INTERACTIONS OF THE STOCK MARKETS AMONG THE UNITED STATES, HONG KONG, TAIWAN AND CHINA

By

Dan Hao

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Name:	**Dan Hao**
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Examining Committee:

Chair: **Gordon Myers**

Ken Kasa
Senior Supervisor

Brian Krauth
Supervisor

Marie Rekkas
Internal Examiner

Date Approved: Friday, April 11, 2003

Title of Project *Interactions Of The Stock Markets Among The United States, Hong Kong, Taiwan And China*

Author:

dan Hao

ABSTRACT

Based on the fact that Hong Kong, Taiwan and the mainland of China share the same culture and they are close geometrically, given that all these three economies play more important roles in the world, this paper is to examine whether these factors help these three economies build a stable relationship in the long-run and how these three economies are affected by the U.S. as the business relationships among them get better. However, no cointegration is found by the Johansen test possibly due to the capital control policy. And the monthly data employed in this paper are responsible for the result of the Granger-Causality test that there is no causality among the stock markets of the U.S., Hong Kong, Taiwan and China, which is not consistent with our intuition. Finally, impulse response functions and the variance decomposition techniques are employed to study the degree to which a change in one country's stock index exerts an influence on a change in other countries' stock indices. We find that all the shocks are short-lived and the stock markets are most affected by their own innovations.

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I. INTRODUCTION

Since the stock market is a commonly used indicator of the economy, numerous studies have been done on the stock markets across countries. There has been a growing body of literature analyzing various issues related to market interdependence, international portfolio flows, stock market development, volatility and co-movement among emerging market stock returns. According to International Finance Corporation's (IFC) Emerging Markets Factbook, market capitalization of emerging stock markets increased from $110 billion in 1985 to $2.659 trillion in 2000. With the faster growth of the emerging markets, the importance of the emerging markets has already been recognized and more attention has been given to them.

Among all the emerging markets, the development of stock markets in the People's Republic of China (PRC) is exceptional. The commencement of Shanghai Stock Exchange in December 1990 announced the re-birth of the stock market in China, which closed in 1949. Soon after that, in April 1991, the Shenzhen stock Exchange opened. But one distinguishing characteristic of the stock markets in China is that there are two types of stocks traded in each of the two markets: class A shares and Class B shares. Class A shares are restricted to Chinese citizens and denominated in Chinese currency RMB, whereas Class B are settled in foreign currencies (US dollars for Shanghai, Hong Kong dollars for Shenzhen). Before February 19, 2001, Class B shares could only be bought and sold by foreigners, but it has opened to Chinese citizens since then. By January 2003, there were a total of 1229 companies listed on China's Stock Exchange.

The rapid expansion of the PRC markets reflects China's significant economic growth. With the on-going reform, business relationships between China and other countries or regions have gradually improved. China has large exports to the U.S. each year. In Asia, China has a closer relationship with Hong Kong, especially after the return of Hong Kong on July 1, 1997. With the official permissions of both the authorities of China and Taiwan, more and more Taiwan companies invest in the mainland of China, which means a stronger business relationship is building up between them.

It is to be noted that these three markets have begun to play more important roles in the world economy. The share of China in the market capitalization and trade volume in the entire emerging market increased by over 10 percentage points within ten years in the 1990s. The Taiwan market accounts for 13% and 45% in terms of market capitalization and trade volume in the emerging market. The Hong Kong market has a share of approximately 2% of the developed markets in both market capitalization and trade volume. Altogether, the three markets account for about 3% to 4% in terms of world market capitalization value, and 5.3% to 11% in world trade volume. (See Huang et al 2000)

Since all these three economies adopt export-led policies and trading is active among them, and given that all three share the same language and the same culture and are close geographically, can these factors help them to build a stable long-run relationship? How are these three economies affected by the U.S. as the relationships among them get better and better? These are the questions this paper addresses.

Section II presents an overview of literature that has focused on similar topics. Section III discusses the nature of data used in my analysis. The formal statistical tests for unit roots, cointegration, causality, and impulse response functions are presented in Section IV. A conclusion is given in the last section.

II. LITERATURE REVIEW

Bailei (1994), Ma (1996) and Su and Heisher (1997) analyzed the markets in China. Wei et al (1995), Hu et al (1997) and Choudhry (1997) addressed the cointegration relationship among different markets.

Choudhry (1997), for example, looks at long-run trends in Latin American stock prices and finds that the stock indices in the "emerging markets" of Argentina, Brazil, Chile, Mexico and Venezuela are cointegrated with an American stock index. His Johansen tests consistently reject the null of zero cointegrating equations, whether the American index was included in the analysis or not. The result is explained by the fact that the stock indices in various countries can be expected to have significant long-run relationships due to close economic ties and policy coordination (among other factors). Based on cultural and linguistic similarity, can these three economies overcome the differences in their economic systems? This is the question the paper will address.

Losq (1987), Bekaert and Harvery (1995) conducted studies on the equity market integration and segmentation. They applied statistical methods to study the time-varying cointegration of different equity markets.

The method of Granger-Causality tests is often used. Wei et al (1995) tested the conventional wisdom that short-term volatility and price changes spill over from developed to emerging markets, but not vice versa by the Granger-Causality tests. Yang and Lim (2001) employed the Granger-causality test on several East Asian stock indices to investigate whether one stock return Granger-Causes the other stock return in the short-term. And they concluded that the Taiwan stock market is independent of other Asian markets of interest due to the high degree of capital controls. Similarly, to address the short-term interaction among the three economies I am interested in, the Granger-Causality test will be employed to check if there is any causal relationship between any two of the three economies, and between any one of the three economies and the U.S. economy.

The impulse response function is widely used when investigating the interdependence among markets. For example, Eun and Shim (1989) estimated the impulse response functions for a 9-country model to test for multilateral interactions. They found that innovations from the U.S. market are rapidly transmitted abroad, but the innovations abroad do not significantly impact U.S. stock returns. Joen and Von Furstenberg (1990) also analyzed interactions among the markets of U.S., Britain, Japan and Germany using impulse response functions. Yang and Lim (2001) used impulse response functions to analyze the interdependence among several East Asian stock markets. The similar issue, interactions among US, Hong Kong, Taiwan and China, will be investigated by estimating impulse response functions from a Vector Autoregresssion (VAR) model.

III. THE DATA

The variables of interest in this paper are the monthly closing values of the following indices:

i) the Dow Jones Industrial Average for U.S. (DOWLOG);

ii) the Hang Seng Index of Hong Kong (HSILOG);

iii) the Taiwan Weighted Volume Index of Taiwan (TWLOG);

iv) the Shanghai Index (Class A shares) or Shenzhen Index (Class A shares) (SHLOG or SZLOG).

The data are from October 1992 to January 2003 and are readily available from the several websites, including Yahoo! Finance, the Federal Reserve and the Securities Information Broadcasting. Divided by the U.S. consumer price index the Dow Jones Index has been adjusted into the real term. Divided by the corresponding exchange rate and then the U.S. consumer price index all other indices have been adjusted into real terms. Since direct comparisons of the index values are relatively uninformative, financial data is often logged. Therefore, all the variables in this paper are in the logarithmic form.

The monthly percentage change of the stock index is calculated using the conventional first difference of logarithmic form as follows:

$$\Delta x_{t,i} = (x_{t,i} - x_{t-1,i})$$

where $\Delta x_{t,i}$ is the percentage change of the stock index for the ith market on the day t and $x_{t,i}$ is the logarithmic form of the corresponding stock index in real term. Table 1 shows the basic statistics.

Table 1
Basic statistics

	DDOW	DHS1	DTW	DSH	DSZ
Mean	0.005422	-0.005995	-0.001920	0.003859	-0.000251
Median	0.012071	-0.006729	-0.008960	-0.001873	-0.004436
Maximum	0.099136	0.345350	0.343581	0.901733	0.535647
Minimum	-0.165295	-0.267169	-0.262023	-0.479015	-0.590376
Std. Dev	0.045997	0.088220	0.097065	0.152345	0.131833

It should be noted that here the Class A shares of Shanghai Index and Shenzhen Index will be used rather than Class B shares. Table 2 below presents the number of listed companies for recent years.

Table 2
Numbers of Listed companies (China)

ii	A or B Share Listed Companies	B shares	A Shares Only	B Shares Only	A&B Shares
200001	955	108	828	26	82
200101	1100	114	966	27	87
200201	1164	112	1026	24	88
200301	1229	111	1089	24	87

Source: http://www.csrc.gov.cn/.

Comparing the Class A shares with Class B shares in terms of the number of listed companies, the trade volume and market capitalization, I can find that Class A shares dominates Class B shares. Before the Class B shares opens to Chinese, foreign investors had already lost their appeals to Class B shares. This is one of the reasons that the government of China decided to open the Class B shares to Chinese in 2001. However, since the exchange rate in China is still heavily controlled by the government and people cannot get exchange freely from the banks according to the official exchange rate, the amount of U.S. dollars and the amount of Hong Kong dollars flowing into the stock markets, which are required in the trades for Class B shares in Shanghai Stock Exchange and Shenzhen Stock Exchange, are quite limited relatively. The policy of opening Class B shares to Chinese actually is compromised by the exchange rate policy in China. Based on the discussion above, I conclude that Class A shares are more representative of the Chinese economy.

IV. EMPIRICAL ANALYSIS

This empirical analysis starts with a basic question: how integrated are these stock markets? The first step to address this question is to test the property of the stock indices series. The Augmented Dickey-Fuller test will be used here. Based on the non-stationary property of the series of interest, I can then do the Johansen cointegration test to check if there is any long-run cointegrating relationship among these stock markets. Another question that will be addressed will be the directions of the causality among these stock markets. The Granger-Causality test will be adopted to determine the temporal ordering of each pair of stock markets in question. To take the study one step further, a vector autoregressive (VAR) model will be employed. The question of concern here is the degree to which a change in one country's stock index exerts an influence on a change in other countries' stock indices series. The technique in the VAR model will be test the proportion of the movements in the stock index that is due to its own shock, versus those originating from other markets.

1. Unit Root Tests:

The unit root issue arises in the presence of non-stationary variables. The major problem associated with regression of non-stationary variables is the potential for spurious regressions. (See Granger and Newbold 1974) Therefore, to avoid the problem of spurious regressions, it is necessary to test the order of integration of each variable in a model, in order to establish whether it is non-stationary and how many times the variables need to be differenced such that a stationary series can be recovered.

The conventional Augmented Dickey-Fuller (ADF) test will be adopted in this paper first. However, several details should be paid attention to given the nature of the data in this study.

Figure 1

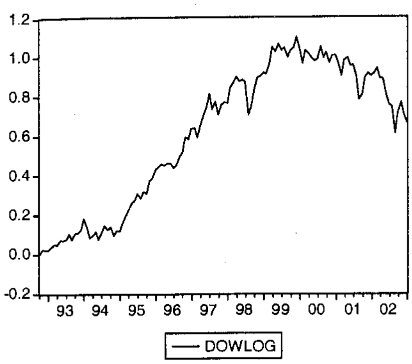


Figure 2

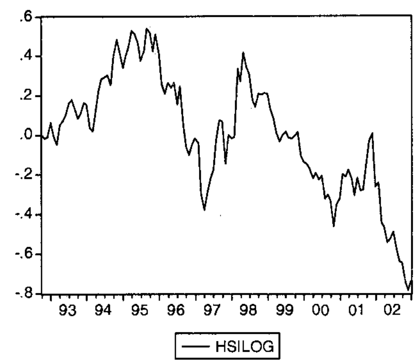
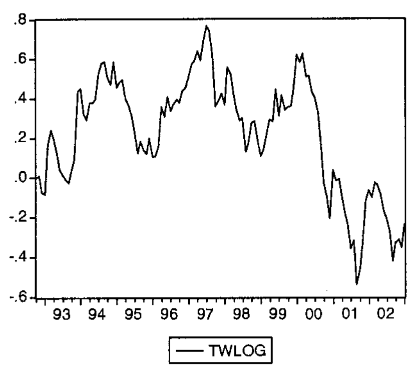


Figure 3



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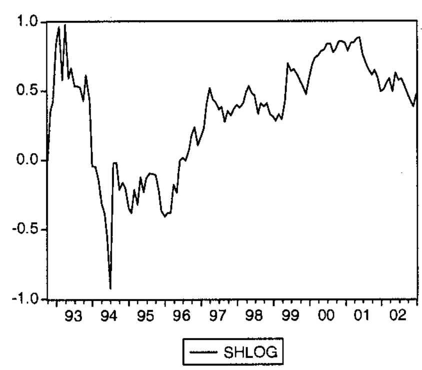

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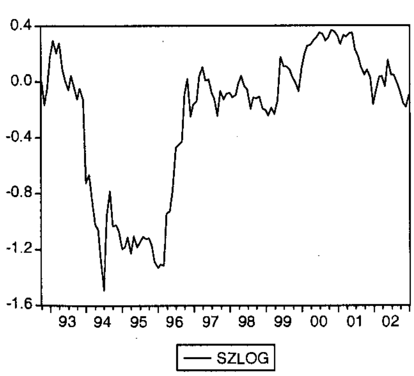


A variable's unit root test must be specified in accordance with the nature of the data. An investigation of our stock market data, shows that these series have a non-zero mean and a linear deterministic trend over time. Therefore, these features of the data should be built into the unit root tests. A constant term and a time variable are required in order to capture the above features.

The result of the unit root test depends on the assumed lag structure. Therefore, it is important that the unit root tests are performed with the appropriate lag structure. Several criteria can be used to determine the appropriate number of lags. In this paper, the number of lags is determined by minimizing the Schwarz Information Criterion (SIC).

The regression equation that is used for the unit root tests is specified as Equation 1 below:

$$\Delta x_t = \alpha + \beta T + \rho X_{t-1} + \sum_{i=1}^{k} \theta_i \Delta x_{t-i} + \varepsilon_t \qquad [1]$$

Based on this equation, the ADF statistics are computed under the null of the presence of a unit root. Elder and Kennedy (2001) indicate that the appropriate alternative hypothesis is that there is no unit root but a time trend exists.

The results of the ADF test show that the null hypothesis of a unit root cannot be rejected at the 5% level, which indicates the presence of a unit root in all the series. And there is no evidence to support the presence of a unit root in the first differences of all the series; hence, changes in the stock indices are stationary. In other words, all the stock index series are integrated of order one, I (1). Table 3 presents the results.

Table 3
Results of Unit Root Tests (Augmented Dickey-Fuller Test)

Series	ADF stat (level)	5% critical value	ADF stat (1st difference)	5% critical value
DOWLOG	-0.116574	-3.446765	-12.09458	-3.447072
TWLOG	-2.278744	-3.446765	-10.18688	-3.447072
HKLOG	-2.264730	-3.446765	-11.02504	-3.447072
SHLOG	-2.545245	-3.446765	-13.35613	-3.447072
SZLOG	-1.942511	-3.446765	-10.68831	-3.447072

The Phillips-Perron tests were also employed here and the same results as the ADF tests I obtained. The above results are consistent with the weak-form efficient market hypothesis. The weak-form efficiency hypothesis asserts that all past market prices and data are fully reflected in securities prices. In other words, technical analysis is of no use. The EMH also implies the stock market corresponds to a fair game to risk neutral investors. Since the coefficient for the lag variable is not significant, we cannot reject the random walk, which means that price movements will not follow any patterns and that past price movements cannot be used to predict future price movements.

Since all the data series are non-stationary and integrated of the same order, I can proceed to test if there is any cointegrating relationship among these data series.

2. Cointegration Tests:

In the study, the Johansen test is employed to test the long-run relationship among the stock indices. If two or more stock indices are found to be cointegrated, it implies that there is a long-run equilibrium relationship between them, and even though the stock index series themselves may be non-stationary they will nevertheless move closely together over time.

The Johansen test is performed under the null hypothesis that *n* cointegrating relationships exist. The critical values for the trace statistics and max-eigenvalue tests are provided by the computer software.

At the beginning of the paper, I mentioned about the culture and the linguistic similarity among the economies of Hong Kong, Taiwan and China and the close geographical proximity among them. I have reason to doubt if there is any long-run relationship among these three economies. Therefore, the Johansen test is adopted to find the answer to the question above. And here the Shanghai Index is used as the data for China.

Table 4
Results of the Johansen Test

Hypothesized No.of CE(s)	Trace Statistic	1% Critical Value	Max-Eigen Statistic	1% Critical Value
None	30.86	48.45	16.38	30.34
At most 1	14.47	30.45	7.80	23.65
At most 2	6.68	16.26	6.68	16.26

This study finds no evidence of cointegration among these three stock indices. In other words, there is no long-run equilibrium trending relationship among these three stock markets.

With the development of these three economies, all these three economies have closer ties with the U.S., which is the most important economy in the world and an important trade partner of these three economies. Whether these three economies will have a long-run equilibrium relationship with the U.S. market will be addressed then in case that the result of no cointegration among Hong Kong, Taiwan and China is spurious since I omitted an important variable, the stock index of the U.S. Therefore, I use the Johansen test again to test if there is any cointegration among the stock indices of U.S., Hong Kong, Taiwan and China. However, no cointegration can be found from Table 5.

Table 5
Results of the Johansen Test

Hypothesized No.of CE(s)	Trace Statistic	1% Critical Value	Max-Eigen Statistic	1% Critical Value
None	48.46	70.05	26.84	36.65
At most 1	31.62	48.45	15.17	30.34
At most 2	16.46	30.45	8.69	23.65
At most 3	7.77	16.26	7.77	16.26

The same conclusion for the cointegration test will be made if I use the Shenzhen index rather than the shanghai index. The result above shows that there is no cointegrating relationship among these four economies. I am not surprised to get such a result since Taiwan and China have varying degree of restrictions on the capital movements (Wei et al., 1995). The central bank in China has the absolute power to control the foreign exchange. And there was a large space for the government in China to adopt policies to stimulate the domestic demand in the early 1990s. Although the export-led policy was adopted, the domestic demand dominates. In other words, the economic atmosphere abroad is not easy to exert instantaneous and severe impact on the stock market in China. The central bank of Taiwan also has heavy influence on the foreign exchange although the influence is less than China. Some empirical studies have argued that the capital control actually helped Taiwan avoid a severe hit in the East Asian Financial Crisis. All the discussions above offer the explanations for the result of the cointegration tests.

3. Granger-Causality Tests:

It is also informative to know which of our four stock indices is causing changes in the others. A common test of this, under the null hypothesis that one series does not "cause" another, is known as Granger-Causality. I will test for all the directions of causality.

The method of Granger-Causality test involves estimating the following equations:

$$\Delta X_t = a + \sum_{i=1}^{k} b_i \Delta X_{t-i} + \sum_{i=1}^{k} c_i \Delta Y_{t-i} + \varepsilon_t$$

$$\Delta Y_t = a' + \sum_{i=1}^{k} b_i' \Delta X_{t-i} + \sum_{i=1}^{k} c'_i \Delta Y_{t-i} + \varepsilon'_t$$

where ΔX_t and ΔY_t denote monthly stock returns of two countries as defined in Section III and ε_t and ε'_t are random disturbance terms. When the null hypothesis that $c_1 = c_2 = \cdots c_k = 0$ is retained, it suggests Y_t does not Granger-cause X_t. Otherwise, I say Y_t does Granger-cause X_t. In our case, the unit root tests already show that the first differences of the variables, which is defined as the stock returns, are stationary. Briefly, the Granger-Causality test consists of running regression of one stock return on its own lagged values and on other stock returns. Hence, if the lagged values of one stock return do not yield a statistically significant relationship, then it can be stated that the stock return does not Granger-Cause the other stock return.

The Schwarz Information Criterion is employed in the bivariate VAR model above and in all cases the optimal number of lag is one. The results of this test are presented in Table 6.

Table 6
Results of Granger-Causality Tests

Null Hypothesis:	F-Statistic	Probability
DHSI does not Granger Cause DDOW	1.07264	0.30245
DDOW does not Granger Cause DHSI	0.00704	0.93325
DSH does not Granger Cause DDOW	0.03923	0.84334
DDOW does not Granger Cause DSH	0.81138	0.36953
DTW does not Granger Cause DDOW	0.12057	0.72903
DDOW does not Granger Cause DTW	0.53690	0.46516
DSH does not Granger Cause DHSI	0.63280	0.42791
DHSI does not Granger Cause DSH	0.97611	0.32517
DTW does not Granger Cause DHSI	0.24052	0.62474
DHSI does not Granger Cause DTW	0.02101	0.88501
DTW does not Granger Cause DSH	0.86447	0.35437
DSH does not Granger Cause DTW	0.47209	0.49336

The results above show that no causality exists among those stock markets. The results are not consistent with our intuition. Since the Hong Kong dollar has been pegged to the U.S. dollar since 1983, the movement of the U.S. market should have an immediate spillover effect to Hong Kong if the U.S. market movement is to reflect the expected change in the interest rate in the U.S. (See Connolly and Wang, 1995) To Taiwan, as I know many of Taiwan's high-tech firms are invested by the U.S. companies. And these Taiwan high-tech firms are listed on the Taiwan stock exchange. Therefore, I have good reason to expect that the U.S. should lead the Hong Kong and Taiwan markets. Our results are not consistent with those found by Wei et al (1995) and Huang et al (2000). For example, Huang (2000) found that the U.S. market led both the Hong Kong and Taiwan markets by one day in terms of price changes. I think the reason here could be that the daily data were used in their study, which is more frequent than the data I use in this paper. Since there is only one-day causality and the stock prices change so quickly, it is no wonder that I cannot capture any causality relationships among those markets by using the monthly data, which will not reflect the day-to-day continuous change patterns among these stock indices.

4. Impulse Response Functions:

Using a Vector Autoregressive (VAR) model, this section analyzes the degree to which a change in one country's stock index series exerts an influence on a change in other countries' stock indices series and the time path of the latter. This VAR model examines the dynamic structure of stock price developments. In other words, the study looks at the effect that a shock (through an innovation or news) in one stock market has on others.

A VAR representation is a system in which each equation has identical right-hand-side variables, and the right-hand-side includes lagged value of all the endogenous variables (Sims, 1980). Consider a pth-order vector autoregressive model:

$$Y_t = A + B_1 Y_{t-1} + B_2 Y_{t-2} + \cdots + B_p Y_{t-p} + E_t$$

where the block letter indicates that it is a vector or a matrix. The above equation can be written in vector MA (∞) form as,

$$Y_t = u + E_t + \eta_1 E_{t-1} + \eta_2 E_{t-2} + \cdots$$

Because the complicated feedbacks, VAR advocates claim that autoregressive systems like these are difficult to describe adequately by just looking at the coefficient estimates or computing long-run equilibrium behaviour. Therefore, they recommend postulating a shock or innovation to one of the elements of E_t and using this equation to trace out the response of the variable over time in the Y vector. (Kennedy, 2001) The matrix η_i can be interpreted as follows:

$$\partial Y_{t+s} / \partial E_t = \eta_s$$

The element of η_s identifies the consequences of a one-unit increase in the variable's innovations at the time t for the value of the variable Y at time (t+s), holding all other innovations at all dates constant. Thus, a plot of the element of η_s as a function of s is called the impulse response function. Plotting the impulse response function is a practical way to visually represent the behaviour of one variable in response to the shock from another variable.

The same data set described earlier will be used. The percentage change in the stock index will be used. The application of unrestricted VAR in first difference is appropriate for this case based on the earlier conclusion that all of the stock index series in this study are found to be I (1) and no cointegrating relationship exists.

With a VAR representation, I have to determine the number of lags that are needed to capture most of the effects that the exogenous variables have on the endogenous variables. Generally, the VAR equation should be estimated with the appropriate lags using the Schwarz Information Criterion (SIC). If so, the optimal number of lags in our case will be one. However, to avoid the possibility of omitting important effects at longer lags, I perform the analysis using six lags in the VAR model. The results of the impulse response function are presented in appendix 4.

The decomposition variance technique is applied following that. Variance decomposition provides a different method of depicting the system dynamics. Impulse response functions trace the effects of a shock to an endogenous variable on the variables in the VAR. By contrast, variance decomposition decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. The variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR. The variance decomposition results, which provide the decomposition of 1-month to 15-month ahead forecasts of stock market returns into fractions that are accounted for by innovations in different markets, are presented in Appendix 4.

Appendix 4 shows the time paths or impulse responses. It appears from these figures that, eventually, all time paths resulting from the impulse response coefficients converge to zero. In other words, I find that all shocks tend to be short-lived in all stock markets. Also I can find that the stock market is affected by its own shock most.

One interesting finding here is that Taiwan responds most to the shock in the U.S. compared with Hong Kong and China. This finding is consistent with the results found by Wei et al (1995). They found that the Taiwanese market is more sensitive than the Hong Kong market to the price and volatility behaviour of the advanced markets even though Taiwan is not as open as Hong Kong and the Taiwanese dollar is not linked to the U.S. dollar while the Hong Kong dollar is.

Taiwan has large export volume to the U.S. every year, of which a large proportion are electronic products. The capital control in Taiwan actually prevents the speculative trading funds flowing into Taiwan stock market but the foreign investments in high-tech industry are large. A large share of the high-tech production firms in Taiwan is invested by the U.S. companies as I mentioned earlier. These high technology stocks accounts for between 50% and 60% of the total market capitalization in Taiwan. (See Huang 2000) Therefore, I can see that the shock from the U.S. has channel to have large effect on the stock market in Taiwan through the change in the real production sector.

It seems that the shock in the U.S. market almost has no effect on the stock market in China at the first period. It is reasonable since I know China has the most severe capital control and a much larger domestic market. Therefore, any shock reflecting the change of the domestic fundamental of the U.S. will not transmit to the stock market in China immediately. However, it takes time to affect China to some extent by the gradual change in China's export, etc.

I can observe that the Taiwan stock market has moderate response to the Hong Kong stock market. China's stock market also responds to the Hong Kong market and Taiwan market within a reasonable range. The capital control from Taiwan and the mainland of China also can explain the above results. Since China's companies have no permission from the authority of Taiwan to invest in Taiwan and capital control policy from both sides, I don't expect a large effect from China stock market to Taiwan stock market.

V. CONCLUSION

Based on the empirical test results and analysis above, I find out that the stock indices in this study follow a random walk, which is consistent with the weak-form efficient market hypothesis. Although Hong Kong, Taiwan and the mainland of China share the same culture, the same language and they are geographically close to each other, there is no stable long-run relationship among their stock markets. Since monthly data are employed in this paper, which eliminates the instantaneous change in the stock indices, I cannot find any causality among the stock market of U.S. and the above three economies. The impulse response functions show that all the shocks are short-lived and the stock markets are most affected by their own innovations. I also notice that Taiwan responds most to U.S. shocks among these three economies. This finding is consistent with the results found by Wei et al (1995). The fact that high technology stocks account for a large share of the total market capitalization in Taiwan might explain this result.

In Asia, the Japanese economy has an important impact on other countries. In future research, whether there is a long-run relationship among Hong Kong, Taiwan, China and Japan should be examined by the Johansen test in case I have omitted an important relevant variable.

In future research, since changes in stock indices are usually very rapid, a longer time-span of data with higher frequency should be employed, which will be more favourable to finding the correct causality relationships by the Granger-Causality test. In this paper, I ignore the existence of the structural breaks. For example, the East Asia Financial Crisis may be responsible for a structural break for Hang Seng Index. Similarly, The burst of the American high-tech bubble could lead to a structural break for Dow Jones Industrial Average Index. In future work, the potential existence of structural breaks should be considered when doing the unit root tests and the cointegration tests.

Appendix 1 Unit Root Tests

DOWLOG:

ADF in level

Null Hypothesis: DOWLOG has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.116574	0.9941
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

ADF in 1st difference

Null Hypothesis: D(DOWLOG) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.09458	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

PP test in level

Null Hypothesis: DOWLOG has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 12 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.584373	0.9994
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

PP in 1st difference

Null Hypothesis: D(DOWLOG) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 11 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.52789	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

TWLOG

ADF in level

Null Hypothesis: TWLOG has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.278744	0.4419
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

ADF in 1^{st} difference

Null Hypothesis: D(TWLOG) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.18688	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

PP in level

Null Hypothesis: TWLOG has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.418672	0.3682
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

PP in 1^{st} difference

Null Hypothesis: D(TWLOG) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 7 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.14627	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

HSILOG

ADF in level

Null Hypothesis: HSILOG has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.264730	0.4496
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

ADF in 1st difference

Null Hypothesis: D(HSILOG) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.02504	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

PP in level

Null Hypothesis: HSILOG has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 6 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.153279	0.5108
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

PP in 1st difference

Null Hypothesis: D(HSILOG) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 12 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-11.07037	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

SHLOG:

ADF in level

Null Hypothesis: SHLOG has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.545245	0.3062
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

ADF in 1st difference

Null Hypothesis: D(SHLOG) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.35613	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

PP in level

Null Hypothesis: SHLOG has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.396794	0.3794
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

PP in 1st difference

Null Hypothesis: D(SHLOG) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-13.41947	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

SZLOG:

ADF in level

Null Hypothesis: SZLOG has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.942511	0.6262
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

ADF in 1st difference

Null Hypothesis: D(SZLOG) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.68831	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

PP in level

Null Hypothesis: SZLOG has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.053767	0.5659
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

PP in 1st difference

Null Hypothesis: D(SZLOG) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.71066	0.0000
Test critical values:	1% level	-4.034997	
	5% level	-3.447072	
	10% level	-3.148578	

Appendix 2 Cointegration Tests

Three variables: Hong Kong, Taiwan and China(shanghai index)
Date: 03/06/03 Time: 20:30
Sample(adjusted): 1993:02 2003:01
Included observations: 120 after adjusting endpoints
Trend assumption: Linear deterministic trend (restricted)
Series: HSILOG SHLOG TWLOG
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.127628	30.85835	42.44	48.45
At most 1	0.062916	14.47369	25.32	30.45
At most 2	0.054113	6.675848	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates no cointegration at both 5% and 1% levels

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.127628	16.38466	25.54	30.34
At most 1	0.062916	7.797846	18.96	23.65
At most 2	0.054113	6.675848	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates no cointegration at both 5% and 1% levels

Four variables: U.S., Hong Kong, Taiwan and China
Date: 03/06/03 Time: 20:20
Sample(adjusted): 1993:02 2003:01
Included observations: 120 after adjusting endpoints
Trend assumption: Linear deterministic trend (restricted)
Series: DOWLOG HSILOG SHLOG TWLOG
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.200412	58.46389	62.99	70.05
At most 1	0.118729	31.62477	42.44	48.45
At most 2	0.069855	16.45792	25.32	30.45
At most 3	0.062684	7.768162	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5%(1%) level

Trace test indicates no cointegration at both 5% and 1% levels

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.200412	26.83911	31.46	36.65
At most 1	0.118729	15.16685	25.54	30.34
At most 2	0.069855	8.689757	18.96	23.65
At most 3	0.062684	7.768162	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates no cointegration at both 5% and 1% levels

Three variables: Hong Kong, Taiwan and China (Shenzhen index)
Date: 03/09/03 Time: 21:23
Sample(adjusted): 1993:02 2003:01
Included observations: 120 after adjusting endpoints
Trend assumption: Linear deterministic trend (restricted)
Series: HSILOG TWLOG SZLOG
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.115419	26.90190	42.44	48.45
At most 1	0.066050	12.18500	25.32	30.45
At most 2	0.032664	3.985122	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates no cointegration at both 5% and 1% levels

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.115419	14.71690	25.54	30.34
At most 1	0.066050	8.199880	18.96	23.65
At most 2	0.032664	3.985122	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates no cointegration at both 5% and 1% levels

Four variables: U.S., Hong Kong, Taiwan and China (Shenzhen index)
Date: 03/09/03 Time: 21:24
Sample(adjusted): 1993:02 2003:01
Included observations: 120 after adjusting endpoints
Trend assumption: Linear deterministic trend (restricted)
Series: DOWLOG HSILOG TWLOG SZLOG
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.171419	53.97407	62.99	70.05
At most 1	0.118898	31.40917	42.44	48.45
At most 2	0.068370	16.21930	25.32	30.45
At most 3	0.062315	7.720955	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates no cointegration at both 5% and 1% levels

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.171419	22.56491	31.46	36.65
At most 1	0.118898	15.18987	25.54	30.34
At most 2	0.068370	8.498341	18.96	23.65
At most 3	0.062315	7.720955	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates no cointegration at both 5% and 1% levels

Appendix 3 Granger-Causality Tests

Pairwise Granger Causality Tests
Date: 03/06/03 Time: 21:31
Sample: 1992:10 2003:01
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
DHSI does not Granger Cause DDOW	122	1.07264	0.30245
DDOW does not Granger Cause DHSI		0.00704	0.93325
DSH does not Granger Cause DDOW	122	0.03923	0.84334
DDOW does not Granger Cause DSH		0.81138	0.36953
DTW does not Granger Cause DDOW	122	0.12057	0.72903
DDOW does not Granger Cause DTW		0.53690	0.46516
DSH does not Granger Cause DHSI	122	0.63280	0.42791
DHSI does not Granger Cause DSH		0.97611	0.32517
DTW does not Granger Cause DHSI	122	0.24052	0.62474
DHSI does not Granger Cause DTW		0.02101	0.88501
DTW does not Granger Cause DSH	122	0.86447	0.35437
DSH does not Granger Cause DTW		0.47209	0.49336

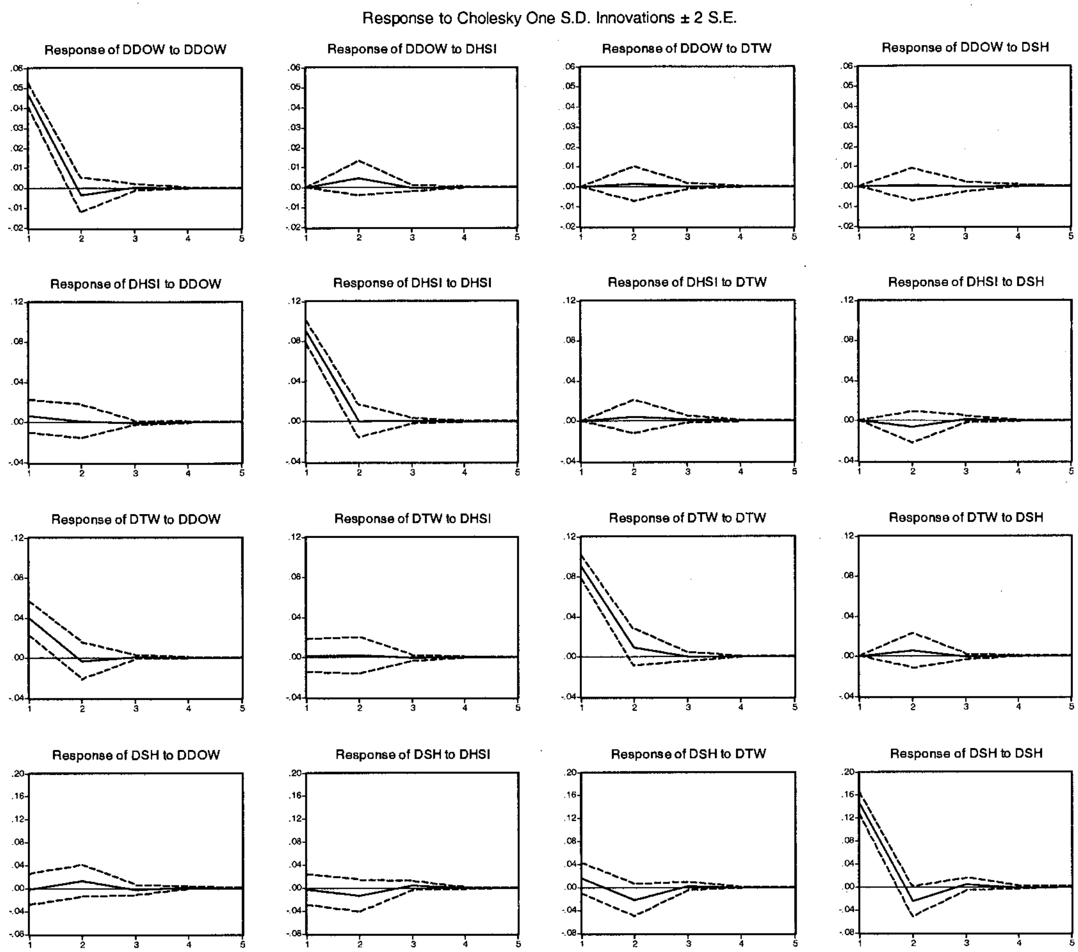
Appendix 4 Impulse Response Functions

VAR with 1 lag

Vector Autoregression Estimates
Date: 03/06/03 Time: 20:52
Sample(adjusted): 1992:12 2003:01
Included observations: 122 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

	DDOW	DHSI	DTW	DSH
DDOW(-1)	-0.095713	-0.032857	-0.152265	0.478339
	(0.10160)	(0.19574)	(0.21479)	(0.32088)
	[-0.94206]	[-0.16786]	[-0.70890]	[1.49069]
DHSI(-1)	0.049327	0.001292	0.020193	-0.158714
	(0.04799)	(0.09247)	(0.10146)	(0.15158)
	[1.02777]	[0.01397]	[0.19901]	[-1.04706]
DTW(-1)	0.015653	0.051527	0.097074	-0.219293
	(0.04824)	(0.09293)	(0.10198)	(0.15235)
	[0.32450]	[0.55446]	[0.95192]	[-1.43944]
DSH(-1)	0.005245	-0.044175	0.038398	-0.170539
	(0.02779)	(0.05353)	(0.05874)	(0.08775)
	[0.18878]	[-0.82522]	[0.65369]	[-1.94339]
C	0.006180	-0.005414	-0.000821	-0.002890
	(0.00428)	(0.00825)	(0.00905)	(0.01353)
	[1.44311]	[-0.65623]	[-0.09065]	[-0.21366]
R-squared	0.015807	0.007949	0.013337	0.065602
Adj. R-squared	-0.017840	-0.025967	-0.020395	0.033657
Sum sq. resids	0.253737	0.941815	1.134033	2.530972
S.E. equation	0.046569	0.089720	0.098451	0.147079
F-statistic	0.469788	0.234380	0.395388	2.053569
Log likelihood	203.5937	123.5915	112.2622	63.28999
Akaike AIC	-3.255635	-1.944124	-1.758396	-0.955574
Schwarz SC	-3.140716	-1.829205	-1.643477	-0.840655
Mean dependent	0.005280	-0.005902	-0.001992	0.000998
S.D. dependent	0.046159	0.088577	0.097462	0.149618

Determinant Residual Covariance	3.02E-09
Log Likelihood (d.f. adjusted)	504.2553
Akaike Information Criteria	-7.938611
Schwarz Criteria	-7.478936



VAR with 6 lags

Vector Autoregression Estimates
Date: 03/08/03 Time: 15:46
Sample(adjusted): 1993:05 2003:01
Included observations: 117 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

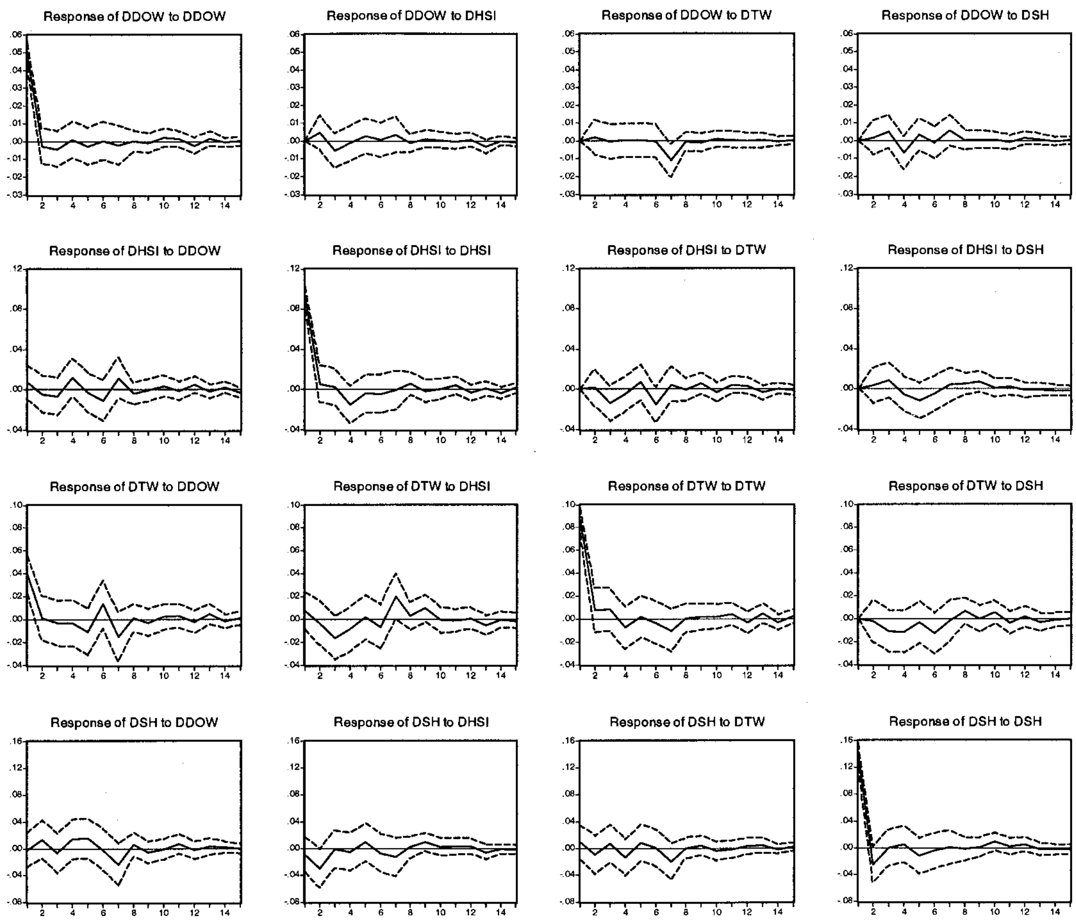
	DDOW	DHSI	DTW	DSH
DDOW(-1)	-0.077916	-0.117006	-0.044973	0.404785
	(0.11178)	(0.20876)	(0.21854)	(0.31760)
	[-0.69704]	[-0.56048]	[-0.20578]	[1.27452]
DDOW(-2)	-0.074269	-0.020122	-0.124769	-0.147957
	(0.11299)	(0.21101)	(0.22090)	(0.32103)
	[-0.65733]	[-0.09536]	[-0.56481]	[-0.46089]

DDOW(-3)	-0.013325	0.271849	0.017571	0.397887
	(0.11312)	(0.21127)	(0.22117)	(0.32141)
	[-0.11780]	[1.28676]	[0.07945]	[1.23793]
DDOW(-4)	-0.064035	-0.161438	-0.227910	0.383795
	(0.11406)	(0.21302)	(0.22301)	(0.32408)
	[-0.56140]	[-0.75785]	[-1.02199]	[1.18425]
DDOW(-5)	-0.003211	-0.091194	0.367817	0.065588
	(0.11885)	(0.22196)	(0.23236)	(0.33768)
	[-0.02701]	[-0.41086]	[1.58296]	[0.19423]
DDOW(-6)	0.054613	0.190784	-0.176335	-0.240651
	(0.12008)	(0.22426)	(0.23477)	(0.34118)
	[0.45480]	[0.85072]	[-0.75109]	[-0.70535]
DHSI(-1)	0.051896	0.058855	-0.049567	-0.344816
	(0.05422)	(0.10126)	(0.10600)	(0.15405)
	[0.95716]	[0.58124]	[-0.46759]	[-2.23834]
DHSI(-2)	-0.049566	0.054001	-0.195300	-0.084867
	(0.05375)	(0.10039)	(0.10509)	(0.15272)
	[-0.92212]	[0.53793]	[-1.85838]	[-0.55569]
DHSI(-3)	-0.003482	-0.162495	-0.086910	-0.019752
	(0.05439)	(0.10157)	(0.10633)	(0.15453)
	[-0.06402]	[-1.59981]	[-0.81735]	[-0.12782]
DHSI(-4)	0.026253	-0.104258	0.003925	0.010108
	(0.05404)	(0.10093)	(0.10566)	(0.15355)
	[0.48578]	[-1.03298]	[0.03715]	[0.06583]
DHSI(-5)	0.012662	-0.042704	-0.124031	-0.168252
	(0.05327)	(0.09949)	(0.10416)	(0.15137)
	[0.23767]	[-0.42921]	[-1.19080]	[-1.11155]
DHSI(-6)	0.048762	-0.036163	0.138246	-0.185780
	(0.05348)	(0.09988)	(0.10456)	(0.15195)
	[0.91179]	[-0.36207]	[1.32217]	[-1.22263]
DTW(-1)	0.020060	0.010876	0.090412	-0.097103
	(0.05749)	(0.10737)	(0.11240)	(0.16335)
	[0.34892]	[0.10129]	[0.80435]	[-0.59445]
DTW(-2)	-0.009886	-0.167510	0.094430	0.071510
	(0.05512)	(0.10294)	(0.10777)	(0.15661)
	[-0.17935]	[-1.62723]	[0.87624]	[0.45661]
DTW(-3)	0.019541	-0.023700	-0.108985	-0.200823

	(0.05410)	(0.10103)	(0.10577)	(0.15371)
	[0.36122]	[-0.23458]	[-1.03042]	[-1.30653]
DTW(-4)	-0.007174	0.112887	-0.009446	0.042373
	(0.05388)	(0.10062)	(0.10533)	(0.15308)
	[-0.13315]	[1.12192]	[-0.08967]	[0.27681]
DTW(-5)	-0.000280	-0.219797	-0.035099	0.057068
	(0.05332)	(0.09959)	(0.10426)	(0.15151)
	[-0.00525]	[-2.20707]	[-0.33667]	[0.37667]
DTW(-6)	-0.122690	0.029169	-0.139086	-0.313129
	(0.05397)	(0.10079)	(0.10551)	(0.15334)
	[-2.27342]	[0.28940]	[-1.31819]	[-2.04212]
DSH(-1)	0.011522	0.024167	-0.016723	-0.182584
	(0.03456)	(0.06455)	(0.06758)	(0.09820)
	[0.33336]	[0.37439]	[-0.24748]	[-1.85923]
DSH(-2)	0.039687	0.063959	-0.078572	-0.031626
	(0.03441)	(0.06426)	(0.06727)	(0.09776)
	[1.15348]	[0.99536]	[-1.16803]	[-0.32351]
DSH(-3)	-0.038920	-0.029936	-0.079731	0.032898
	(0.03486)	(0.06511)	(0.06816)	(0.09905)
	[-1.11637]	[-0.45978]	[-1.16975]	[0.33212]
DSH(-4)	0.022251	-0.112372	-0.009826	-0.068259
	(0.03359)	(0.06273)	(0.06567)	(0.09544)
	[0.66245]	[-1.79129]	[-0.14962]	[-0.71522]
DSH(-5)	-0.001728	-0.059189	-0.104924	-0.141836
	(0.03295)	(0.06153)	(0.06441)	(0.09361)
	[-0.05244]	[-0.96197]	[-1.62894]	[-1.51522]
DSH(-6)	0.048463	0.053723	-0.047543	-0.056656
	(0.03161)	(0.05904)	(0.06180)	(0.08981)
	[1.53313]	[0.91001]	[-0.76927]	[-0.63081]
C	0.006367	-0.009232	-0.004700	-0.013796
	(0.00504)	(0.00942)	(0.00986)	(0.01433)
	[1.26239]	[-0.98017]	[-0.47669]	[-0.96278]
R-squared	0.155768	0.181896	0.224455	0.206369
Adj. R-squared	-0.064466	-0.031522	0.022139	-0.000666
Sum sq. resids	0.217327	0.758011	0.830732	1.754443
S.E. equation	0.048603	0.090770	0.095025	0.138094
F-statistic	0.707285	0.852300	1.109427	0.996785
Log likelihood	201.8631	128.7792	123.4201	79.68550
Akaike AIC	-3.023300	-1.774004	-1.682394	-0.934795

Schwarz SC	-2.433092	-1.183796	-1.092186	-0.344587
Mean dependent	0.005314	-0.006741	-0.003655	-0.004311
S.D. dependent	0.047108	0.089373	0.096094	0.138048
Determinant Residual Covariance		2.72E-09		
Log Likelihood (d.f. adjusted)		489.7063		
Akaike Information Criteria		-6.661646		
Schwarz Criteria		-4.300814		

Response to Cholesky One S.D. Innovations ± 2 S.E.



Variance Decomposition of DDOW:

Period	S.E.	DDOW	DHSI	DTW	DSH
1	0.048603	100.0000	0.000000	0.000000	0.000000
2	0.048966	98.81992	0.935675	0.139754	0.104649
3	0.049726	96.55774	2.112233	0.147726	1.182297

4	0.050219	94.71185	2.146882	0.147031	2.994233
5	0.050474	94.04105	2.401519	0.153881	3.403551
6	0.050492	93.98087	2.413052	0.156919	3.449158
7	0.052133	88.30117	2.744317	4.482140	4.472368
8	0.052156	88.23096	2.800560	4.496419	4.472057
9	0.052199	88.11553	2.848138	4.542591	4.493739
10	0.052258	88.08162	2.850637	4.571587	4.496156
11	0.052288	88.05178	2.850938	4.576015	4.521262
12	0.052361	87.99237	2.857284	4.564278	4.586064
13	0.052487	87.66583	3.211870	4.543790	4.578514
14	0.052495	87.65312	3.211304	4.546065	4.589516
15	0.052504	87.62683	3.236945	4.546090	4.590135

Variance Decomposition of DHSI:

Period	S.E.	DDOW	DHSI	DTW	DSH
1	0.090770	0.539132	99.46087	0.000000	0.000000
2	0.091118	0.825695	99.02544	0.015909	0.132953
3	0.092860	1.353486	95.39424	2.349905	0.902367
4	0.095081	2.790345	93.53650	2.486200	1.186959
5	0.096248	2.861493	91.46583	2.924790	2.747887
6	0.098352	4.012746	87.81193	5.268676	2.906645
7	0.099198	5.272530	86.32821	5.382838	3.016419
8	0.099544	5.406721	86.02554	5.354724	3.213015
9	0.099963	5.366425	85.34368	5.625621	3.664275
10	0.100085	5.490253	85.13627	5.715490	3.657989
11	0.100278	5.490503	84.96779	5.856050	3.685655
12	0.100520	5.692471	84.69758	5.915168	3.694784
13	0.100623	5.728946	84.52584	6.043569	3.701646
14	0.100740	5.753908	84.48876	6.030426	3.726906
15	0.100841	5.869667	84.33751	6.036643	3.756179

Variance Decomposition of DTW:

Period	S.E.	DDOW	DHSI	DTW	DSH
1	0.095025	17.05757	0.603286	82.33914	0.000000
2	0.095436	16.92328	0.745247	82.27344	0.058034
3	0.097858	16.20878	3.562949	78.94921	1.279053
4	0.099296	15.84648	4.250489	77.27995	2.623086
5	0.100015	16.88934	4.218942	76.20497	2.686751
6	0.102003	17.85686	4.504099	73.39202	4.247013
7	0.105552	18.71998	7.804937	69.48378	3.991301
8	0.105805	18.64286	7.834376	69.15841	4.364350
9	0.106278	18.55323	8.548279	68.57297	4.325518
10	0.106467	18.52412	8.527081	68.35964	4.589153
11	0.106665	18.53923	8.516392	68.25941	4.684976
12	0.106755	18.55496	8.505454	68.23998	4.699603
13	0.107155	18.59615	8.732757	67.92272	4.748369
14	0.107232	18.60824	8.721839	67.91219	4.757734
15	0.107269	18.60196	8.739698	67.90272	4.755624

Variance Decomposition of DSH:

Period	S.E.	DDOW	DHSI	DTW	DSH
1	0.138094	0.018066	0.472813	0.401613	99.10751
2	0.144585	0.941196	4.793447	0.841930	93.42343
3	0.144937	1.164733	4.773618	1.092327	92.96932
4	0.146455	2.049572	4.800121	1.982696	91.16761
5	0.148272	3.041481	5.081369	2.267396	89.60975
6	0.148520	3.047059	5.284101	2.260631	89.40821
7	0.152351	5.374211	5.739066	3.915090	84.97163
8	0.152496	5.531732	5.742434	3.907848	84.81799
9	0.152933	5.645785	6.065954	3.952916	84.33534
10	0.153324	5.622962	6.046822	4.028648	84.30157
11	0.153538	5.827975	6.062614	4.030862	84.07855
12	0.153695	5.847472	6.088334	4.059627	84.00457
13	0.153922	5.859649	6.235094	4.125851	83.77941
14	0.153977	5.876539	6.237900	4.136377	83.74918
15	0.154010	5.873974	6.248604	4.149720	83.72770

Cholesky Ordering: DDOW DHSI DTW DSH

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