The Macroeconomic Determinants of Stock Price Volatility: Evidence From Taiwan, South Korea, Singapore and Hong Kong

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Abstract

This paper investigates the roles of macroeconomic variables, i.e., money supply, oil price, exchange rate and inflation on the stock price using four Asia stock markets as samples (Taiwan, South Korea and Singapore and Hong Kong). A structural VAR model is applied to observe the differences of the structure of fluctuations after the 1997 financial crisis. Our results suggest that there exists no cointegrating relationship among variables during the pre-crisis period while exists one during the post-crisis period. Oil prices and exchange rate are found to be the main factors that would significantly and negatively affect stock returns throughout the period. Results also indicate that effect of inflation has increased substantially for Singapore and Hong Kong after the crisis.

Key words: stock price, volatility, SVAR, cointegration, ECM

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Introduction

In recent year, many international researchers focused their attention on the emerging financial markets, especially in Asia. Asia stock markets provide attractive investment opportunities to foreign investors, and became a kind of investment icon in the world financial market. Although some Asia newly industrialized countries, for example Taiwan, South Korea, Singapore and Hong Kong, had gained exceptionally good marks in world stock market, these Asia countries' stock markets had stunned the investors from investment as their markets are suffering high level of volatility. Among the most famous events creating such market turmoil is 1997 Asian financial crisis, and it was rapidly escalated into the whole Asian economic disaster, accompanied by the devaluation of currencies, the collapse of stock markets and the application for the IMF bailout package by the government of South Korea. This disastrous phenomenon was quite contrary to the strong performance of Asia stock markets. During July, 1997 and November, 1998, the financial crisis hit South Korea stock market (45.90% decline), Singapore stock market (41.04% decline), Hong Kong stock market (36.03% decline) and Taiwan stock market(24.56% decline) the most severely, while other Asian countries also suffered from the similar shock.

Hence, the most important question arises: what is the factors causing the stock volatility? Wongbangpo and Sharma (2002) investigated the explanatory power of various macroeconomic variables using monthly ASEAN (Association of Southeast Asian Nations) stock returns and find that key macroeconomic factors (for example, interest rate, exchange rate, GDP and CPI) play a dominant role of influencing stock market volatility. Maysami and Koh (2000) found that the conditional volatilities of inflation and interest rates have large direct impacts on Singapore stock market volatility.

There is also evidence that oil price volatility shocks have asymmetric effects on economy. Hamilton (1983) showed that oil price increases are responsible for almost every post World War II US recession. Later other researchers extended Hamilton's base findings using alternative data and estimation procedures (Burbridge and Harrison, 1984; Gisser and Goodwin, 1986). Hamilton (1983) using Granger causality examined the impact of oil price shocks on the US economy in 1949-1972. Hamilton found that changes in oil prices Granger-caused changes in GNP whereas oil prices were determined exogenously. Gisser and Goodwin (1986) found that oil price shocks affect a set of macro variables and their results are similar to those of Hamilton (1983) and Burbridge and Harrison(1984). Sadorsky (1999) used a vector autoregressive model with four variables and monthly data over the period 1947-1996 to show that oil prices and oil price volatility both play important roles in affecting real stock returns. Especially after 1986, oil price movements explain a large error variance in real stock returns than do interest rates (Darby, 1982; Hamilton, 1983 Burbridge and Harrison,1984; Gisser and Goodwin,1986; Mork,1989;Ferderer,1996). Although the bulk of the empirical research has studied the relation between oil price changes and economic activity, it is surprising that little research has been conducted on the relationship between oil price shocks and financial markets. Besides, studies examining the effects of oil shocks on the stock market and economic activity focus mainly on a few industrialized countries such as the United States, United Kingdom, Japan and Canada (Lee, 1992; Jones and Kaul, 1996; Huang et al., 1996; Sadorsky, 1999).

The goal of this paper is to identify the sources of stock prices fluctuations for four Asian stock markets, such as Taiwan, South Korea, Singapore and Hong Kong, and discuss whether there exist different structures of transmissions of fluctuations after the 1997 crisis. Unlike most studies in the literature that only estimate the contemporaneous relationship among time series. This paper is the first to use theoretically motivated restrictions to identify the effects of several important macro shocks on stock prices in a structural VAR framework. In our paper, we build a long-run structural VAR model, developed by Blanchard and Watson (1986), to examine the macroeconomic determinants of stock market fluctuations, which include stock prices, inflation, money supply, real oil price and the real exchange rate. We also use impulse response analysis and forecast error variance decomposition to trace out the contributions made by the macro shocks to real shock price fluctuations.

The paper proceeds as follows: Section 2 motivates the empirical SVAR model. In section 3, we detail the data source and report the empirical results. Finally, in Section 4, the conclusions of the analysis are summarized.

The structural VAR model

In this section, we employ the long-run structural VAR model to examine the influence of real shocks on the fluctuations of stock prices. We apply Blanchard and Watson (1986) method to show how our assumptions help in characterizing the stock prices process, and how this process can be recovered from the data. The structural VAR approach is applied to supplement the innovation information that could be lost using the traditional recursive Choleski technique. Cooley and LeRoy (1985) have criticized that Choleski factorization which identifies orthogonal shocks as structural disturbance could be misspecified. They argue that this technique fails to explain the "true" structural relationships as it implies a recursive contemporaneous model that is rarely derived from economic theory.

In our structural VAR model, we assume that the volatility of stock prices can be determined by such disturbances as inflation, money supply, real oil price and real exchange rate. Bundling these variables in a model enables us to distinguish the impacts separately and measure the relative importance of shocks. Consider the following covariance-stationary VAR process, which can be viewed as a dynamic simultaneous system of linear equations yields a VAR reduced from. It is assumed that the structural system is represented by a linear-invariant, stochastic dynamic relationship. We follow by demonstrating conditions under which a dynamic simultaneous system of linear equations yields a VAR reduced from. It is assumed that the structural system is represented by a linear-invariant, stochastic dynamic relationship,

$$X = A(L)\varepsilon \tag{1}$$

where X is $k \times 1$ vector of endogenous variable. $A(L) = I + A_1 L + A_2 L^2 + \ldots + A_p L^p$, is an $k \times k$ matrices polynomial in the lag operator L. Term ε, fundemnetal structural disturbances, are assumed to be a vector of serially independent distributed error terms with zero mean and constant variance; that is, cov(ε)=I and I is an identity matrix. The Wold vector moving average (VMA) representation is given by

$$X = B(L)e \tag{2}$$

where B (L) is an invertible $k\times k$ matrix with B(0)=I and e is a $k\times 1$ vector of white noise innovations with $Eee' = \Omega$, where E is the expectation operator. The VMA representation provides us a useful tool to examine the dynamic response of X sequence to the structural disturbances inclused in e vector.

We further assume that the linear relationship between e and ε is such that

$$e = C(0)\varepsilon \tag{3}$$

where C (0) is $k\times k$ matrix with full rank, and combining equations (1), (2) and (3) yields,

$$A(L) = B(L)C(0) \tag{4}$$

we can also obtain the variance-covariance matrix from equation (3), such that

$$C(0)C(0)' = \Omega \tag{5}$$

In order to identify the structural shocks and make structural inferences from the data, C needs to be identified. The traditional VAR approach identifies C by assuming that C is lower triangular. In contrast, we employ an identification strategy based on long-run restrictions following Blanchard and Quah (1989). In the next section, we estimate Eq.(1) with $x_t = (\mathrm{MS_t}, \mathrm{POIL_t}, \mathrm{INF_t}, \pi_t, \mathrm{STOCK_t})'$, where MS_t is money supply, $POIL_t$ is real oil price, INF_t is inflation, π_t is exchange rate and $STOCK_t$ is stock prices. In order to recover the estimates of the structural disturbances, e, it is necessary to identify C (0). For example, our model includes five variables, there are 25 $(k\times k)$ independent elements in Ω and 15 $(k\times(k+1)/2)$ unknow elements in C (0), we need to impose 10 restrictions on C (0) to identify the structural parameters. The ten restrictions take the following form, expressed below in terms of the matrix off long-run multiplier：

$$\begin{bmatrix} \Delta MS \\ \Delta OIL \\ \Delta \pi \\ \Delta STOCK \\ \Delta INF \end{bmatrix} \quad \begin{bmatrix} C_{11} & 0 & 0 & 0 & 0 \\ 0 & C_{22} & 0 & 0 & 0 \\ 0 & C_{32} & C_{33} & C_{34} & C_{35} \\ 0 & C_{42} & C_{43} & C_{44} & C_{45} \\ C_{51} & C_{52} & C_{53} & C_{54} & C_{55} \end{bmatrix} \quad (6)$$

In this model , we first assume a structure of block exogeneity in which oil is exogeneous to the rest of the variables; that is, either the contemporneous or the lagged values of the exogeneous variables do not have any effect in the formation of C(0) matrix.

One additional assumption arises from the assumption of long-run monetary neutrality which implies the demand for stock price and exchange rate are independent of contemporaneous shocks to the money supply. But there is a potential problem with the interpretation of the nominal shock. Sargent (1987) points out that the variations of money stock generated via open market operations may not be neutral due to the fiscal effects of changes in the government’s interest payments. However, our study would still be based upon this assumption, but only focuses on the short-run effect of the nominal money supply shocks.

The long-standing position of the stock market has been to prevent imported inflation through maintaining the dollar at a strong level, and an appreciating currency is generally accompanied by increase in reserves and money supply and a decline in interest rates (Pebbles & Wilson, 1996). As such, we hypothesize that stock prices are positively related to appreciating currency and increasing money supply and negatively related to falling interest rates. The intuition behind the relationship between interest rates and stock prices is straightforward. Since the rate of inflation is positively related to money growth rate (Fama, 1981), an increase in the money supply may lead to an increase in the discount rate and lower stock prices. An increase in expected inflation rate, under general circumstances, is likely to lead to economic tightening polices that would have a negative effect upon stock prices. The rise in the rate of the inflation, additionally, increases the nominal risk-free rate and raises the discount rate in the valuation model. Since cash flows do not rise at the same rate as inflation (DeFina, 1991), the rise in discount rate leads to lower stock prices.

DATA AND EMPIRICAL RESULTS

3.1 The Data

This paper mainly discusses what factors affects the volatility of stock prices. The empirical analysis has been carried out using monthly data for the period 1981:1 to 2002:12 for Taiwan, South Korea, Singapore and Hong Kong. We choose 1981 as starting point partly because Taiwan and South Korea began their market liberalization regimes in 1981 and partly because data are limited (data prior to 1981 are not available). South Korea and Hong Kong data are obtained from the International Financial Statistics and Taiwan and Hong Kong's data are from the Financial Statistics. The variables include "STCCK": stock market index; "MS": seasonally adjusted M_2 series; "π": real exchange rates which are relative to U.S. dollar; "INF": the first differences of the natural logarithm pf consumer price index (1990 as base year). The data for the price of oil (POIL), provided by the World Bank, are an extension of Backus and Crucini's (2000) series. All variables are in logarithms and seasonally adjusted. The sample, which covers the period from January 1981 through December 2002, is divided into two sub-periods— the pre-crisis period (January 1981 to June 1997) and post-crisis period (July 1997 to December 2002).

3.2 Unit root test

We employ PP (Phillip-Perron) test to exaime if the variables have a unit root or not. The Phillip-Perron test which would tolerate weakly dependent and heterogeneously distributed disturbances may be better than the conventional Dickey and Fuller (1981) unit root test. Table1 provides the results of the unit root test for the stationarity of the level as well as for the first differenced series. Both statistics of z (τ_μ) and z (τ_τ) show all the variables are non-stationary in level, but are stationary in first difference. Therefore, we conclude that all the variable are I (1) for each period.

Table 1

Philips-Perron unit root test

Variable	Pre-Crisis (1981/1-1997/6) Level		Pre-Crisis First Difference		Post-Crisis (1997/7-2002/12) Level		Post-Crisis First Difference	
	$z(\tau_\mu)$[1]	$z(\tau_\tau)$[2]	$z(\tau_\mu)$	$z(\tau_\tau)$	$z(\tau_\mu)$	$z(\tau_\tau)$	$z(\tau_\mu)$	$z(\tau_\tau)$
Taiwan								
INF	-2.06	-2.17	-4.24	-4.62	-1.06	-0.17	-3.94	-4.02
POIL	-0.01	-2.03	-4.51	-4.97	-0.61	-1.03	-4.51	-4.97
π	-2.09	-2.21	-5.27	-6.02	-0.09	-1.21	-4.97	-5.02
MS	-1.76	-1.94	-3.42	-4.11	-0.76	-1.14	-3.62	-3.68
STOCK	-2.15	-2.22	-6.03	-5.43	-1.15	-0.12	-4.03	-5.43
South Korea								
INF	-2.13	-2.21	-4.06	-4.91	-2.13	-0.21	-3.06	-4.91
POIL	-1.86	-1.94	-3.28	-5.26	-1.86	-0.94	-3.28	-7.26
π	-2.18	-2.21	-4.19	-5.69	-2.18	-1.21	-6.19	-7.69
MS	-0.56	-1.14	-2.94	-3.71	-0.56	-0.14	-6.94	-6.61
STOCK	-0.77	-1.68	-2.43	-3.55	-0.77	-1.28	-4.43	-4.55
Singapore								
INF	-0.73	-1.43	-3.25	-4.01	-0.73	-2.21	-5.06	-4.91
POIL	-2.09	-2.14	-4.75	-3.93	-2.09	-2.54	-3.28	-6.26
π	-0.46	-1.27	-3.42	-3.94	-0.46	-1.21	-4.19	-4.69
MS	-0.73	-1.76	-4.03	-5.61	-0.73	-2.14	-4.94	-6.71
STOCK	-0.16	-1.05	-2.46	-3.82	-0.16	-2.18	-9.43	-2.55
Hong Kong								
INF	-0.43	-1.19	-3.73	-6.92	-0.43	-2.17	-4.24	-5.62
POIL	-0.82	-1.24	-6.82	-2.63	-0.82	-2.03	-4.51	-4.97
π	-2.19	-2.22	-7.96	-3.12	-2.19	-2.21	-5.27	-3.02
MS	-1.17	-1.84	-8.73	-4.19	-1.17	-1.94	-3.42	-4.11
STOCK	-1.08	-1.53	-4.29	-5.71	-1.08	-2.22	-6.03	-6.43

[1] There is no trend in the equation. The 5% critical value is –2.23
[2] There is trend in the equation. The 5% critical value is –3.45
* denotes for rejection of the unit root null at the 5% level.

3.3 Cointegration tests

As a prerequisite for latter analysis, we first examine whether the variables are non-stationary, and if they are, whether there is any cointegrating relationship, in order to appropriately construct the VAR model. Engle and Granger (1987) demonstrate that a VAR in differences will be misspecified if the variables are cointegrated. The differenced system would on longer have a multivariate time series representation with an invertible moving average. Thus, it is necessary to determine if the non-stationary level variables share common stochastic trends before employing the VAR techniques. If the level variables are non-stationary but share a common trend, (in order words, there exists a linear combination of the level variables, which is stationary), then the VAR model should be replaced by an error correction representation (ECM). For this purpose, we apply the Johansen (1988) and Juselius (1990) maximum likelihood rank tests to the test the long-run equilibrium relationship(s) among the variables.

Table 2 lists the results of the cointegration test. As for the pre-crisis period, the λ_{trace} test shows that we can not reject the null hypothesis of r=0 against the alternative of r=1 at the 95% critical levels for four countries. The λ_{max} test also can not reject the null hypothesis of r=0 against the null of r=1. The finding of no cointegration implies that there is no linear long-run equilibrium relationship among the variables for the pre-crisis period. Based on the findings that each individual series is an I (1) process, and there exists no cointegrating relationship, we proceed to apply the VAR representation in terms of the first-differenced variables of interest. We use the Sims-Bernanke procedure (1986) to retrieve the contemporaneous relationship among the variables. The results are shown in Table 3.

Table2

Cointegration test results : x = (MS, POIL, INF, π ,STOCK)′

	Pre-crisis (1981/1-1997/6)				Post-crisis (1997/7-2002/12)			
	Maximal eigevaule test		Trace test		Maximal eigevaule test		Trace test	
	H_0	$\lambda_{\max}$	H_0	λ_{trace}	H_0	$\lambda_{\max}$	H_0	λ_{trace}
Taiwan	r =0	49.11	r =0	101.43	r =0	53.17	r =0	129.51
	r =1	23.56	r≦1	52.34	r =1	37.56	r≦1	76.34
	r =2	20.49	r≦2	28.76	r =2	26.59	r≦2	38.78
	r =3	6.21	r≦3	8.27	r =3	9.71	r≦3	12.19
	r =4	2.06	r≦4	2.06	r =4	2.48	r≦4	2.48
South Korea	r =0	62.76	r =0	142.48	r =0	75.96	r =0	168.18
	r =1	43.52	r≦1	79.72	r =1	38.92	r≦1	92.22
	r =2	20.61	r≦2	36.2	r =2	30.21	r≦2	53.3
	r =3	10.52	r≦3	15.59	r =3	20.22	r≦3	23.09
	r =4	5.07	r≦4	5.07	r =4	2.87	r≦4	2.87
Singapore	r =0	53.92	r =0	101.4	r =0	58.72	r =0	141.5
	r =1	21.63	r≦1	47.48	r =1	50.53	r≦1	82.78
	r =2							
Hong Kong	r =3	39.56	r =0	81.48	r =0	49.56	r =0	88.88
	r =4	18.35	r≦1	41.92	r =1	27.35	r≦1	39.32
		16.22	r≦2	23.57	r =2	6.28	r≦2	11.97

Note: 1. x denotes the variables included in the cointegration vector. The number of lags used in the system is 4, which is chosen on the basis of the Schwartz Information Criterion, Ljung-Box Q-Statistics.

2. The critical values are obtained from Johansen and Juselius (1990).

Table 3 Coefficients of VAR equation (Pre-crisis 1981/1-1997/6)

Varibles	ΔMS	ΔPOIL	Δ π	Δ INF
Pre-crisis	0.361	-2.238	-0.218	0.376
Taiwan	(0.71)	(-3.73*)	(-4.18*)	(1.28)
	0.496	-7.155	-0.284	0.138
South Korea	(0.72)	(-3.42*)	(-5.28*)	(0.91)
	0.875	-2.157	-0.654	0.943
Singapore	(1.82)	(-3.64*)	(-5.91*)	(1.51)
	0.624	-0.384	-0.197	0.738
Hong Kong	(1.19)	(-3.25*)	(-5.18*)	(1.81)

Note: * denotes significance at the 5 percent level.

For the pre-crisis period, the coefficients for the POIL and π are all statistically significant at the 1% level, but MS and INF are insignificant. This result suggests that for each country, the oil price and exchange rate are the main factors that would significantly and negatively affect stock returns.

Because the test statistic in Table 2 reveals a cointegrating relationship among the variables during post-crisis period, the VAR representation with level variables is no longer justifiable; thus we employ an ECM representation. Since all of the variables in levels are I(1) processes, equation (1) can be written as the following error correlation representation

$$\Delta X_t = \sum_{i=1}^{p-1} \Pi_i \Delta X_{t-i} + \Pi X_{t-p} + \delta_t \tag{7}$$

The results of the error-correction regressions are reported in Table 4. In all error-correction equations three lags were induced to achieve white noise errors. The equilibrium error term, Z_{t-1}, used in the error correction regressions was obtained from the OLS estimation. Following Banerjee et al. (1986), we have selected the cointegrating regression with the highest R-squared, which is subject to the least amount of bias. The cointegrating regressions used to obtain the cointegrating errors for the error-correction analysis rely on stock price in all empirical countries for the post-crisis period as the dependent variable. The results reported in Table 4 provides further evidence that stock price and macroeconomic variables are linked together with a long-run equilibrium relationship that prevents any deviations from equilibrium lasting too long. The t-value of 2.75, 5.14, 2.11 and 2.68 for the coefficient of the error-correction term, Z_{t-1}, provides strong evidence for our previous finding that there are strong trend components binding these variables together during the post-crisis period. This result suggests again that for each country, oil price and exchange rate seem to be a main factor that would negatively affect stock price and also supports the earlier assumption of the long-run neutrality of money. While noted, rate of inflation now exerts significant and positive influence on Singapore and Hong Kong stock market for the post-crisis period.

Table 4 Coefficients of ECM equation (Post-crisis period 1997/7-2002/12)

Variables	Taiwan	South Korea	Singapore	Hong Kong
Z(-1)	3.061(2.75*)	3.192(5.14*)	2.158(2.21*)	2.187(2.68*)
ΔMS(-1)	0.067(0.24)	3.125(1.75)	3.398(1.01)	2.114(1.54)
ΔMS(-2)	2.143(1.28)	1.382(0.13)	1.328(1.52)	1.429(0.39)
ΔMS(-3)	2.047(0.73)	1.682(0.94)	3.812(0.82)	0.192(1.87)
ΔPOIL(-1)	-3.413(-3.49*)	-1.522(-2.72*)	-2.378(-2.98*)	-2.214(-2.46*)
ΔPOIL(-2)	-1.047(-2.31*)	-2.292(-3.28*)	-1.318(-3.17*)	-0.283(-2.27*)
ΔPOIL(-3)	-0.067(-2.81*)	-3.125(-3.73*)	-3.197(-3.22*)	-0.114(-3.86*)
Δ π (-1)	-1.143(2.17*)	-4.382(-3.51*)	-2.328(-4.72*)	-0.429(-2.83*)
Δ π (-2)	-0.027(2.24*)	-3.125(-2.75*)	-3.398(-2.01*)	-2.114(-1.54)
ΔSTOCK(-1)	1.143(1.28)	1.352(2.13*)	4.328(2.02*)	5.429(0.39)
ΔINF(-1)	-2.043(1.13)	-2.082(-0.94)	3.812(2.12*)	5.192(2.67*)
ΔINF(-2)	-2.013(0.59)	-2.012(-0.72)	3.618(2.38*)	4.216(6.36*)
Constant	1.038(1.14)	2.516(1.26)	4.387(1.89)	2.519(1.63)

1. Lag values are shown in parantheses next to the independent variables.
2. t-statistics are reported in parentheses next to the estimated coefficients.
3. * denotes significance at the 5 percent level.
4. The cointegrating errors, Z_{t-1}, used in the error-correction regressions have been obtained from the estimate of cointegrating equations where the stock price indices were used as dependent variables for the post-crisis.

3.4 Impulse Responses

By using impulse responses analysis, we can obtain when one macro shock changes, stock prices change or not and its pattern of dynamic response. Table 5 lists the results of impulse responses during the pre-crisis period. An impulse response analysis for a horizon of 30 months illustrates the response of the stock price to one standard deviation shock to all macroeconomic variables. Results shows stock price is sensitive to shocks from the stock price themselves as well as from oil price and exchange rate, which is negative and significant. Stock price responds intensively to a shock in itself. Over the 30-month period, the effect remains substantial for Taiwan, South Korea and Hong Kong, while decreasing in Singapore.

Table 5 Impulse response analysis (Pre-crisis 1981/1-1977/6)

Country	Steps Ahead	Response of stock prices (to one standard deviation shock in STOCK)				
		MS	POIL	π	STOCK	INF
Taiwan	1	0.023	-0.032	-0.072	0.061	0.024
	6	0.019	-0.054	-0.057	0.033	0.019
	12	0.018	-0.043	-0.041	0.048	0.015
	24	0.017	-0.042	-0.033	0.047	0.014
	30	0.005	-0.061	-0.057	0.035	0.006
South Korea	1	0.014	-0.035	-0.045	0.051	0.018
	6	0.017	-0.045	-0.039	0.044	0.009
	12	0.016	-0.042	-0.046	0.036	0.005
	24	0.014	-0.024	-0.053	0.028	0.005
	30	0.011	-0.021	-0.064	0.025	0.008
Singapore	1	0.019	-0.026	-0.061	0.048	0.006
	6	0.017	-0.038	-0.038	0.015	0.008
	12	0.013	-0.039	-0.054	0.004	0.004
	24	0.015	-0.054	-0.053	0.002	0.003
	30	0.014	-0.041	-0.036	0.001	0.001
Hong Kong	1	0.012	-0.042	-0.067	0.062	0.008
	6	0.011	-0.057	-0.055	0.045	0.007
	12	0.017	-0.063	-0.041	0.031	0.003
	24	0.019	-0.061	-0.062	0.028	0.001
	30	0.008	-0.074	-0.037	0.029	0.001

Table 6 Impulse response analysis (Post-crisis 1997/7-2002/12)

Country	Steps Ahead	Response of stock prices (to one standard deviation shock in STOCK)				
		MS	POIL	π	STOCK	INF
Taiwan	1	0.024	-0.032	-0.018	0.024	-0.024
	6	0.013	-0.024	-0.016	0.018	-0.032
	12	0.009	-0.017	-0.028	0.019	-0.034
	24	0.002	-0.026	-0.014	0.017	-0.018
	30	0.001	-0.023	-0.025	0.024	-0.021
South Korea	1	0.031	-0.041	-0.017	0.032	-0.052
	6	0.018	-0.033	-0.028	0.011	-0.043
	12	0.007	-0.027	-0.014	0.026	-0.034
	24	0.004	-0.046	-0.016	0.024	-0.027
	30	0.002	-0.020	-0.027	0.027	-0.029
Singapore	1	0.021	-0.062	-0.054	0.041	0.017
	6	0.016	-0.051	-0.027	0.024	0.009
	12	0.004	-0.047	-0.026	0.027	0.008
	24	0.003	-0.039	-0.031	0.018	0.002
	30	0.002	-0.037	-0.022	0.016	0.001
Hong Kong	1	0.026	-0.027	-0.047	0.011	0.052
	6	0.016	-0.039	-0.026	0.023	0.033
	12	0.014	-0.028	-0.034	0.017	0.027
	24	0.013	-0.025	-0.022	0.015	0.038
	30	0.011	-0.041	-0.021	0.028	0.029

Table 6 lists the results of impulse response during the post-crisis period. There is a positive relationship between stock prices and inflation in our empirical countries. The relationship between stock prices and inflation has been the focus in a few of researches. The Fisherian relation between rates of return on assets or nominal interest rates and excepted inflation leads us to guess that one reasons for various assets is to hedge against the effect of inflation. Hence, stock prices should be positively related to inflation. Fama and Schwert (1977) proposed that while government bonds and real estate were hedged against inflation, stocks cannot serve the function. Fama (1981) found that the negative relation that inflation is the most important determinant of stock prices. A negative relationship existed between inflation and stock prices because the nominal quantity of money did not vary sufficiently with stock prices. As such, the negative relation between stock prices and inflation is a spurious one. This is a plausible explanation in our empirical countries' case for the pre-crisis period. However, for the post-crisis, a few investors lack confidence, so they did not invest in stock market. Exchange rate variable is negatively related to stock prices in these four countries. The competition in the world exporting market explains the positive stock price-exchange rate relation, yet the negative relation could be justified via the asset view of the exchange rate. We observe further that goods and money market variables are fundamental determinants of Asia countries' share price values, while the long run relationship between the exchange rate and stock prices in Hong Kong is facilitated by the adopted independent floating exchange rate policy. The negative sign of the oil prices may suggest that for countries which are heavily dependent on imported oil, an unexpected rise in the oil price would bring up the domestic price level and finally reflects domestic production decline.

3.5 Variance Decompositions

Variance decompositions measure the relative contribution of forecast error variance (FEV) of each shock as a function of forecast horizon. While the impulse-response function reveals the dynamic effects of a one-time shock, the variance decompositions is a convenient measure of the relative importance such shocks to the system. The innovation accounting analyses is very sensitive to the ordering of the variables. Our empirical variables are arranged as follows: money supply is placed first since it is exogeneous to other variables, followed by oil prices, exchange rate, stock prices and inflation. Nake and Tufte(1997) consider this the most common ordering based on theory. The present placement may reflect our priors, and it should be noted that changes in this sequence did not affect results significantly. In this paper, we discuss the effect of macro shocks on stock prices.

Table 7 Variance decomposition analysis (Pre-crisis 1981/1-1977/6)

Country	Steps ahead	Forecast error variance of stock prices (explained innovations)				
		MS	POIL	π	STOCK	INF
Taiwan	1	1.42	8.32	6.92	82.22	1.12
	6	3.23	7.62	6.41	80.32	2.42
	12	4.14	8.12	8.41	76.91	2.42
	24	3.64	10.31	9.42	72.83	3.81
	30	3.11	13.72	10.23	71.74	1.20
South Korea	1	1.32	6.73	7.12	83.62	1.21
	6	3.51	7.55	6.91	81.21	0.82
	12	4.73	8.14	9.61	75.11	2.41
	24	4.62	17.72	14.12	60.62	2.92
	30	6.11	17.73	15.82	58.91	1.47
Singapore	1	1.13	7.52	5.92	83.52	4.01
	6	3.22	6.51	4.42	81.42	4.41
	12	2.13	9.03	6.41	78.03	4.40
	24	3.61	14.24	12.41	63.92	6.92
	30	3.14	17.03	13.81	62.81	3.21
Hong Kong	1	0.34	7.81	11.12	80.61	2.22
	6	2.51	8.62	7.92	80.22	1.83
	12	3.72	9.24	8.62	76.12	3.40
	24	3.64	10.81	8.13	71.61	6.91
	30	1.13	10.84	11.81	74.92	2.40

Table 7 shows the results of variance decompositions analysis. The variance decomposition analysis is likely to reinforce the results of the impulse response analysis. Not surprisingly, the variances in all empirical countries stock prices are mainly attributed to STOCK itself. However, the effect drops as the horizon lengthens. During the pre-crisis period, at 30-month horizon, the portion of FEV explained by STOCK itself remains large in Taiwan and Hong Kong, but becomes less in other countries. For Taiwan, South Korea and Hong Kong, about 15% or more of the variance of STOCK can be attributed largely to innovations in π , and POIL. Moreover, about 20% of FEV of STOCK in Singapore can be split among π , POIL, and slightly INF.

Table 8 Variance decomposition analysis (Post-crisis 1981/1-1977/6)

Country	Steps ahead	Forecast error variance of stock prices (explained by ahead innovations)				
		MS	POIL	π	STOCK	INF
Taiwan	1	1.16	6.91	8.61	72.11	11.21
	6	1.22	6.42	7.63	72.22	12.51
	12	2.13	8.42	8.11	70.82	10.52
	24	3.61	7.42	11.31	64.73	12.93
	30	3.12	8.23	11.71	65.62	11.32
South Korea	1	1.42	10.01	7.82	70.73	11.03
	6	3.51	7.91	7.63	70.12	10.83
	12	4.71	9.62	8.22	65.03	12.42
	24	4.62	9.13	9.81	60.52	15.92
	30	1.13	11.84	16.81	59.22	11.00
Singapore	1	1.12	10.91	7.63	71.42	11.02
	6	3.23	9.42	6.62	69.31	11.42
	12	2.12	9.43	9.02	68.01	11.42
	24	4.62	9.41	12.31	60.81	13.95
	30	3.91	11.05	12.12	62.72	10.21
Hong Kong	1	2.31	10.12	6.92	70.52	12.23
	6	2.52	8.94	8.71	69.13	11.80
	12	4.33	8.01	9.32	66.02	13.42
	24	3.61	10.12	10.91	59.53	16.93
	30	3.12	13.81	13.93	59.81	10.43

Table 8 shows the results of variance decompositions analysis during the post-crisis period. The FEV of STOCK can be distributed among POIL, π and INF. An innovation in POIL can explain the FEV of STOCK from a high of about 10 % in Hong Kong, South Korea , Singapore, and to a low of only 7% in Taiwan. Moreover, it is shown that for each country, the inflation effect is statistically significant, a finding which reinforces the earlier impulse response results.

Conclusion

This paper investigates the sources of stock price fluctuations with respect to four newly industrialized countries in Asia, for example Taiwan, South Korea, Singapore and Hong Kong. We use monthly time-series data and build a long-run structural VAR model, developed by Blanchard and Watson (1986), to examine the macroeconomic determinants of stock market fluctuation, which includes stock prices, inflation, money supply, real oil price and the real exchange rate. We also use innovation accounting to trace out the contributions made by the macro shocks to real shock price fluctuations.

We found that for the pre-crisis period, variables of interest do not form a long run equilibrium relationship. Based on the VAR model, we found that inflation and money supply are not significant while changes in exchange rates and oil prices are. For the post-crisis period, exchange rate variable is positively related to stock prices in Taiwan, but negatively related in other countries. Moreover, there is a positive relationship between stock price and inflation in Singapore and Hong Kong but negative relationship in South Korea and Taiwan. Oil price are also proven to be an important and factor to determine stock volatility in our empirical countries, which are heavily dependent on imported oil. That is consistent with the finding of the Sadorsky (1999).

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