



*UNDERSTANDING VOLATILITY IN HONG KONG'S FINANCIAL MARKETS*

**Key Points:**

- *Financial market volatility affects real economic activity and may impair the intermediary function of financial markets. This study presents some “stylised facts” regarding volatility in Hong Kong’s financial markets in the last two decades.*
- *The stock market possesses the greatest average historical return volatility, followed by the holding period return volatility of the quasi-government bond market. The forward exchange market is the least volatile market. Measured in term of the daily change in the yields, volatility in the money market is greater than the quasi-government bond market. After rising to high levels during the Asian financial crisis, volatility in many markets has declined to below their pre-crisis levels, indicating more stable financial market conditions in Hong Kong after the crisis.*
- *The correlation between volatility movements of local financial markets is positive in general. This positive relationship tends to be stronger during crises, suggesting that the benefit of risk diversification by investing in different domestic financial markets is limited.*
- *Volatility in Hong Kong stock and money markets is positively correlated with overseas markets. The synchronisation of the volatility movements may stem from the globalisation process.*
- *The study indicates the existence of negative relationship between financial market volatility and real economic activity. Movements in financial market volatility contain information on future economic growth.*

Prepared by: Ip-wing Yu and Laurence Fung  
Market Research Division  
Research Department  
Hong Kong Monetary Authority

## **I. INTRODUCTION**

Price movements in financial markets are closely monitored by individual investors as well as financial market regulators. To an investor, volatility of the return on financial assets represents the risk of investment, an important element that directly affects an individual's investment decision. To the policy makers, the volatility of financial market carries information that may be useful for a number of different reasons. Below we review these in greater details.

### **(a) *Macroeconomic implications***

The existing literature suggests that financial market volatility affects real economic activity. For instance, Campbell et al. (2001) examine the US economy over the period 1962-1997 and find that lagged volatility in stock market is counter-cyclical and has predictability power on the US quarterly GDP growth in the period studied. De Ceuster and Valckx (2001) confirm that both interest rate and stock market volatility help forecast business cycles in the US, Germany and Japan. Specifically, they show that high interest rate volatility increases the probability of a future recession in all three countries. By contrast, stock market volatility has such an effect for Japan only.

Two important channels appear to explain how financial market volatility affects the real economy. One is the wealth effect of asset prices on consumption spending. If asset price volatility implies uncertainty about the expected future returns, an increase in volatility is likely to depress current consumption.<sup>1</sup> The second channel operates through the so-called balance sheet effects (Bernanke and Gertler (1995)). Assets held by firms in their balance sheets are commonly taken as collateral by financial intermediaries in their lending decision. An increase in the volatility of asset prices would decrease the expected value of available collateral and hence reduce the available credit for investment, thereby affecting economic growth.

### **(b) *Financial market functioning***

Some studies confirm that price volatility in financial markets will impair their intermediary function between savings and investments. By examining firms listed in the US in 1971-1991, Choe, Masulis and Nanda (1993) note that the sources of external financing in the corporate sector depends on stock market volatility. In particular, they show that in periods of high market volatility, common stock issues are scarcer than in tranquil periods. The diminished role of the stock market as a source

---

<sup>1</sup> Financial market volatility affects the certainty of the final wealth from investment in financial assets and will therefore influence consumer spending.

of funds in volatile times forces firms to either seek funds from more expensive alternatives or cut down their investments.

Volatility in asset market may also create systemic risk in the payment system. While it is generally expected that financial institutions can manage their risk exposure under normal conditions, excessive volatility under extreme circumstances such as the stock market crash in 1987 may lead to defaults of some financial institutions and pose systemic risks to the payment system.

**(c) *Globalisation of financial markets***

The integration of financial markets as a result of technological innovation and market liberalisation has made an economy susceptible to financial instability originating abroad. The experience of the 1997 Asian financial crisis demonstrates how a volatility shock emanating from a small emerging market economy can spread to other markets, large or small. Given the cross-market linkages, the change in the correlation of financial market volatility between countries over time would affect the effectiveness of an individual investor's decision to optimise the risk of a portfolio through geographical diversification.

As a small, open economy and one of the major financial centres in the world, Hong Kong's financial markets are commonly perceived as being vulnerable to volatile international capital flows, leading to increased asset price fluctuation. There are however very few systematic studies on the volatility pattern of local financial markets. This paper establishes some "stylised facts" regarding volatility in the domestic stock, quasi-government bond, money and forward exchange markets in the last two decades. The scope of the study includes the evolution of volatility in individual financial markets and the correlation between them, the relationship between asset price volatility and real economy, and the interaction of volatility between the local and foreign financial markets.<sup>2</sup> These findings will contribute to the modelling work of financial market volatility and spillover effect across markets, which are to be covered in a separate study.

---

<sup>2</sup> Similar studies on other countries' financial markets can be found in BIS (1996) and Kortian and O'Regan (1996).

The remainder of this paper is organised as follows. Section II introduces the data and defines the measures of volatility and intermarket linkage used in the study. A general overview of the volatility pattern of individual market is presented in Section III. With the exception of stock market, volatility in Hong Kong financial markets has declined to below their pre-crisis levels after the Asian financial crisis in 1997-98. Section IV discusses the correlation between financial markets. Results show that volatility in different financial markets moves in tandem with one another in general. The volatility linkage between domestic stock and money markets and their overseas counterparts is examined in Section V. The correlation study contained therein confirms that the volatility linkage between domestic and overseas markets has increased during the recent globalisation process. Section VI looks into the relationship between financial market volatility and real economic activity. The findings demonstrate that movements in financial market volatility contain information on future economic performance. A conclusion is provided in the final section.

## II. DATA AND MEASURES OF VOLATILITY AND INTERMARKET LINKAGE

Daily data are obtained for those financial market instruments contained in Tables 1a and 1b below.<sup>3</sup>

**Table 1a. Hong Kong Market**

<b>Financial Market</b>	<b>Instrument</b>	<b>Data Series</b>
Stock Market	Hang Seng Index (HSI)	Daily return on HSI (in %)
Quasi-government Bond Market	2-year and 10-year Exchange Fund Notes (EFN)	i. Daily change in yield (in %) ii. Daily holding period return (in %)
Money Market	1-week and 3-month interbank offered rates (HIBOR)	Daily change in interest rate (in %)
Forward Exchange Market <sup>4</sup>	1-month and 12-month HK\$ per US\$ forward exchange rate	Daily change in HKD/USD forward (in %)

<sup>3</sup> The data are from Bloomberg, CEIC and Datastream.

<sup>4</sup> Under the Linked Exchange Rate system, the spot exchange rate movement moves within a narrow range under the convertibility undertaking arrangement. The forward exchange rates, being free from HKMA market operations, can fluctuate to reflect market sentiment. Thus, volatility in the foreign exchange market is better captured by changes in the forward exchange rates.

**Table 1b. Overseas Market**

Financial Market	Instrument	Data Series
US Stock Market	S&P Composite Index	Daily return on index (in %)
Japanese Stock Market	Nikkei 225 Stock Average Index	
Money Market	1-month and 3-month London interbank offered rates on US\$ (LIBOR)	Daily change in interest rate (%)

Starting dates of the data series vary from early 1980s to 1990s, subject to availability.<sup>5</sup> All data end in mid-July 2003. To examine the evolution of volatility over time, the sample periods are divided into three sub-periods: (i) the pre-crisis period up to 30 September 1997, (ii) the crisis period from 3 October 1997 to 31 December 1998, and (iii) the post-crisis period from 4 January 1999 to 15 October 2002.<sup>6</sup>

For the purpose of this paper, historical volatility of a financial market is defined as the weighted standard deviation of daily returns (or daily changes) over the preceding 60 trading days.<sup>7</sup> For stock and forward exchange markets, the daily returns are given by the percentage return based on the closing prices of the relevant stock indices and forward exchange rates. Since bond price data are not available, the daily return in the bond market is derived using the approximation suggested by Shiller (1979).<sup>8</sup> In addition to the daily returns, daily changes in the yields in the quasi-government bond market and in the interest rates in the money market are also considered.<sup>9</sup> When conducting the market co-movement analysis in Sections IV and V,

<sup>5</sup> For Hong Kong and overseas stock and money markets, data start from April 1982. For the forward exchange market, data start from January 1984. For the 2-year and 10-year EFN yields, data start from February 1993 and June 1997 respectively.

<sup>6</sup> The division of the sample period largely corresponds to the turmoil in Hong Kong financial markets during the Asian financial crisis.

<sup>7</sup> The traditional measure of the standard deviation gives equal weight to all observations over the sample period, thus neglecting the stronger impact of recent events. By calculating the weighted standard deviation, more weight is placed on the more recent observations. In this study, the weight for the  $i$ -th most recent observation is  $(61-i)/(1+2+3+\dots+60)$ .

<sup>8</sup> For bonds selling at or near par value, Shiller (1979) suggests an approximate expression for the  $n$ -period holding period return  $H_t^{(n)}$ , where  $H_t^{(n)} = (R_t^{(n)} - \gamma_n R_{t+1}^{(n-1)}) / (1 - \gamma_n)$ ,  $\gamma_n = \gamma(1 - \gamma^{n-1}) / (1 - \gamma^n)$ ,  $\gamma = 1 / (1 + \bar{R})$ ,  $R_t^{(n)}$  is the yield to maturity and  $\bar{R}$  is the mean value of the yield to maturity.

<sup>9</sup> Volatility of financial markets is commonly based on asset returns. However, there exists alternative measure of volatility for interest rate and bond markets. For example, a study by Kortian and O'Regan (1996) of Reserve Bank of Australia measures volatility in terms of changes in bond yields. In this study, the volatility of money market is measured by daily changes in interest rates, while the volatility of quasi-government bond market is measured by daily changes in yields as well as daily holding period returns.

rolling correlation coefficients between historical volatility of two financial markets based on a 250-day window are calculated.<sup>10</sup>

### **III. FINANCIAL MARKET VOLATILITY – DESCRIPTIVE STATISTICS**

Table 2 contains summary statistics of the historical volatility measures of the major financial markets in Hong Kong. Over the full sample period, in terms of return volatility, the stock market demonstrates the greatest average volatility, reflecting the more risky nature of stock investment.<sup>11</sup> It is followed by the quasi-government bond market. As expected, the least volatile market is the forward exchange market. Based on daily changes in the interest rates or yields, among the two interest rate instruments, the money market is more volatile than the quasi-government bond market.

---

<sup>10</sup> The choice of 60 trading days for calculating the historical volatility and 250-day for correlation coefficients follows a similar study by the Reserve Bank of Australia (Kortian and O'Regan (1996)).

<sup>11</sup> It should be noted that the sample period varies among different markets, subject to the data availability.

**Table 2. Summary Statistics of Historical Volatility Measures<sup>1</sup>**

Data Series	Mean			Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis <sup>6</sup>	
	Full Sample <sup>2</sup>	Pre-Crisis Period <sup>3</sup>	Crisis Period <sup>4</sup>							
<b>Based on Daily Return</b>										
Stock Market										
Hang Seng Index	1.583	1.475	3.009	1.559	1.357	6.419	0.649	0.817	2.298	10.306
Quasi-government Bond Market										
2-year EFN	0.751	0.629	2.020	0.554	0.589	4.175	0.217	0.583	3.318	16.393
10-year EFN	0.591	0.458	1.108	0.469	0.515	2.209	0.198	0.351	2.052	8.062
Forward Exchange Market										
1-month Forward	0.043	0.046	0.131	0.011	0.028	0.392	0.003	0.048	2.761	13.587
12-month Forward	0.106	0.094	0.441	0.051	0.060	1.610	0.008	0.129	3.374	19.445
<b>Based on Daily Change</b>										
Money Market										
1-week HIBOR	0.498	0.514	1.341	0.211	0.321	3.646	0.035	0.548	2.770	11.727
3-month HIBOR	0.255	0.205	1.540	0.073	0.124	7.200	0.010	0.580	8.244	81.909
Quasi-government Bond Market										
2-year EFN	0.101	0.082	0.306	0.068	0.075	0.615	0.029	0.090	3.349	15.747
10-year EFN	0.082	0.064	0.166	0.062	0.066	0.316	0.028	0.053	2.091	7.619

Notes: <sup>1</sup> Except the skewness and the kurtosis statistics, the rest of the statistics are in percentage terms. The statistics of median, maximum, minimum, standard deviation, skewness and kurtosis are based on data for the full sample. <sup>2</sup> For the stock market and the money market, data start from April 1982. For the 2-year and 10-year quasi-government bond yield, data start from February 1993 and June 1997 respectively. For the forward exchange market, data start from January 1984. <sup>3</sup> The pre-crisis period ends on 30 September 1997. <sup>4</sup> The crisis-period is from 3 October 1997 to 31 December 1998. <sup>5</sup> The post-crisis period is from 4 January 1999 to 18 July 2003. <sup>6</sup> Kurtosis measures whether the series has a fat-tailed distribution. If the kurtosis exceeds 3, the distribution is peaked relative to the normal. If it is less than 3, the distribution is flat relative to the normal.

The skewness statistics are all positive and the kurtosis coefficients are greater than three. This implies that market volatility in Hong Kong tends, on average, to be higher than what would be expected from a normal distribution and the probability of a high level of variability is significant. The results of these higher moment statistics are consistent with the findings in other countries' financial markets.

The evolution of financial market volatility over time is shown in Charts 1 to 4. In general, volatility in Hong Kong financial markets rose to high levels during the crisis period, after which all, except the stock market, declined to below their pre-crisis levels (Table 2). In particular, the money and forward exchange markets experienced rapid declines in their volatility after the crisis. The developments denote more stable financial market conditions in Hong Kong after the crisis when compared to the pre-crisis period. Apart from the subsiding of speculative moves, the significant reduction in the volatility in the money and forward exchange markets may also be attributable to institutional changes initiated after the crisis, which included the package of seven technical measures to strengthen the currency board arrangements against volatile international capital flows. For example, one of the measures is to replace the Liquidity Adjustment Facility (LAF) by Discount Window. This gives banks easier access to the overnight liquidity provided by the Exchange Fund, which helps dampening excessive interest rate volatility. The Convertibility Undertaking, under which the Hong Kong Monetary Authority commits to buy Hong Kong dollar for US dollar at a rate of HKD7.80 per USD, also provides a clear demonstration of the Government's commitment to the Linked Exchange Rate system. These measures help strengthen public confidence in the Hong Kong dollar exchange rate and hence reduce the volatility in the forward market.

Regarding the movements in volatility in individual financial markets, it is noteworthy that stock market volatility has become more persistent since early 1990s, i.e. it remains at a high level for a longer period after rising during special events and crises (Chart 1).<sup>12</sup> In the money market, return volatility moved within a tight range until the eruption of the Asian financial crisis. Relative to longer-term money market rates, short-term rates tend to fluctuate more (Chart 2).<sup>13</sup> Volatility died down rapidly after the crisis and subsided to the lowest level in the last two decades after the terrorist attack in the US on 11 September 2001.

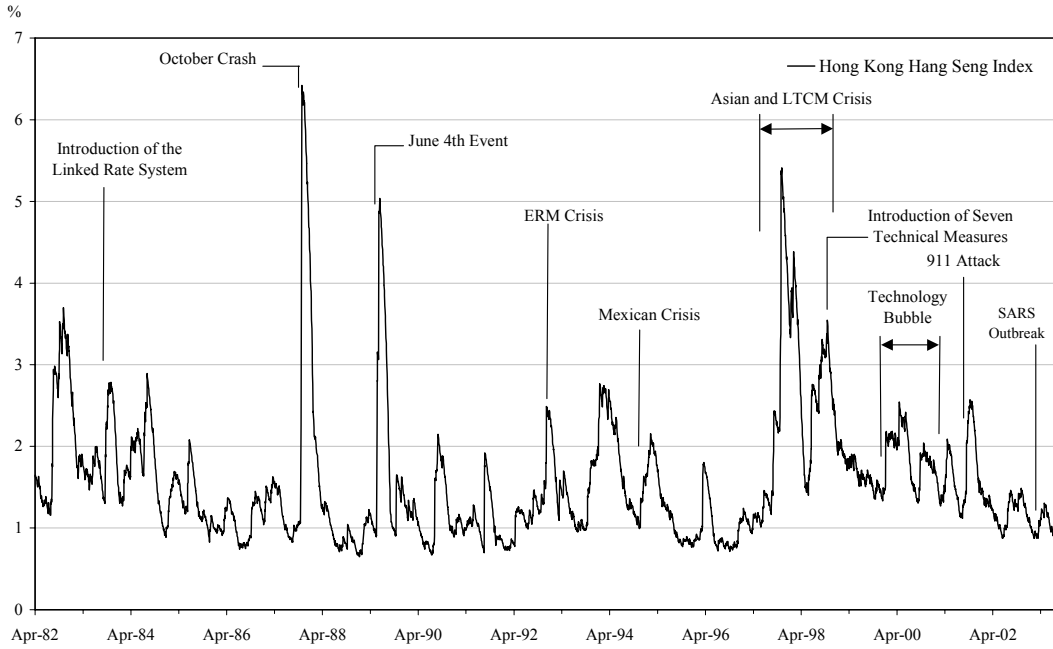
---

<sup>12</sup> Notwithstanding this, the rise in volatility during the October market crash in 1987 remained unparalleled in the history of Hong Kong stock market.

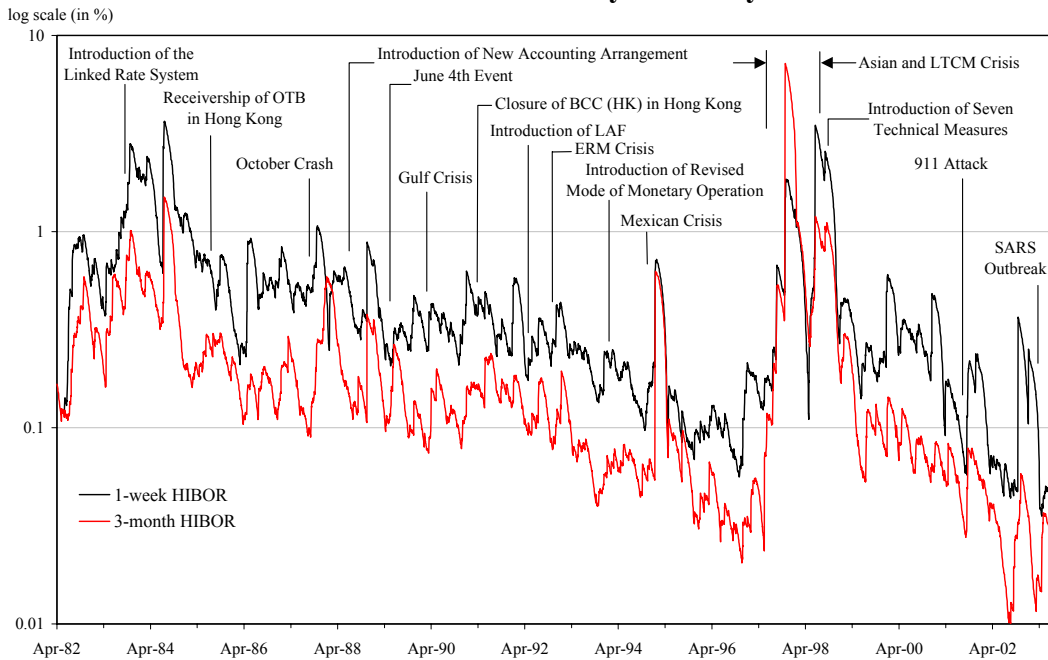
<sup>13</sup> Tse and Yip (2001) attributed the reduction in the short-term money market volatility to the introduction of the accounting arrangements in 1988 and the introduction of the Liquidity Adjustment Facility (LAF) in 1992.



**Chart 1. Historical Volatility of Stock Market**

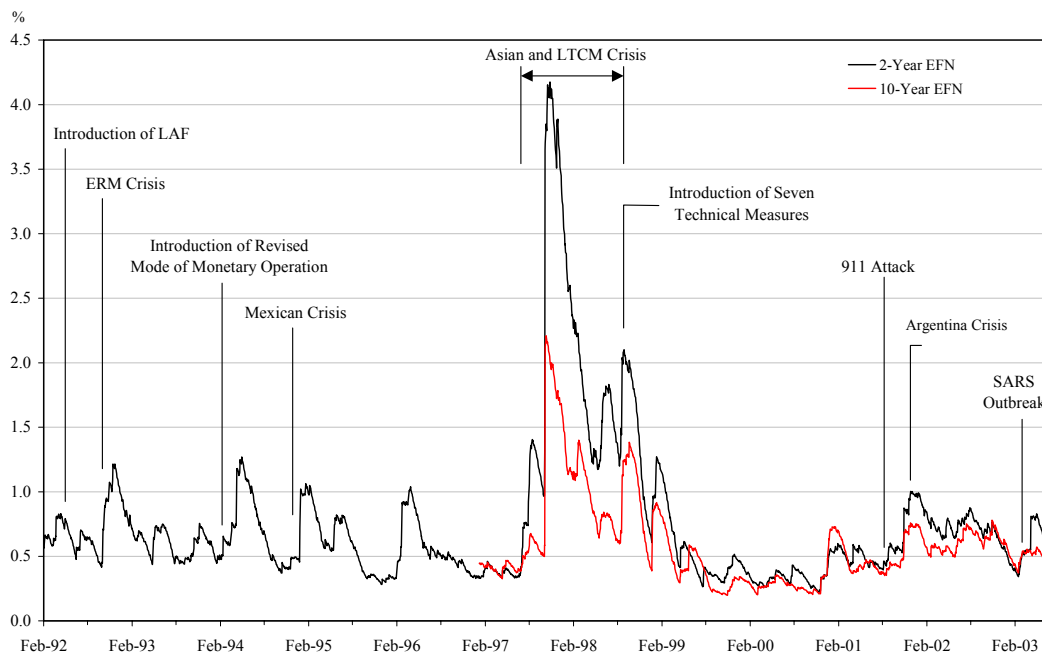


**Chart 2. Historical Volatility of Money Market**



Similar to the money market, the holding period return volatility of short-term quasi-government bonds generally surpasses that of long-term quasi-government bonds (Chart 3). Market volatility returned to a relatively low level (as compared with the pre-crisis level) during mid-1999 to end-2000.<sup>14</sup> However, starting from 2001, there are signs that volatility has been rising slightly. Nonetheless, volatility has stabilised recently.<sup>15</sup>

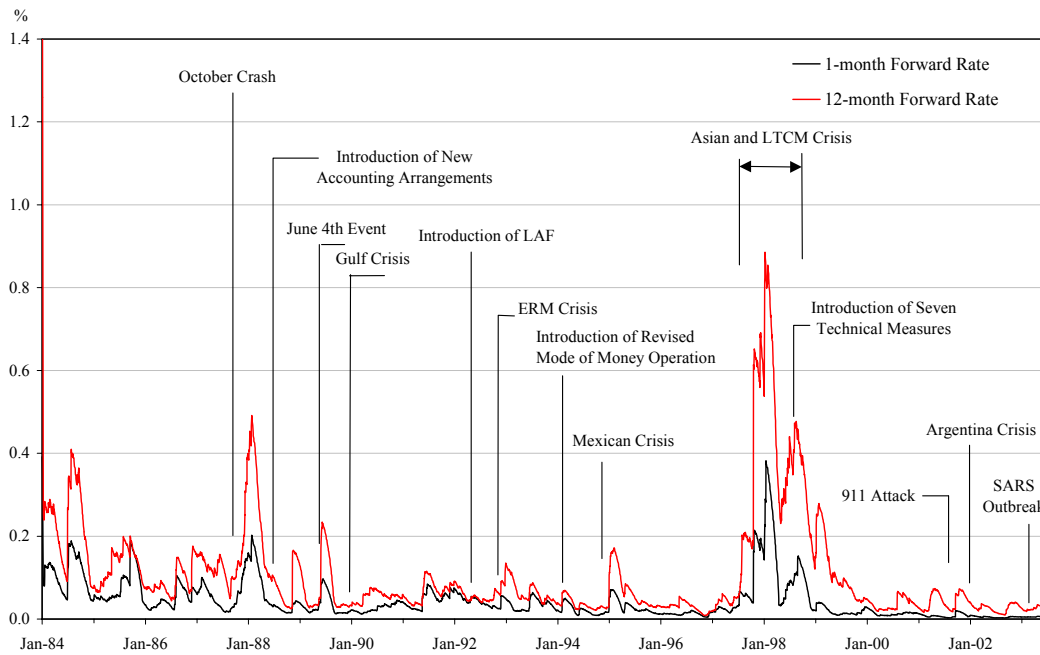
**Chart 3. Historical Holding Period Return Volatility of Quasi-government Bond Market**



Finally, volatility in the forward exchange market has been relatively stable over the past 20 years, despite several event-driven rises (Chart 4). The volatility of long-term forward exchange rate is higher than that of other short-term rates, suggesting that a larger currency risk is associated with a longer time horizon.

<sup>14</sup> It should be noted that the average historical volatilities among quasi-government bonds of various tenors are not significantly different from one another in the post-crisis period (Table 2).

<sup>15</sup> A similar pattern, though in a smaller scale, is observed for the historical volatility of quasi-government bond market in terms of daily changes in yields.

**Chart 4. Historical Volatility of Forward Exchange Market**

#### IV. FINANCIAL MARKET VOLATILITY – CORRELATION ANALYSIS

Aside from discussing the general trend and evolution of financial market volatility in individual financial markets in Hong Kong, it is equally important to investigate whether there are close interactions among volatility movements of financial markets. If volatility movements are highly and positively correlated, financial stability can be threatened under extreme circumstances. In order to illustrate the relationship between volatility movements across financial markets, correlation coefficients of historical volatility of financial markets based on a 250-day moving window are computed in this section and their graphical illustrations are presented in Charts 5 to 7.<sup>16</sup>

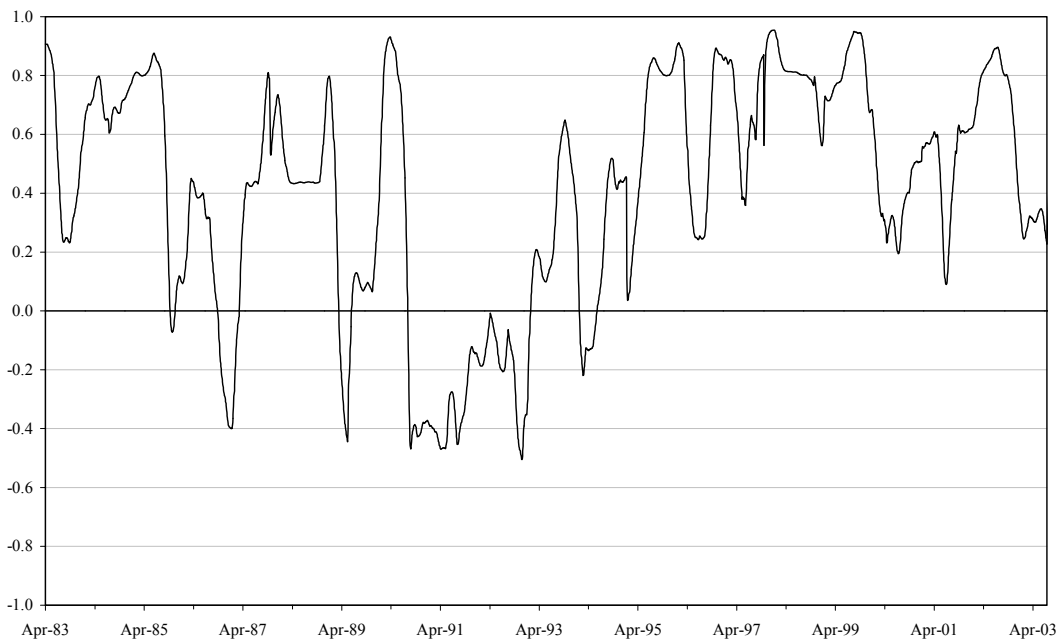
In general, while the correlations vary over time, they remain positive for most of the period, implying that the volatility in different financial markets tend to move together. This positive relationship is found to be stronger during crises. A few interesting observations from these correlation analyses and their implications are fleshed out below.

<sup>16</sup> The correlation charts of forward exchange market against the other three financial markets are not presented here, as their correlations exhibit large variation over time, with no clear trends or patterns. These correlation charts are available upon request.

**(1) Stock market vs. money market**

There is a marked change from an unstable relationship before 1994 to the consistently positive correlation thereafter in Chart 5 between these two markets. In the absence of evidence of causality between the two markets, the comovement may reflect their similar reactions to common shocks and information flow.

**Chart 5. Correlation between Stock and Money Market (3-month HIBOR) Volatility**

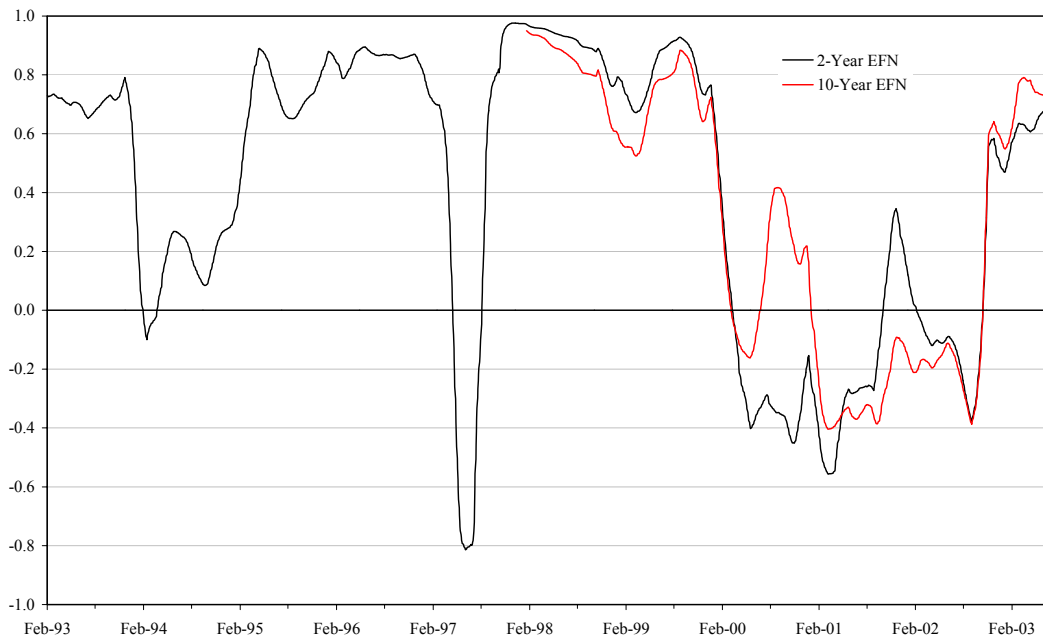


**(2) Stock market vs. quasi-government bond market**

In Chart 6, a strong positive relationship between the return volatility of the two markets is observed for most of the time from 1995 to 1999, except for a short period of negative correlation before the run-up to the handover in July 1997. The anomaly is partly attributable to the fact that while the quasi-government bond market volatility declined slightly from mid-1996 to mid-1997, the stock market volatility has been edging up since mid-1996 as a result of more volatile capital inflows in speculation of a smooth political transition in July 1997.

There was a remarkable drop in the return volatility correlation between the stock and quasi-government bond markets from late 1999 to late 2002. From a risk diversification angle, the low or even negative correlation implies that the benefits of portfolio diversification can be achieved from investing in these two markets. Starting from late 2002 (until mid 2003), however, the return volatility correlation rises sharply and stays well above 0.5. The highly positive correlation means that the benefits of portfolio diversification from investing in both domestic stock and quasi-government bond markets can be limited.

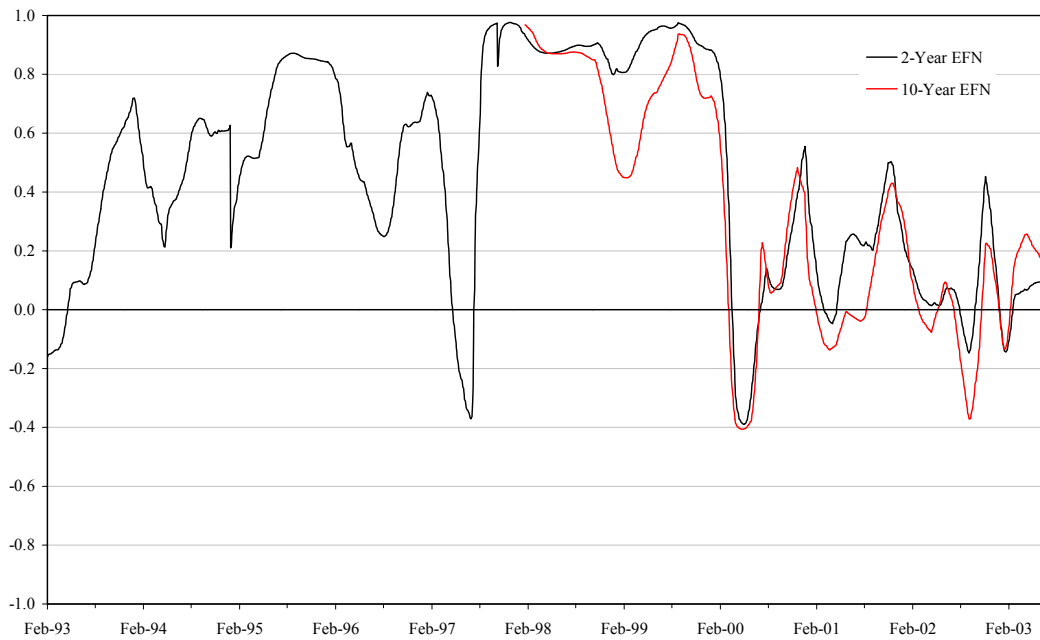
**Chart 6. Correlation between Stock and Quasi-government Bond Markets Return Volatility**



### **(3) *Quasi-government bond market vs. money market***

Volatility in the quasi-government bond and money markets (based on daily change in yields) are positively correlated for most of the time as illustrated in Chart 7. However, the strong positive relationship has weakened since 2000. The recent weak association between the volatility of the money market rate and the quasi-government bond yield is probably because of market's divergent view on the future movements of short- and long-term rates.

**Chart 7. Correlation between Quasi-government Bond and Money Markets (3-month HIBOR) Volatility**

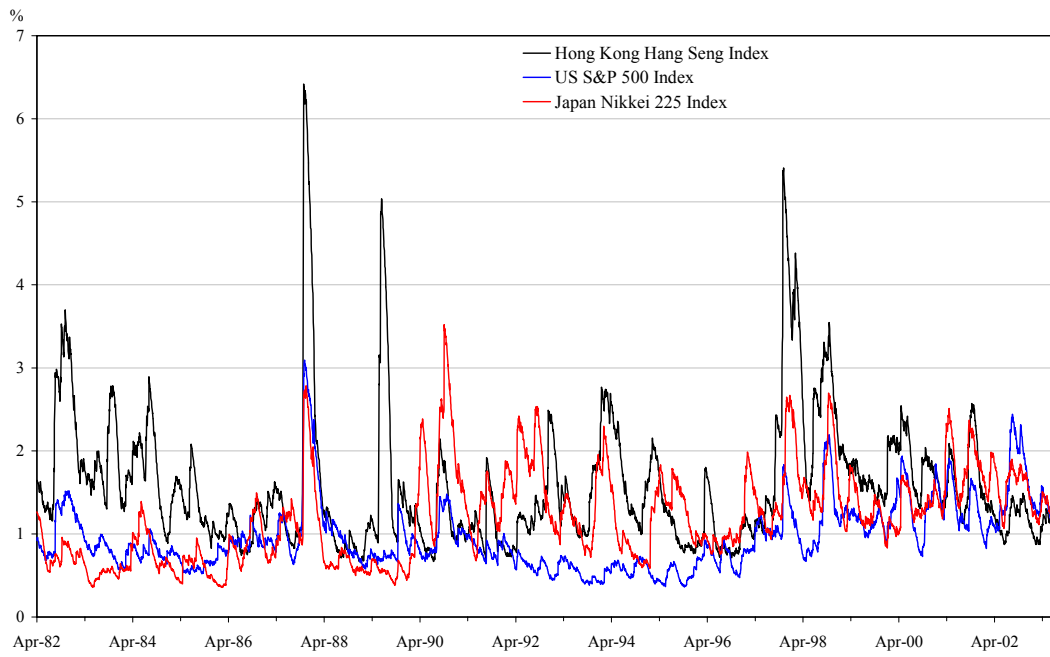


## V. VOLATILITY LINKAGES WITH OVERSEAS MARKETS

As mentioned in the introduction, the globalisation of financial markets has rendered economies increasingly vulnerable to financial market instability overseas. To policy makers and portfolio investors alike, domestic financial markets can no longer be treated as an isolated marketplace given the increased co-movements of interest rates and the closely synchronised stock price movements across nations. From a risk management point of view, it is of prime interest to assess the interdependencies or linkages between volatilities of domestic and overseas financial markets. In this section, such volatility linkage is examined, with the focus on the stock and money market pair.<sup>17</sup>

### (a) *Linkage with overseas stock market volatility*

Chart 8 depicts the movement of historical volatility of stock market indices in Hong Kong, the US and Japan since 1982. A summary of descriptive statistics of the historical volatility of these stock markets is reported in Table 3. In general, the average volatilities in the US and Japanese stock markets are less than that of Hong Kong. However, there are notable upward shifts in volatility in these two markets since 1997 and mid-1990 respectively.

**Chart 8. Historical Volatility of Selected Stock Markets**

<sup>17</sup> It should be noted that the analysis here is not an attempt to establish a causal relationship or to examine the spillover effect between local and overseas markets.

**Table 3. Summary Statistics of Historical Volatility Measures of Hong Kong and Overseas Stock Markets<sup>1</sup>**

Data Series	Full Sample <sup>2</sup>	Mean			Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis <sup>6</sup>
		Pre-Crisis Period <sup>3</sup>	Crisis Period <sup>4</sup>	Post-Crisis Period <sup>5</sup>						
Hong Kong Hang Seng Index	1.583	1.475	3.009	1.559	1.357	6.419	0.649	0.817	2.298	10.306
USA S&P 500	0.961	0.826	1.237	1.344	0.858	3.094	0.361	0.408	1.575	6.622
Japan Nikkei 225	1.199	1.069	1.811	1.477	1.156	3.522	0.356	0.545	0.797	3.494

Notes: <sup>1</sup> Except the skewness and the kurtosis statistics, the rest of the statistics are in percentage terms. The statistics of median, maximum, minimum, standard deviation, skewness and kurtosis are based on data for the full sample. <sup>2</sup> The full sample period is from April 1982 to 15 October 2002. <sup>3</sup> The pre-crisis period ends on 30 September 1997. <sup>4</sup> The crisis period is from 3 October 1997 to 31 December 1998. <sup>5</sup> The post-crisis period is from 4 January 1999 to 18 July 2003. <sup>6</sup> Kurtosis measures whether the series has a fat-tailed distribution. If the kurtosis exceeds 3, the distribution is peaked relative to the normal. If it is less than 3, the distribution is flat relative to the normal.



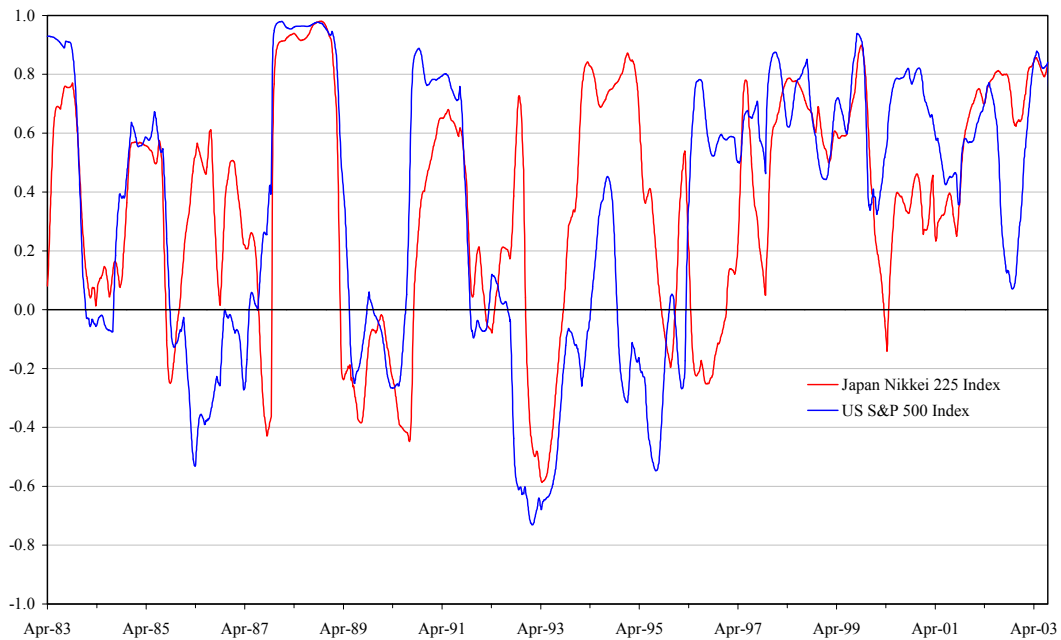
The average correlation coefficients between Hong Kong and other overseas stock markets are given in Table 4. As shown in the table, the average correlation coefficients during the post-crisis period are over 0.5, up from 0.3 or smaller in the pre-crisis period. For investors who are interested in diversifying risk through an international portfolio of stocks, such a high level of volatility correlation would reduce the benefits of geographical diversification, especially during periods of financial market turmoil. For policy makers, the high degree of volatility comovement may signal that financial markets react in a similar fashion to common shocks and information flows.

**Table 4. Correlation between Hong Kong and Overseas Stock Markets Volatility**

	Average Correlation Coefficient between HSI and	
	<u>USA</u> S&P 500	<u>Japan</u> Nikkei 225
Sample Period		
Full Sample	0.328	0.366
Pre-Crisis	0.210	0.286
Crisis	0.707	0.633
Post-Crisis	0.601	0.548

Chart 9 shows the rolling correlation between the volatility of Hong Kong and overseas stock markets (as measured by the S&P 500 Composite Index and the Nikkei 225 Stock Average Index). The chart depicts a strongly positive correlation between the volatility of Hong Kong and overseas stock markets since early 1996. This reflects a high degree of volatility linkage and synchronisation among national stock markets in the past few years. The substantial weakening of the correlation between the volatility of Hong Kong and the US stock markets in 2002 may partly be due to idiosyncratic factors such as accounting irregularities in the US when the US stock market experienced sharp fluctuations.

**Chart 9. Correlation between Hong Kong and Overseas Stock Markets Volatility**



**(b) Linkage with overseas money market volatility**

Under the Linked Exchange Rate system, Hong Kong interest rates generally track closely their US counterparts. Nevertheless, short-term interest rates are also affected by the level of interbank liquidity and the inflow and outflow of capital. It is therefore interesting to see how closely the volatility of local money market rates (HK\$ HIBOR) aligns with that of overseas interbank rates, especially US\$ rates.

Chart 10 presents the historical volatility of London interbank rates of US\$ (US\$ LIBOR) along with the volatility of 3-month HK\$ HIBOR. Two features stand out: volatility of the US\$ LIBORs are consistently lower than the HK\$ HIBORs; and the downward trend in HK\$ HIBOR volatility level before the outbreak of the Asian financial crisis in mid-1997 is remarkable.<sup>18</sup>

<sup>18</sup> From 1985 to early 1997, the 3-month HIBOR volatility drops by over 60%. During this period, major policy initiatives include the introduction of New Accounting Arrangement in 1988, the introduction of LAF in 1992 and the introduction of revised mode of monetary operation in 1994.

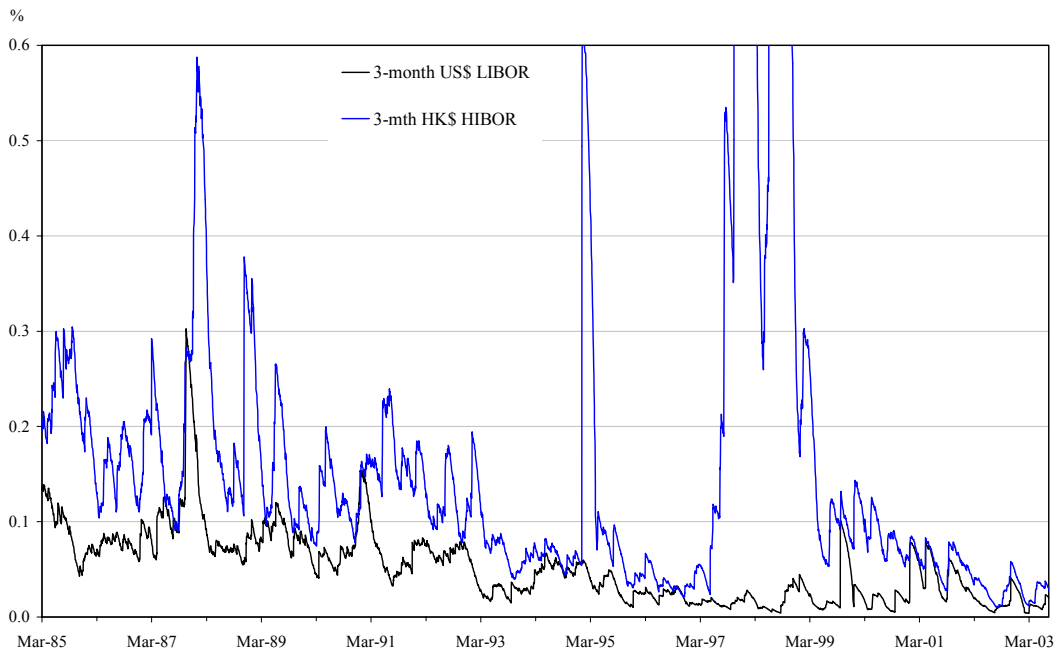
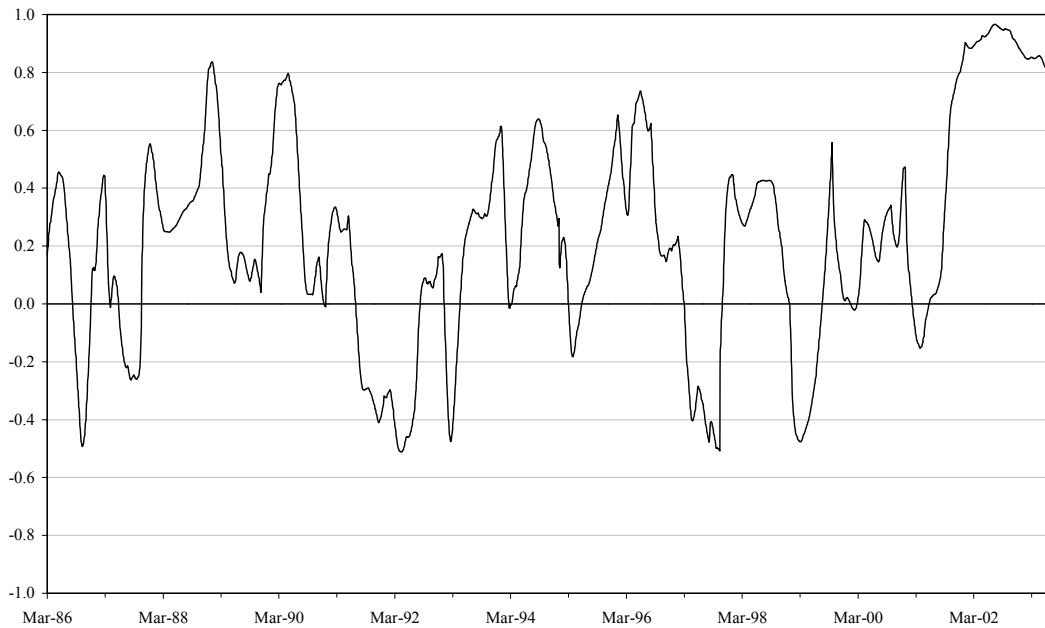
**Chart 10. Historical Volatility of US\$ LIBOR and HK\$ HIBOR**

Chart 11 shows the rolling correlation between the volatilities of the 3-month US\$ LIBOR and HK\$ HIBOR. Apart from a few events that impact mainly on the domestic interbank market, such as the closure of BCC (HK) in the summer of 1991, the European Exchange Rate Mechanism (ERM) crisis in 1992, the Asian financial crisis during 1997-1998, the tension over the Taiwan Strait in 1999, as well as the Argentina currency crisis in early 2001, the two series are positively correlated for most of the time. Starting from mid-2001, the positive relationship strengthens sharply. The increasingly synchronised interest rate movement may in part be due to the absence of idiosyncratic factors in both money markets. As shown in Table 5, the average correlation coefficients between the two in the post-crisis period are higher than that in the pre-crisis period.

**Table 5. Correlation between HK\$ HIBOR and US\$ LIBOR Volatility**

	Average Correlation Coefficient (HIBOR vs LIBOR)	
	1-month Rate	3-month Rate
Sample Period		
Full Sample	0.264	0.229
Pre-Crisis	0.230	0.167
Crisis	0.166	0.272
Post-Crisis	0.375	0.375

**Chart 11. Correlation between 3-month HK\$ HIBOR and US\$ LIBOR Volatility**

To summarise, volatility in Hong Kong stock and money markets moves increasingly closely with that in overseas financial markets. The higher degree of volatility synchronisation may stem from an increase in cross-border commercial linkages and the rapid movement in international capital flow.

## **VI. FINANCIAL MARKET VOLATILITY AND THE REAL ECONOMY**

Policy makers' primary concern about financial market volatility is its potential destabilising impact on real economic activity. As discussed in the introduction, the effect is transmitted through two major channels: the wealth effect on private consumption, and the balance sheet effects on both consumption and investment. In the existing literature, Hamilton and Lin (1996) find that volatility in the S&P500 index is useful for identifying and forecasting economic turning points. Also, Hu (1995) notes a strong negative association between stock market volatility and real investment in the US. These studies not only confirm a strong relationship between financial market volatility and real economic activity, but also the possible use of financial market volatility as a leading indicator of the economic cycle.

In this section, historical volatilities of Hong Kong financial markets are used to examine whether a similar relationship can be established with domestic economic activity. In particular, the possible use of financial market volatility in predicting economic cycles and activity, especially the growth of real GDP, real private consumption expenditure and real private investment is discussed.

*(a) Correlation between financial market volatility and economic activity*

To establish the association between financial market volatility and economic activity, correlation analyses are performed between financial market volatility in the current period and growths in real consumption, investment and GDP in the next period. Based on the results from Table 6, there appears to be a weak and negative correlation between financial market volatility and future economic activity.<sup>19</sup> That is, a more volatile financial market in the current period may be followed by a moderation in the growth of real economic activity in the next period, and vice versa. Apart from this relationship, a few findings from the table are worth noting.

**Table 6. Correlation between Financial Market Volatility and Growth of Real Variables**

	Market Volatility (in %, in preceding quarter)				
	Hang Seng Index	1-week HIBOR	2-year EFN		12-month Forward
			Yield change	Holding period return	
<b>Real GDP Growth</b>					
Pre-crisis	-0.102	0.224	-0.034	0.048	0.217
Crisis	-0.260	-0.491	-0.324	-0.265	-0.531
Post-crisis	-0.152	-0.147	-0.551	-0.595	-0.338
<b>Real Consumption Growth</b>					
Pre-crisis	-0.046	0.014	-0.125	-0.033	0.008
Crisis	-0.052	-0.602	-0.107	-0.052	-0.289
Post-crisis	0.007	-0.152	-0.662	-0.756	-0.259
<b>Real Investment Growth</b>					
Pre-crisis	-0.351	-0.163	-0.268	-0.320	-0.067
Crisis	-0.180	-0.889	-0.195	-0.153	-0.201
Post-crisis	-0.218	-0.322	-0.731	-0.737	-0.735

<sup>19</sup> Similar results are obtained for 3-month HIBOR, 1-month forward rate, as well as 10-year quasi-government bond yield.

First, stock market volatility is not highly correlated with changes in private consumption. In particular, during the crisis period, stock market volatility has little correlation with changes in private consumption. This result seems to suggest that private consumption is not much affected by stock market volatility. By contrast, there is strong evidence of a negative correlation between stock market volatility and changes in real investment as suggested by Hu (1995).

Secondly, the negative effect of the volatility of short-term interest rate on all real variables, particularly on the change in private investment, is relatively higher during the crisis period. The same observation, however, is not found in the volatility of long-term interest rate. During the crisis period, the negative correlation between the volatility of long-term interest rate and changes in real economic activity is not particularly strong. This outcome may imply that during crises, investors pay more attention to the variability of the short-term interest rate, while during other periods, it is the long-term rate that is a more important variable for investment and consumption decisions.

**(b) Business cycles and financial market volatility**

To further examine whether financial market volatility contains information on real GDP growth in the next quarter, a Granger causality test (Granger (1969)) is conducted.<sup>20</sup> Table 7 presents the test results under the null hypothesis that the average volatility in the respective financial market (in one-quarter lag) does not Granger-cause the real GDP growth.

**Table 7. Granger Causality Test of Financial Market Volatility on Real GDP Growth**

Financial Market Volatility (one-quarter lag)	F-statistics	P-value
Hang Seng Index	8.550*	0.004
3-month HIBOR	6.946*	0.010
10-year EFN		
Yield change	6.011*	0.023
Holding period return	5.554*	0.028
12-month Forward	5.051*	0.028

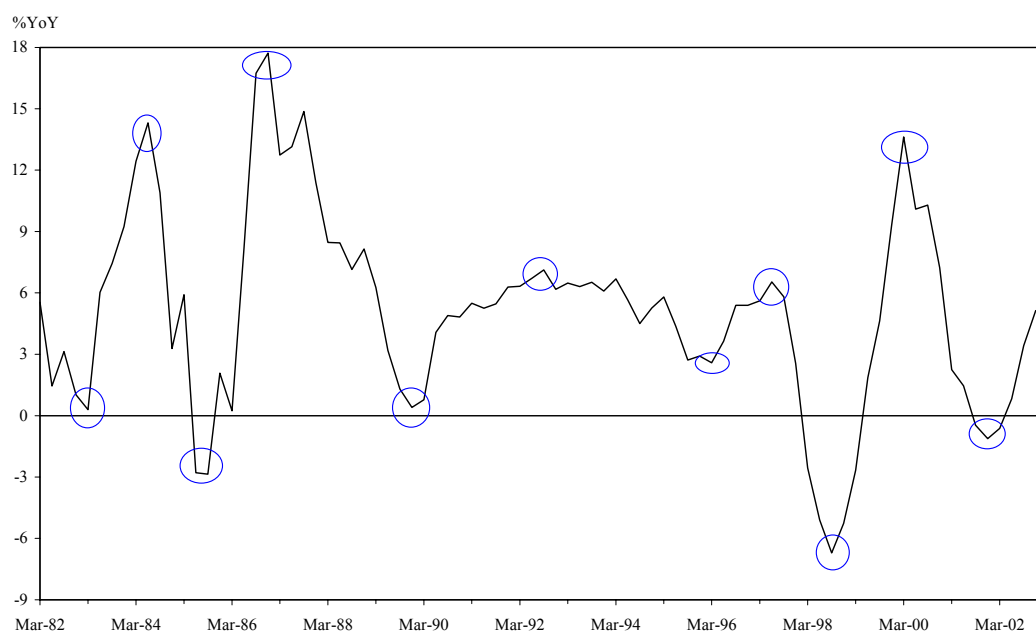
Note: \* indicates significance at 5% level.

<sup>20</sup> Broadly speaking, a variable X is said to Granger-cause a variable Y if the information in past X helps to improve the forecasts of the Y variable. In other words, Y is Granger-caused by X if it can be predicted more efficiently when the information in past X is taken into account in addition to the information of past Y variable.

The test results reject the null hypothesis, implying that current financial market volatility has a statistically significant effect on real GDP growth in the next quarter. In other words, the volatility in financial market contains information on future economic activity that is not already contained in current and past economic activity.

As an example to illustrate its potential use as a forward-looking indicator for economic activity, the magnitude of financial market volatility before an economic turning point is compared with the average volatility. For the period under study (March 1982 – March 2003), eleven economic turning points, including five peaks and six troughs of real GDP growth, are identified (Chart 12).<sup>21</sup> A t-test is applied to compare the average financial market volatility in the three months before these turning points against the overall financial market volatility in the rest of the period. Results in Table 8 show that in general, pre-peak financial market volatilities are significantly below their period averages, while the reverse is true for pre-trough financial market volatilities.<sup>22</sup> These results demonstrate that financial market volatility prior to an economic upswing and downswing is significantly different from the average.

**Chart 12. Hong Kong Real GDP Growth and Economic Turning Points**



<sup>21</sup> The five economic peaks are Q2 1984, Q3 1986, Q3 1992, Q2 1997 and Q1 2000. The six economic troughs are Q1 1983, Q3 1985, Q4 1989, Q1 1996, Q3 1998 and Q4 2001. These economic turning points are identified based on eye-balling the real GDP growth in Chart 12.

<sup>22</sup> 1-week HIBOR, 1-month forward rate, as well as 2-year quasi-government bond yield are tried. Their test results are similar to but less pronounced than those presented.

**Table 8. Financial Market Volatility and Economic Turning Points**

	Mean Volatility (in %)		
	Pre-Peak	Pre-Trough	Overall
Hang Seng Index	1.280*	1.892*	1.579
3-month HIBOR	0.195*	0.244	0.261
10-year EFN			
Yield changes	0.045*	0.092*	0.085
Holding period returns	0.321*	0.638	0.608
12-month Forward	0.110	0.124*	0.105

Notes: 1. The t-test checks whether the mean volatility in the pre-peak or the pre-trough period is significantly different from the mean volatility of the overall period.  
2. The overall period refers to the full sample period from Q2 1982 to Q1 2003, excluding all pre-peak and pre-trough periods.  
3. \* indicates significance at 5% level.

Overall, the analysis presented in this section is able to provide an indicative relationship between financial market volatility and real economic activity. The results support the use of information on financial market volatility as a tool to help policy makers forecast economic performance.

## VII. CONCLUSION

This study unfolds the characteristics and dynamics of volatility in Hong Kong financial markets and the linkages among them over the last two decades. Some important findings are worth reiterating here. First, the positive correlation between the return volatility of stock and quasi-government bond markets during crises and the lack of such relationship during normal times suggests that a diversified portfolio may mitigate risk at tranquil periods only. Secondly, the increased synchronisation of volatility of Hong Kong stock and money markets with overseas financial markets indicates a high volatility linkage probably through globalisation process. Finally, correlation analyses indicate the existence of negative correlation between financial market volatility and real economic activity. Financial market volatility contains information on future economic performance.

This study marks a first step to understand the characteristics and evolution of financial market volatility in Hong Kong. Findings of this study will be useful input to further studies in areas regarding the source of volatility, the role of macroeconomic developments in predicting volatility, and the issue of volatility spillover and contagion effect.



**References:**

- Bank for International Settlements (1996): *Financial Market Volatility: Measurement, Causes and Consequences*, BIS Conference Papers Vol. 1, March.
- Bernanke, B. S. and M. Gertler (1995): "Inside the Black Box: The Credit Channel of Monetary Policy Transmission", *Journal of Economic Perspectives* 9 (4), 27-48.
- Campbell J. Y., M. Lettau and B.G. Malkiel (2001): "Have Individual Stock Become More Volatile? An Empirical Exploration of Idiosyncratic Risk", *Journal of Finance* 56 (1), 1-43.
- Choe, H., R. W. Masulis and V. Nanda (1993): "Common Stock Offerings across the Business Cycle: Theory and Evidence", *Journal of Empirical Finance* 3-31.
- De Ceuster, M. J. K. and N. Valckx (2001): "Financial Market Volatility: Information in Predicting Recessions", Bank of Finland Discussion Paper 14.
- Granger, C. W. J. (1969): "Investigating Casual Relations by Econometric Models and Cross-Spectral Methods", *Econometrica*, 37, 424-438.
- Hamilton J. D. and G. Lin (1996): "Stock Market Volatility and the Business Cycle", *Journal of Applied Econometrics* 11 (5), 573-593.
- Hu, Z. (1995): "Stock Market Volatility and Corporate Investment", IMF Working Paper 95/102.
- Kortian T. and James O'Regan (1996): "Australian Financial Market Volatility: An Exploration of Cross-Country and Cross-Market Linkages", *Reserve Bank of Australia Research Discussion Paper 9609*.
- Shiller, R. J. (1979): "The Volatility of Long-Term Interest Rates and Expectations Models of the Term Structure", *Journal of Political Economy*, 87 (6), 1190-1219.
- Tang R. and F. Ho (2000): "Relationship between the Hong Kong and US Stock Markets", Hong Kong Monetary Authority Research Memorandum 13/2000.
- Tse Y. K. and Paul S. L. Yip (2001): "The Impacts of Hong Kong's Currency Board Reforms on the Interbank Market", *Singapore Management University and Nanyang Technological University Working Paper Series*.