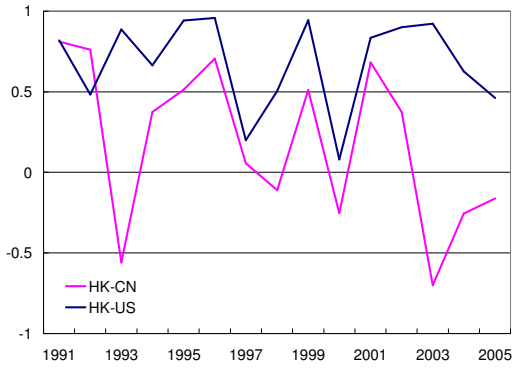
closely correlated with that of the US, whereas the Mainland index appears to have a pattern of its own. There is little positive correlation between the Hang Seng Index and the Shanghai Index.

Chart 6: Stock market integration

A. Market capitalisation



B. Correlation of market indices



Sources: Hong Kong Exchange and staff estimates.

In summary, despite relatively high real economy integration between Hong Kong and the Mainland as measured by trade, cross-border consumption and FDI, the Mainland appears to have little in common with Hong Kong in terms of monetary policy rates and the co-movements of the stock market indexes, notwithstanding a quite close correlation of monetary conditions. The Hong Kong dollar's peg to the US dollar and the largely closed nature of the Mainland capital account, which drives a wedge between domestic and external fund flows, may have prevented convergence of the financial market indicators. This situation may change in the future as the Mainland progressively liberalises capital account controls.

III. BUSINESS CYCLE CO-MOVEMENTS THROUGH TIME

A business cycle is usually defined as fluctuations of real GDP around some measure of its potential level. Business cycle synchronisation refers to the degree of co-movements of output fluctuations across economies and time. Following the conventions of the existing literature, we provide two measures of business cycle synchronisation: correlations of real GDP growth rates and their band-pass (BP) filtered cyclical component, and correlations of output gaps and their

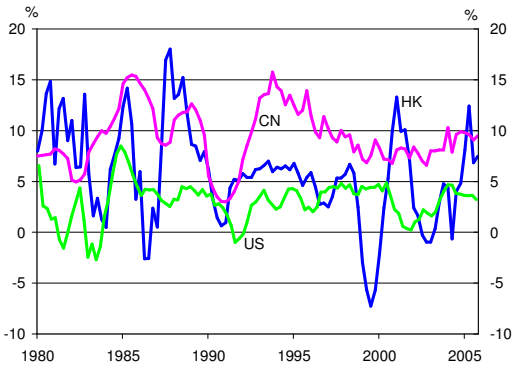
BP filtered cyclical component.[3,4] In addition, the co-movements of these measures are examined using the principal component analysis to determine whether there is a common factor that explains synchronisation among the three economies.[5]

Correlations of GDP growth

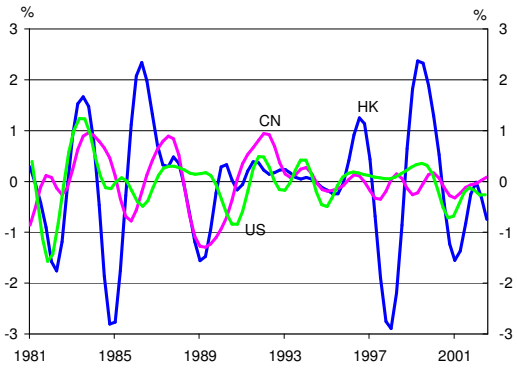
Chart 7 depicts the year-on-year GDP growth rates and their cycles for the three economies over the past 25 years. The left panel (Chart 7A) displays GDP growth rates and the right panel (Chart 7B) displays BP filtered GDP growth rate.[6] Two observations are worth mentioning here. First, business cycles in Hong Kong appear to be quite volatile, compared with those in Mainland China and particularly those in the US. Secondly, the volatility of business cycles on the Mainland has declined markedly since 1995 and followed the US cycles rather closely.

Chart 7: GDP growth – Hong Kong, the Mainland, and the US

A. Real GDP, year-on-year growth rates



B. Real GDP cycles (BP-filtered)



Sources: CEIC and staff estimates.

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3 See Frankel and Rose (1998) and IMF Occasional Paper 152 (1997), for instance.

4 The cyclical component of quarterly real GDP is derived by using the band-pass filter proposed by Baxter and King (1999). This filter removes low-frequency trend variation (slowly evolving secular trends) and smoothes high-frequency irregular variation (rapidly varying seasonal or irregular components), while retaining the major features of business cycles.

5 See Gerlach-Kristen (2005) for example.

6 BP filter retains frequency components between 6 and 32 quarters.

Table 1 presents Hong Kong's output correlations with the Mainland and the US from 1979 to 2005. Two observations are in order. First, the correlation of Hong Kong's real GDP growth rates with those of the Mainland has increased markedly over time, while the correlation with the US turned negative in the 1990s before reaching the high of 0.85 during the last five years. The negative correlation in the 1990s was largely due to a sharp drop of the GDP growth in Hong Kong associated with the Asian financial crisis in 1997-98. However, after adjusting the irregular variation using the BP filter, the correlations with the US were even higher than those with the Mainland over the two periods. Secondly, the correlation of cyclical components of GDP showed similar patterns for both economy pairs. In particular, the correlation rose markedly during 2000-2002 after dipping into its lows in the 1990s. The BP filtered correlation analysis suggests that Hong Kong's business cycle was equally synchronised with both the Mainland and the US in recent years.

Table 1: Output correlations

HK with:	Correlation of real GDP (YoY growth rates)			Correlation of GDP cycles (band-pass filtered)		
	1979-1989	1990-1999	2000-2005	1979-1989	1990-1999	2000-2002
CN	0.04	0.36	0.46	0.28	0.13	0.92
US	0.09	-0.21	0.85	0.32	0.18	0.92

Sources: CEIC and staff estimates.

We examine this further by analysing the correlations of the eight-year moving windows over the sample period. The rationale of using an eight-year moving window is that a full business cycle in the US usually last between six quarters and eight years (Baxter and King, 1999).

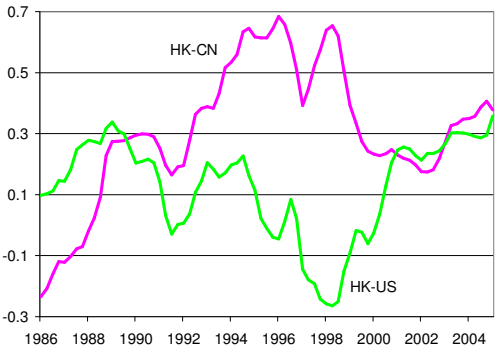
Chart 8 displays Hong Kong's correlation coefficients of the eight-year moving windows with the Mainland and the US. Quite remarkably, the eight-year moving correlation coefficient of GDP growth between Hong Kong and the Mainland rose from around minus 0.2 in the early 1980s to close to 0.7 in the mid-1990s. This was probably driven by rapid trade integration following the opening of the Mainland economy. However, the correlation coefficient dropped significantly from

1997 to 2002 (Chart 8A), a period when Hong Kong was severely affected by the Asian financial crisis in 1997-98, to which China was largely immune. The correlation coefficient has since recovered to around 0.4 in eight years up to 2004, reflecting the rapid recovery of the Hong Kong economy and continued high growth on the Mainland. While the correlation of GDP growth rates in Hong Kong and the Mainland China increased until 1998, those between Hong Kong and the US started to move into the opposite direction after 1988, reaching minus 0.3 in 1998 before a sharp recovery to 0.4 in eight years up to 2004, the same degree of correlation as between Hong Kong and the Mainland.

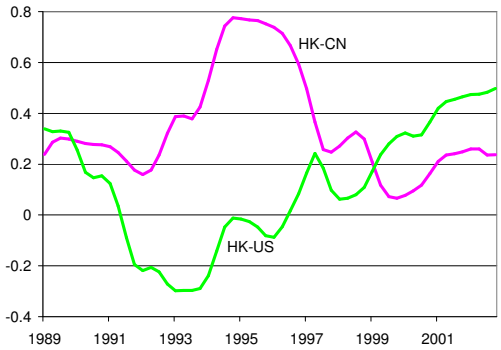
Compared with their counterparts in panel A, the correlations of the BP-filtered GDP growth rates in panel B demonstrate a similar but smoother pattern. While moving together in the same direction, the cyclical correlations between Hong Kong and the US have been persistently higher than those between Hong Kong and the Mainland since 1999.

Chart 8: Growth and cycle correlation

A. Real GDP, year-on-year growth rates



B. Real GDP cycles (BP-filtered)



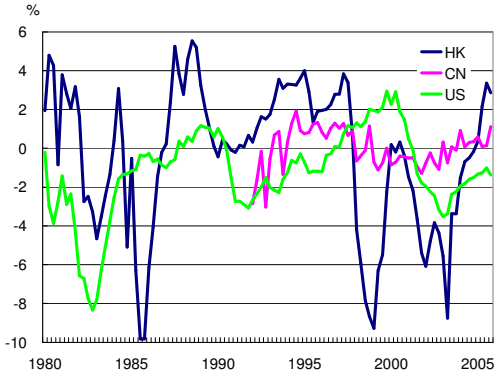
Note: For Chart A, the first correlation reported is for the period between 1979:Q1 and 1986:Q4. For Chart B, the first correlation reported is for the period between 1982:Q1 and 1989:Q4 as the BP filter often drops the first and the last three years of data in calculation.
Sources: CEIC and staff estimates.

Correlations of output gaps

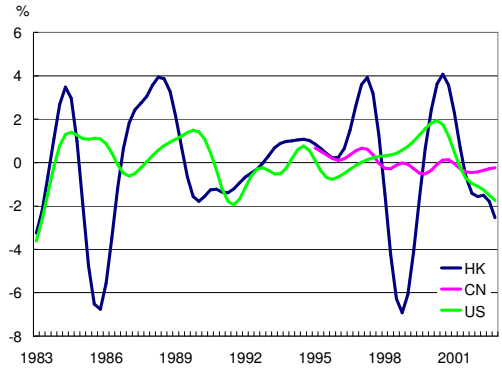
Chart 9 shows output gaps as a percentage of potential GDP on a quarterly basis for the three economies as well as their BP filtered components. Similar to the year-on-year GDP growth rate, Hong Kong's output gaps show the largest fluctuations among the three economies. It experienced some substantial under-utilisation of resources in the mid 1980s, the late 1990s, and 2003. The latter two occasions correspond to the Asian financial crisis and SARS respectively. Hong Kong's output gaps have rebounded sharply in recent periods, suggesting the economy is experiencing increased capacity constraint.

Chart 9: Output gaps and cycles

A. Output gap



B. BP-filtered output gap



Sources: US Congressional Budget Office and staff estimates.

Table 2 reports the correlation of output gaps and their cyclical components for the three pairs of economies. Following the methodology used in Dodsworth, *et al.* (1997), a business cycle is identified from a trough to a trough and we calculate correlation coefficients of both output gaps and BP-filtered output gaps for the identified cycles. These correlation coefficients are reported in Table 2A. The correlation coefficients of output gaps and their cyclical components for Hong Kong and the Mainland were quite high in the 1990s, but they dropped substantially during 1998-99 and 2003, before rising again to similar levels in the early 1990s. The output gap correlations between Hong Kong and the US were low before the mid 1990s and were even negative from the mid 1990s to 1998-99. Since then, the correlation between these two economies increased markedly, recording a correlation coefficient of 0.98 in the latest cycle. Hong Kong's output gaps appeared

to be more correlated with those of the Mainland before the Asian financial crisis in 1997-98 but more correlated with those of the US after the crisis. Table 2A also shows that the output gap correlation between the Mainland and the US was high before the mid 1990s, but it became negative in the second half of 1990s before rising to a relatively high level again in the latest cycle.

Table 2B shows the output gap correlation for longer periods. It shows that the correlation between Hong Kong and the Mainland in the new millennium rose to 0.52 from 0.32 in the 1990s. Over the same period, the correlation of output gaps between Hong Kong and the US recovered even more strongly and reached 0.51 during the period from 2000 to the present, from a large negative value of -0.57 in the 1990s. The correlation coefficients of the output gaps between China and the US changed from positive in the 1990s to negative during 2000 to 2005, although the magnitudes were small.

Table 2A: Output gap and cycle correlation

	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Cycle 6
Based on Ygap:	1980Q1-1985Q4	1985Q4-1990Q1	1990Q1-1995Q3	1995Q3-1999Q1	1999Q1-2003Q2	2003Q2-present
HK-CN	-0.51	0.07	0.67	0.69	0.21	0.67
HK-US	0.00	0.38	0.15	-0.70	0.46	0.98
CN-US	0.67	0.75	0.59	-0.56	0.02	0.64
Based on BP-filtered Ygap:	1980Q1-1985Q4	1985Q4-1990Q1	1990Q1-1996Q1	1996Q1-1998Q4	1998Q4-2003Q2	
HK-CN			0.98	0.78	0.20	
HK-US	0.15	-0.35	0.21	-0.51	0.39	
CN-US			0.89	-0.39	0.35	

Note: Numbers in grey colour are from IMF(1997) study.
Sources: IMF (1997) and staff estimates.

Table 2B: Output gap and cycle correlation

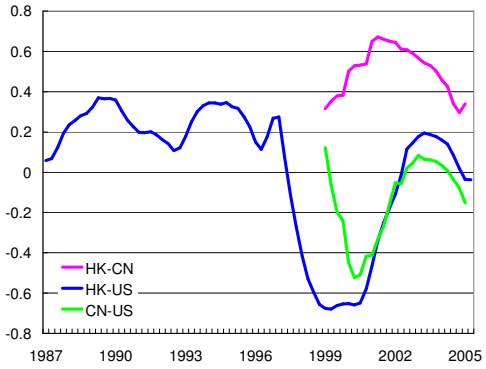
Based on Ygap:	1980-1989	1990-1999	2000-present
HK-CN		0.32	0.52
HK-US	0.24	-0.57	0.51
CN-US		0.12	-0.19

Source: Staff estimates.

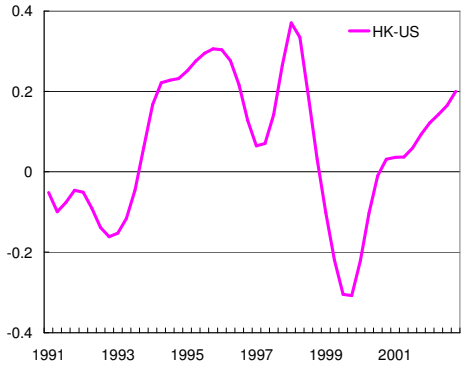
Chart 10 presents the time-varying correlation coefficients using the eight-year rolling windows. Chart 10A indicates that the output gap correlations for the Hong Kong-Mainland pair were higher than those for the Hong Kong-US pair. The correlation between Hong Kong and the US appeared to track closely with that between the Mainland and the US from 1999 to 2005.

Chart 10: Output gap and cycle correlation

A. Output gap correlation



B. BP-filtered output gap correlation



Note: For Chart A, the first correlation reported is for the period between 1980:Q1 and 1987:Q4. For Chart B, the first correlation reported is for the period between 1984:Q1 and 1991:Q4.
Sources: Staff estimates.

Principal component analysis

The correlation analysis suggests that Hong Kong's business cycle synchronisation with the Mainland has increased over time. Despite the LERS, the correlation of business cycles between Hong Kong and the US in the 1990s was negative. In addition, the correlation analysis also suggests that Hong Kong was more correlated with the Mainland when there was a common external shock to both of them (for example, the Asian financial crises in 1997-98). However, the three economies tend to move closely together in 2000-2005, a period when the US economy was growing strongly. Because the US is the second largest export market of both Hong Kong and the Mainland, one would wonder whether the increased correlation between Hong Kong and the Mainland was affected by a common factor, that is, the US effect.

To study this question, we apply a principal component analysis to test whether there is a common factor affecting business cycles among these three economies. Table 3 reports the proportions of the variance of output growth and inflation explained by the first principal component. For the full period, the first principal component explains 48% and 61% of the variance in GDP growth and inflation respectively for the three economies. For both variables the first principal component explains the largest share of the variance in the most recent period (2000-05) and the smallest in the 1990s. The former might reflect the strong US income effect on the global economy in recent years and the latter might be due to the Asian financial crisis and brief periods of deflation experienced in Hong Kong and the Mainland. Factor loadings for the full period for both GDP and CPI show that loadings for each economy are similar, suggesting they are likely to be influenced by a common factor. Whether the US is the common factor will be analysed in the next section.

Table 3: Principal component analysis

(%)

	GDP growth			CPI inflation		
	Variance explained by 1st Principal Component	Factor Loading		Variance explained by 1st Principal Component	Factor Loading	
Full Period	48	US	37	61	US	32
		CN	38		CN	29
		HK	24		HK	39
1980-1989	49	US	44	57	US	45
		CN	44		CN	10
		HK	12		HK	44
1990-1999	46	US	-20	57	US	33
		CN	56		CN	25
		HK	64		HK	42
2000-2005	77	US	36	63	US	28
		CN	30		CN	35
		HK	34		HK	37

Note: The factor loadings are the normalised first eigenvector of the principal component analysis..
Sources: CEIC and staff estimates.

IV. THE TRANSMISSION OF ECONOMIC SHOCKS

The correlation analysis in the previous section reveals important information on the degree of business cycle synchronisation. However, it does not tell us how economic shocks are transmitted across the three economies, which is more appropriately handled using a structural economic model, in our case a structural vector auto regression (SVAR) model. Our analysis follows most closely the approach adopted in Genberg, Salemi, and Swoboda (1987), Cushman and Zha (1997) and, for East Asia, Genberg (2005). Because of the size of the US economy, it is reasonable to assume that the US output and price and interest rate shocks will affect both Hong Kong and the Mainland, but not vice versa. Similarly, because of the relative sizes of Hong Kong and the Mainland we assume that Mainland shocks are transmitted to Hong Kong but the economic developments in Hong Kong have no influence on the Mainland.

Our VAR system contains seven variables: CPI inflation, real GDP growth in the Unites States, the three-month US Treasury bill rate, inflation and real GDP growth in Mainland China, and finally inflation and real GDP growth in Hong Kong. As already noted, the system of equations is specified so that the Hong Kong variables have no effect on either the Mainland or US variables, Mainland variables have no effect on the United States, but they do effect Hong Kong, and US variables influence both the Mainland and Hong Kong.

The contemporaneous correlation between the error terms in each variable is assumed to obey the same causal structure illustrated in equation (4):

$$\begin{pmatrix} \Delta y_t^{US} \\ \Delta p_t^{US} \\ TB_t^{US} \\ \Delta y_t^{CN} \\ \Delta p_t^{CN} \\ \Delta y_t^{HK} \\ \Delta p_t^{HK} \end{pmatrix} = \begin{pmatrix} 1 & a_{12} & a_{13} & 0 & 0 & 0 & 0 \\ a_{21} & 1 & a_{21} & 0 & 0 & 0 & 0 \\ a_{31} & a_{31} & 1 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & a_{45} & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & a_{66} \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_{yt}^{US} \\ \varepsilon_{pt}^{US} \\ \varepsilon_{tbt}^{US} \\ \varepsilon_{yt}^{CN} \\ \varepsilon_{pt}^{CN} \\ \varepsilon_{yt}^{HK} \\ \varepsilon_{pt}^{HK} \end{pmatrix} \qquad (4)$$

where Δy_t^* and Δp_t^* denote quarterly real GDP growth rate and CPI inflation for these three economies and TB_t^{US} represents quarterly average of three-month US treasury bills. ε_t^* represents corresponding shocks.

The equations are estimated using the Seemingly Unrelated Regression method over the sample period from the first quarter of 1990 to the last quarter of 2005 with the number of lags set to be 4.[7] To fully identify the system we set $a_{12}= a_{13}= a_{21}= a_{45}= a_{66}=0$. Although this implies a causal structure between the shocks within each economy, we do not make use of this in the analysis that follows.

Panel A of Table 4 presents the variance decompositions of the Hong Kong variables to see to what extent Hong Kong's output and inflation variations can be explained by US shocks, Mainland shocks, and

[7] The 4 lags are chosen because of sample size and the nature of quarterly data. Two lags are also used for robustness checks and they do not appear to make a difference.

its own shocks. A few observations emerge from this table. First, Hong Kong's output and price developments are mostly affected by its own domestic factors in the short run. Secondly, for the medium (5 years) and long run (10 years), US shocks (combining shocks from GDP, CPI, and three-month interest rates) appear to have explained 60% and 45% of Hong Kong's output and price variations respectively. Thirdly, the Mainland has only limited impact on real GDP growth in Hong Kong. However, it appears that Mainland shocks explain more than one-third of Hong Kong's inflation developments. Fourthly, Hong Kong's own shocks account for about 30% and 20% of its output and price variations respectively over the medium to long run.

These results appear to be consistent with our intuitions. In addition to the fact that the US is a key market for exports from both Hong Kong and the Mainland, the choice of the exchange rate regime in Hong Kong and on the Mainland may have played a role in explaining the increased business cycle synchronisation. The peg of the Hong Kong dollar and the renminbi (up to July 2005) to the US dollar could reinforce the transmission of shocks in these two pairs of economies. For example, our earlier results show that Hong Kong's integration with the US through trade and FDI channels is much weaker than that with the Mainland. The fact that US shocks are the dominant force in Hong Kong's output and price movements possibly suggests the endogenous effect through the LERS. This is also confirmed by the US effect on the Mainland economy in Panel B of Table 4. Over the medium to long run, the US output effect explains about 67% and 79% of Mainland output variations respectively, surprisingly higher than that in Hong Kong, although the US shocks only explain less than one-third of the variations of Mainland prices. This result appears to suggest that other than the external demand channel (as the US is currently the Mainland second largest trading partner), Mainland's de-facto US dollar pegged exchange rate regime may also help explain the large US effect. On the other hand, as the real economy channel currently dominates economic integration between Hong Kong and the Mainland, the Mainland's inflation rate exerts a big impact on Hong Kong's domestic price development, whereas on the Mainland, its own domestic factors tend to explain most of its own price developments.

Table 4: Variance decomposition of shocks

	Output			Price		
	US	CN	HK	US	CN	HK
Panel A. Impact on Hong Kong						
In 1 quarter	37.63	7.69	54.68	2.22	1.71	96.06
One year	56.27	7.62	36.11	21.47	10.03	68.51
5 year	57.92	8.47	33.61	41.74	34.49	23.77
10 year	60.92	8.00	31.08	44.57	35.91	19.52
Panel B. Impact on China						
In 1 quarter	19.21	80.79	0.00	0.32	99.68	0.00
One year	33.09	66.91	0.00	5.49	94.51	0.00
5 year	67.11	32.89	0.00	27.31	72.69	0.00
10 year	78.79	21.21	0.00	30.65	69.35	0.00

Source: Staff estimates.

To understand whether US shocks are responsible for the business cycle synchronisation between Hong Kong and the Mainland, we estimate two separate VAR specifications, one containing only the US and Mainland variables and the other only the US and Hong Kong variables.[8] The moving-average representation of these systems can be written as the follows:

$$\Delta y_t^{HK} = \sum_{i=0}^{\infty} a_i^{US} \xi_{t-i}^{US} + \sum_{i=0}^{\infty} a_i^{HK} \xi_{t-i}^{HK} \qquad (5a)$$

$$\Delta p_t^{HK} = \sum_{i=0}^{\infty} b_i^{US} \xi_{t-i}^{US} + \sum_{i=0}^{\infty} b_i^{HK} \xi_{t-i}^{HK} \qquad (5b)$$

$$\Delta y_t^{CN} = \sum_{i=0}^{\infty} c_i^{US} \xi_{t-i}^{US} + \sum_{i=0}^{\infty} c_i^{CN} \xi_{t-i}^{CN} \qquad (6a)$$

$$\Delta p_t^{CN} = \sum_{i=0}^{\infty} d_i^{US} \xi_{t-i}^{US} + \sum_{i=0}^{\infty} d_i^{CN} \xi_{t-i}^{CN} \qquad (6b)$$

[8] The two SVARs are estimated using SUR and the same lag length for the sample period from 1990:Q1 to 2005:Q4. Another approach is to continue to use the previous seven-variable specification for Hong Kong together with the five-variable specification using only US and Mainland variables for the Mainland. Not reported here, the results are quite similar to what reported here.

The effects of US shocks on the real growth rates in Hong Kong and in the Mainland are represented by $\Delta y_t^{HK}(US) \equiv \sum_{i=0}^{\infty} a_i^{US} \xi_{t-i}^{US}$ and $\Delta y_t^{CN}(US) \equiv \sum_{i=0}^{\infty} c_i^{US} \xi_{t-i}^{US}$ respectively. Corresponding decompositions can be made for inflation in Hong Kong and the Mainland. This would give:

$\Delta y_t^{HK}(US)$ = the effect on Hong Kong's real growth of US shocks only
$\Delta p_t^{HK}(US)$ = the effect on Hong Kong's inflation rate of US shocks only
$\Delta y_t^{CN}(US)$ = the effect on the Mainland's real growth of US shocks only
$\Delta p_t^{CN}(US)$ = the effect on the Mainland's inflation rate of US shocks only

$\Delta y_t^{HK}(HK)$ = the effect on Hong Kong's real growth of Hong Kong shocks only
$\Delta p_t^{HK}(HK)$ = the effect on Hong Kong's inflation rate of Hong Kong shocks only
$\Delta y_t^{CN}(CN)$ = the effect on the Mainland's real growth of Mainland shocks only
$\Delta p_t^{CN}(CN)$ = the effect on the Mainland's inflation rate of Mainland shocks only

Through these two SVAR systems, we examine how synchronised the economies of Hong Kong and the Mainland would be if there were only domestic shocks, i.e., if the common effect from the United States were absent. The results are presented in Table 5, and they reveal a lack of co-movements between the two economies resulting from purely domestic shocks. For example, the correlation between real GDP growth rates that one would observe if there were only domestic shocks is merely 0.09 during 1994-2005. This is in sharp contrast with the much higher correlations reported in Table 1, which refers to the actual data. The conclusion would have to be that the high actual correlation between Hong Kong and the Mainland growth rates and inflation must have come from the effects of shocks originating in the United States. This is also what we have found out.

Table 5: Correlations of domestically generated output growth rates (row 1) and inflation (row 2) between Hong Kong and the Mainland

	1994-2005	1994-1997	1998-2000	2000-2005
GDP	0.09	-0.01	0.11	0.12
CPI Inflation	0.09	0.26	-0.29	0.14

Note: Estimates calculated using historical decompositions from equations 5(a, b) and 6(a,b).
Source: Staff estimates.

Table 6 reports the correlations between $\Delta p_t^{HK}(US)$ and $\Delta p_t^{CN}(US)$ on the one hand and $\Delta y_t^{HK}(US)$ and $\Delta y_t^{CN}(US)$ on the other, i.e., between the evolution of growth and inflation in the two economies related exclusively to US shocks. These correlations are generally much higher (except for inflation rates during 1998-2000) implying that the high business cycle and inflation co-movements between the Hong Kong and the Mainland economy after the 1990s could be mostly driven by their high correlation with the US economy.

Table 6: Correlations of output growth rates (Row 1) and inflation (Row 2) in Hong Kong and the Mainland generated exclusively by US shocks

	1994-2005	1994-1997	1998-2000	2000-2005
GDP	0.43	0.48	0.53	0.62
CPI Inflation	0.63	0.60	-0.39	0.59

Note: Estimates calculated using historical decompositions from equations 5(a,b) and 6(a,b).
Source: Staff estimates.

Overall, the structural VAR analysis reveals that over the medium and long run, US shocks appear to affect both output and inflation developments in Hong Kong strongly. Mainland shocks affect Hong Kong's inflation development significantly, but its impact is still smaller than that exerted by shocks in the US. Furthermore, it appears that the components of both output growth and inflation that are domestically generated in Hong Kong and on the Mainland are hardly correlated. The generally high degree of synchronisation of output growth between Hong Kong and the Mainland presented in the previous section is therefore largely attributed to the common US factor. The common high correlation with the US leads to the high correlation between Hong Kong and the Mainland.

V. CONCLUSION AND POLICY IMPLICATIONS

This paper has examined various aspects of economic and financial market integration among Hong Kong, the Mainland, and the United States. We have found that economic integration between Hong Kong and the Mainland has deepened over time. This is especially prominent in the areas of trade, FDI, and tourism-related consumption. However, Hong Kong has little in common with the Mainland in terms of the movements of interest rates and stock market indices, undoubtedly reflecting the substantially closed capital account on the Mainland. We have also examined synchronisation of GDP growth among the three economies. The findings suggest that the co-movements of the business cycle in Hong Kong with those of the Mainland and the US have increased markedly since 2000, following some low and even negative correlations with the US in the 1990s. This high correlation naturally raises the question of what drives the co-movements among the three economies. Our structural VAR analysis suggests that over 60% of the variations in output shocks and over 45% of the variations in price changes in Hong Kong can be explained by US shocks, whereas Mainland China shocks explain over one-third of Hong Kong's price movements. Using a methodology that permits us to distinguish between the effects of common US shocks and idiosyncratic domestic shocks, we conclude that there is little correlation between the component of the business cycles attributable to domestic shocks in Hong Kong and the Mainland, whereas the influence of the US shocks on the two economies leads to a high degree of synchronisation. In other words, the business cycle co-movements of Hong Kong and the Mainland are largely due to the common influence of economic conditions in the Unites States, possibly because of their US dollar-pegged exchange rate system.

Our results also show that Hong Kong's business cycles are quite volatile compared with those of the Mainland and the US. Hong Kong's price developments are strongly affected by domestic forces in the short run, although the influences from the US and the Mainland are dominant over the medium and long run. This is somewhat puzzling given that Hong Kong is a small open economy. One explanation may be that large swings of property prices are responsible for the importance of

domestically generated shocks.[9] This is plausible since the rental component of the composite CPI is highly affected by property prices and has a weight of 30% in the index. Therefore, policy considerations to reduce large volatilities emanating from property prices are warranted to improve the smooth functioning of the LERS.

Our analysis also suggests that while the three economies are normally highly synchronised, they can move apart when shocks unrelated to the United States materialise. This is revealed by our findings that during the Asian financial crises in 1997-98, the co-movement of business cycle between the Mainland and Hong Kong increased sharply; but their co-movement with the US economy turned negative. This pattern suggests that both economies are sensitive to regional shocks to which the US economy is largely immune. It means that measures that help maintain regional economic stability are important even where extra-regional influences on business cycles are normally dominant.

The results of this study are mostly drawn from a time when the Mainland economy was under tight capital control and its exchange rate was largely pegged to the US dollar. As the Mainland progressively liberalises its capital account by encouraging capital outflows (for example, through the QDII scheme), economic shocks, specifically financial market shocks, from the Mainland to Hong Kong are likely to increase progressively over time. This may increase synchronisation of real growth and inflation. But because of the structural differences between the two economies, it does not necessarily mean that the domestic shocks would become more similar. Since it is the similarity of shocks that matter the most for the choice of exchange rate regime, the LERS, which links the Hong Kong dollar to the US dollar, would continue to be desirable for the foreseeable future.

[9] See comments by Peng (2005) on Gerlach and Gerlach-Kristen (2005).

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