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Stock market and macroeconomic fundamental dynamic interactions: ASEAN-5 countries

Praphan Wongbangpo[a], Subhash C. Sharma[b,*]

[a]*Kintana, 1314 Chesapeake Terrace, Sunnyvale, CA 94089, USA*
[b]*Department of Economics, Southern Illinois University Carbondale, Carbondale, IL 62901-4515, USA*

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Abstract

The concurrent growth in some ASEAN stock markets and their economies in the last two decades raises empirical questions regarding the fundamental connection between stock price and key macroeconomic variables. This study investigates the role of select macroeconomic variables, i.e., GNP, the consumer price index, the money supply, the interest rate, and the exchange rate on the stock prices in five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand). We observe long and short term relationships between stock prices and these macroeconomic variables. Moreover, the macroeconomic variables in these countries cause and are caused by stock prices in the Granger sense. Since the stock prices interact with the key macroeconomic variables in the short and long run, decent government economic or financial policies can yield impressive gains in both the sectors. © 2002 Elsevier Science Inc. All rights reserved.

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1. Introduction

Recently, international investors and researchers have focused their attention on the emerging financial markets, especially in southeast Asia. Stock markets in these countries have provided attractive investment opportunities to foreign investors, and have become investment icons in the global financial markets. In fact, stock markets of countries in the

* Corresponding author. Tel.: +1-618-453-5070; fax: +1-618-453-2717.
E-mail address: sharma@siu.edu (S.C. Sharma).

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Association of Southeast Asian Nations (ASEAN) experienced a tremendous growth in the market capitalization along with a high and steady growth rate of GDP in the last decade. According to Tongzon (1998), the growth rate of real GDP of the ASEAN-5, which consists of Indonesia, Malaysia, Philippines, Singapore and Thailand averaged 7.3% in the period 1987–1992. This average growth rate was significantly higher than that of the developed economies as a group and that of the world (2.8% and 2.2%, respectively). Individually, the average annual GDP growth rate during the period 1987–1995 was around 9% for Malaysia, Singapore and Thailand, while Indonesia and Philippines achieved 6.6% and 3.3%, respectively (Chia & Pacini, 1997, p. 9). Concurrently, the ASEAN-5 stock markets have impressive growth in capitalization from 1990 to 1996. Over the 7-year period (1990–1996) the market capitalization in Indonesia, Malaysia, Philippines, Singapore and Thailand grew 816.38%, 360.20%, 637.66%, 83.6% and 211.81%, respectively (World Stock Exchange Fact Book, 1997). Thus, except in Singapore, the ASEAN stock markets have grown more than two-fold in Thailand and up to eight times in Indonesia. The significant growth in ASEAN stock markets is a result of financial reforms undertaken since the early 1980s. However, these markets remain much smaller regarding trading activities and market capitalization compared to the U.S. and other developed stock markets.

Several studies have modeled relationships between U.S. share prices and real economic activities. Fama (1981) documents a strong positive correlation between common stock returns and real variables, such as the capital expenditure, industrial production, GNP, the money supply, lagged inflation and the interest rate. Geske and Roll (1983), and Huang and Kracaw (1984) also document a significant linkage between variations in the U.S. stock market and real economic activities. Furthermore, Chen, Roll and Ross (1986) investigate the effect of macroeconomic factors (industrial production, the money supply, inflation, the exchange rate, and long and short term interest rates) on the stock market returns in the United States using a multivariate arbitrage-pricing model (APM). These variables fundamentally influence either the future cash flow or the risk adjusted discount rate in a standard stock price valuation model, in which the stock price is broadly interpreted as the present value of the expected future cash flow. Chen (1991) documents that domestic variables, such as the lagged production growth rate, default premium, term premium, short run interest rate, and market dividend–price ratio, are indicators for the current and future economic growth. These results confirm the finding of Chen et al. (1986) on the ability of domestic variables to forecast excess market returns *via* their forecast of the macroeconomy. Dhakal, Kandil and Sharma (1993) examine the interactions between the money supply and U.S. share prices based on the money market equilibrium condition. The results from a vector autoregressive technique indicate that changes in money supply have significant direct and indirect (*via* real output, inflation and interest rate) causal impacts on changes in U.S. stock prices. In addition, Abdullah and Hayworth (1993) observed that the U.S. stock returns are related positively to inflation and growth in money supply, yet negatively to budget and trade deficits, and also to short and long term interest rates.

Moreover, Poon and Taylor (1991) investigate the effect of macroeconomic variables similar to those of Chen et al. (1986) on the U.K. stock market and conclude that the interrelationship between the macroeconomic variables and stock prices in the U.K. are different from those of the U.S. as described by Chen et al. (1986). Cheng (1995) also analyzes U.K. stock price returns and macroeconomic factors by using canonical correlation analysis. The results indicate that the U.K. security returns are significantly influenced by a number of systematic economic factors. This finding is in-line with Chen et al. (1986), but contradicts that of Poon and Taylor (1991).

For Japanese stock market, Hamao (1988) concludes that changes in expected inflation, unanticipated changes in risk premia, and the term structure of interest rates significantly affect the Japanese stock returns. Through the arbitrage pricing theory, Brown and Otsuki (1990) explore the effects of the money supply, a production index, crude oil prices, exchange rates, call money rates, and a residual market error on the Japanese stock market. They observe that these factors are associated with significant risk premia in Japanese equities. Recently, Mukherjee and Naka (1995) observe a long run relationship between the Japanese stock market and six macroeconomic variables. In their study, the signs of the long run elasticities of macroeconomic variables are generally consistent with their *a priori* hypotheses.

So far, only a handful of studies have been devoted to investigating the role of fundamental macroeconomic variables on stock markets in developing countries. Fung and Lie (1990) examine the role of the Taiwanese stock market in response to GNP and the money supply, and conclude that the Taiwanese stock market is inefficient since it fails to capture information regarding changes in these economic variables. Furthermore, Kwon, Shin and Bacon (1997) investigate the relationship between the Korean stock market and basic economic factors using a regression analysis. They observe that the Korean stock returns are influenced by some significant economic factors (i.e., dividend yields, the exchange rate, the interest rate, the oil prices and the money supply, which are quite different from those of the U.S. and Japan).

This study examines the interdependence between stock markets and fundamental macroeconomic factors in the ASEAN-5 countries, i.e., Indonesia, Malaysia, Philippines, Singapore and Thailand. We investigate the existence of long and short run relationships between stock price indices and a set of selected macroeconomic variables: GNP, consumer price index, the money supply, the interest rate, and the exchange rate, from 1985 to 1996. Detection of interrelationships between stock markets and macroeconomic variables holds implications for investors, as well as for policy makers. The short run analysis will reveal fundamental functions of stock markets in recognizing changes in economic conditions, or in signaling the future performance of the macroeconomy. Finally, the results of this study based on ASEAN economies are likely to hold implications for other small emerging economies.

The remainder of this study is structured as follows. Section 2 deals with the hypothesized model between stock prices and macroeconomic factors. Data details are provided in Section 3. Section 4 contains the empirical results and their interpretations. Finally, Section 5 concludes this study with concluding remarks and policy implications.

2. The hypothesized model

The basis of our hypothesized model is the interrelationship among the four markets, i.e., the goods market, the money market, the securities market and the labor market. However, Walras' law allows any one of these markets to be dropped from analysis. Thus, following the literature in the analysis of securities markets, the labor market is dropped from explicit consideration. However, since we are dealing with trade-oriented countries we have included an external competitiveness measure which plays a significant role in their economies. Following the previous literature (e.g., Chen et al., 1986; Dhakal et al., 1993; Mukherjee & Naka, 1995, among others), the goods market variables considered are the gross national product (GNP), and the consumer price index (CPI). The money market variables considered are the money supply and the nominal interest rate. These selected variables cover a wide range of macroeconomic aspects. The security market is represented by stock price indices. Finally, as an external competitiveness measure the nominal exchange rate of each country *vis-a-vis* the U.S. dollar is included in the model. We believe that for these trade oriented developing economies the exchange rate plays a significant role in the stock market movements. The exchange rate takes into account the foreign exchange market and the trade balance. Thus, we investigate the long and short run relationship between stock price indices (SP) and GNP, CPI, money supply (MON), the nominal interest rate (INT), exchange rate (EX), by considering the following model:

$$X_t = (\mathrm{SP}_t, \mathrm{GNP}_t, \mathrm{CPI}_t, \mathrm{MON}_t, \mathrm{INT}_t, \mathrm{EX}_t)' \tag{1}$$

Following Geske and Roll (1983), Chen et al. (1986), Fama (1990), and Mukherjee and Naka (1995) among others, we hypothesize a positive relation between stock prices and GNP. The level of real economic activity, or GNP, will likely influence stock prices through its impact on corporate profitability in the same direction: an increase in output may increase expected future cash flows and, hence, raise stock prices, while the opposite effect would be valid in a recession.

The relation between the increased price level and stock prices has been generally theorized as negative (Fama & Schwert, 1977; Fama, 1981; Chen et al., 1986). In a competitive economy, inflation raises a firm's production costs, decreases its future cash flow, and lowers its revenue. DeFina (1991) attributes this negative effect of the aggregate price level on stock prices to nominal contracts that disallow the immediate adjustments of the firm's revenue and costs. However, one would argue that stock prices could react positively to the change in price level through hedging. Equities serve as a hedge against inflation as they represent claims on real assets.

We hypothesize that the money supply may have a positive or a negative effect on stock prices. Changes in money supply may affect stock prices through changes in portfolio substitution or inflationary expectations. Dhakal et al. (1993) explains the money supply stock prices interaction through the portfolio substitution such that a change in the money supply causes a change in the equilibrium position of money in relation to other assets in the portfolio, altering the demand for other assets that compete with money balances. *Ceteris paribus* an increase in the money supply creates an excess supply of money balances and an excess demand for equity, and results in an increase in equity prices. However, a negative effect of the money supply on stock prices is also conceivable through the positive inflationary effect.

We hypothesize a negative relation between interest rates and stock prices. The volatility of interest rates is definitely critical for the asset pricing. The standard economic argument revolves around the discount rate used in computing the present value of asset prices. An increase in interest rates raises the required rate of return, which in turn inversely affects the value of the asset. Measured as the opportunity cost, the nominal interest rate will affect investors' decisions on asset holdings. A rise in this opportunity cost will motivate them to substitute equity shares for other assets in their portfolios. Thus, an increase in interest rates has a negative effect on stock prices from the perspective of asset portfolio allocation. Also, an increase in interest rates may cause a recession and thus cause a decline in future corporate profitability. Corporate profitability may also be reduced by rising financing costs due to rising interest rates. Finally, the higher interest rates have discouraging effects on mergers, acquisitions and buyouts. Among others, Abdullah and Hayworth (1993) hypothesized a negative relation between interest rates and U.S. stock returns. Chen et al. (1986) provide empirical support on this negative relationship between interest rate and equity prices.

We hypothesize a positive relation between the exchange rate and the stock price. Solnik (1987), Soenen and Hennigar (1988), Ma and Kao (1990), and Mukherjee and Naka (1995) among others, indicate that both exchange rate levels and changes affect the performance of a stock market. For an export dominated country, Ma and Kao (1990), and Mukherjee and Naka (1995) suggest that currency depreciation will have a favorable impact on a domestic stock market. As the ASEAN's currencies depreciate against the U.S. dollar, products exported from the ASEAN countries become cheaper in the world market. As a result, if the demand for these goods is elastic, the volume of exports from these countries would increase, which in turn causes higher cash flows, profits and the stock price of the domestic companies. The opposite should hold when the currencies of these countries appreciates against the U.S. dollar.

3. Data

Monthly data from 1985 to 1996 is used in this study. The choice of time period corresponds to the parallel growth in stock markets and economies in all five ASEAN countries. ASEAN stock prices are the end-of-period closing share price indices. They are the Jakarta composite stock price index (JCSPI) for Indonesia, the Kuala Lumpur stock exchange composite index (KLSE) for Malaysia, Philippine stock exchange composite index (PSE) for Philippines, the stock exchange of Singapore index (SES) for Singapore, and the stock exchange of Thailand index (SET) for Thailand. These stock price indexes are obtained from the World Stock Exchange Fact Book (1997) and DataStream (Thailand). All other variables are obtained from the June 1999 volume of International Financial Statistics CD-ROM. Nominal GNP is used as a measure of economic activity. Since the monthly data on GNP or the industrial production index for these countries is not available, we interpolated the nominal GNP annual series to the monthly frequency by using the expand procedure in SAS/ETS. CPI represents the aggregate price level. M1 is used to represent the money supply. Short term interest rate is represented by the treasury bill rate in Philippines. The remaining ASEAN-4 countries use the money market rate for the short term interest rate. Exchange rate is represented by the market rate in Indonesia, Philippines and

Singapore. The official rate is used for Malaysia and Thailand. All series are transformed into natural logs prior to the empirical analysis.[1]

4. Empirical results

4.1. Long run relationship

First, the stationarity of each series is examined by using the Dickey–Fuller, augmented Dickey–Fuller (ADF) (Said & Dickey, 1984) and Phillips and Perron (Phillips & Perron, 1988; Perron, 1988) tests. Since the methodology of testing for unit roots is well known, the details are omitted. To save space only the ADF and PP test statistics for log first difference based on a standard regression with a constant and time trend are reported in Table 1. Both the ADF and PP tests fail to reject the null hypothesis of the existence of a unit root in log levels but reject the same null hypothesis in the log first difference of the series. Thus, all the time series used in this study are integrated of order 1, or $I(1)$.

Next, the number of significant cointegrating vectors are tested by using the maximum likelihood based $\lambda_{\max}$ and λ_{trace} statistics introduced by Johansen (1988, 1991), and Johansen and Juselius (1990). Prior to testing for the number of significant cointegrating vectors, the likelihood ratio (LR) tests are performed to determine the lag length of the vector autoregressive system. The LR tests yield lag lengths of 6, 7, 8, 3, and 5 for Indonesia, Malaysia, Philippines, Singapore, and Thailand, respectively. Following Johansen (1992), a systematic test procedure for the model specification is performed to examine both the rank order and the deterministic component for the cointegrating system simultaneously (see also Harris, 1995, p. 97). The λ_{trace} statistics to test for the deterministic components are reported in Table 2. Table 2 reveals that there are deterministic trends in levels of data and no intercept in the cointegrating vectors for Indonesia, Philippines, and Thailand, while the long run models for Malaysia and Singapore should contain an intercept as the deterministic term.[2] We conjecture that strengths of their economies and security markets contribute to the difference in the model specification. Note that the stock market of Singapore was delinked from the exchange in Malaysia, and that could be a reason for similar models in two countries. Also, economically, it is undoubtedly a fact that the economies in Malaysia and Singapore are much more stable than those of the rest of ASEAN countries.

The λ_{trace} and $\lambda_{\max}$ statistics are presented in Table 3. Since the λ_{trace} statistics take into account all $(n - r)$ of the smallest eigenvalues, it tends to have more power than the $\lambda_{\max}$ statistics (Kasa, 1992; Serletis & King, 1997). Moreover, Johansen and Juselius (1990) emphasize the use of the λ_{trace} statistics in cases where a conflict between these two test statistics occurs. Therefore, we observe that at the 5% level of significance, there are four cointegrating vectors significant in Thailand, and three in Indonesia, Malaysia, Philippines and Singapore. The Lagrange multiplier test statistics in Table 4 indicate no serial correlation among residuals for each country.

Johansen and Juselius (1990) noted that the first cointegrating vector corresponding to the largest eigenvalue is the most correlated with the stationary part of the model, and hence is most useful. Moreover, the coefficients in the first cointegrating vector seem to possess the

Table 1
Unit root tests for ASEAN stock prices and macroeconomic variables (log first difference)

	Log length	ADF test		PP test						
		Model 1	Model 2	Model 1			Model 2			
		t_{α^*}	$t_{\alpha^\sim}$	$Z(t_{\alpha^*})$	$Z(\alpha^*)$	$Z(\Phi_1)$	$Z(t_{\alpha^\sim})$	$Z(\alpha^\sim)$	$Z(\Phi_2)$	$Z(\Phi_3)$
Indonesia										
SP	0	-10.57^{**}	-10.54^{**}	-10.60^{**}	-129.98^{**}	55.24^{**}	-10.57^{**}	-129.89^{**}	36.22^{**}	54.32^{**}
GNP	12	-4.51^{*}	-4.52^{*}	-6.80^{**}	-113.82^{**}	35.40^{**}	-4.84^{**}	-24.68^{*}	25.51^{*}	39.18^{**}
CPI	9	-5.01^{**}	-4.98^{**}	-10.16^{**}	-110.71^{**}	54.02^{**}	-10.11^{**}	-110.69^{**}	32.84^{**}	49.25^{**}
MON	4	-6.49^{**}	-6.47^{**}	-18.61^{**}	-187.42^{**}	222.08^{**}	-18.54^{**}	-187.51^{**}	114.37^{**}	171.53^{**}
INT	2	-8.35^{**}	-8.32^{**}	-12.41^{**}	-126.56^{**}	75.01^{**}	-12.35^{**}	-126.53^{**}	49.59^{**}	74.37^{**}
EX	0	-11.92^{**}	-11.99^{**}	-11.93^{**}	-139.99^{**}	106.83^{**}	-12.00^{**}	-139.55^{**}	46.93^{**}	70.39^{**}
Malaysia										
SP	5	-6.06^{**}	-6.05^{**}	-11.68^{**}	-147.75^{**}	67.85^{**}	-11.70^{**}	-147.90^{**}	44.44^{**}	66.66^{**}
GNP	1	-2.95^{*}	-2.04	-9.91^{**}	-87.59^{**}	36.35^{**}	-4.37^{**}	-81.25^{**}	26.96^{**}	48.31^{**}
CPI	0	-10.13^{**}	-10.66^{**}	-10.04^{**}	-110.77^{**}	49.79^{**}	-10.61^{**}	-109.30^{**}	36.01^{**}	54.02^{**}
MON	12	-2.92^{*}	-3.51^{*}	-13.34^{**}	-143.00^{**}	110.36^{**}	-13.62^{**}	-141.65^{**}	60.73^{**}	91.07^{**}
INT	10	-3.52^{**}	-3.58^{*}	-11.93^{**}	-142.73^{**}	70.21^{**}	-11.94^{**}	-142.53^{**}	46.47^{**}	69.70^{**}
EX	1	-6.87^{**}	6.87^{**}	-11.35^{**}	-145.28^{**}	73.67^{**}	-11.32^{**}	-145.34^{**}	41.90^{**}	62.82^{**}
Philippines										
SP	0	-10.21^{**}	-10.33^{**}	-10.18^{**}	-118.16^{**}	53.02^{**}	-10.28^{**}	-118.15^{**}	34.04^{**}	51.06^{**}
GNP	1	-3.02^{*}	-3.31	-6.50^{*}	-54.44^{**}	26.83^{**}	-4.51^{**}	-71.95^{**}	24.94^{**}	39.36^{**}
CPI	0	-6.72^{**}	-6.76^{**}	-6.62^{**}	-66.39^{**}	20.68^{**}	-6.67^{**}	-67.50^{**}	13.60^{**}	20.41^{**}
MON	11	-4.65^{**}	-4.75^{**}	-12.99^{**}	-139.09^{**}	135.33^{**}	-12.95^{**}	-139.21^{**}	54.69^{**}	81.98^{**}
INT	5	-6.78^{**}	-6.75^{**}	-11.06^{**}	-112.94^{**}	188.67^{**}	-11.01^{**}	-122.93^{**}	38.95^{**}	58.41^{**}
EX	0	-13.17^{**}	-13.23^{***}	-13.11^{**}	-167.89^{**}	108.32^{**}	-13.16^{**}	-167.48^{**}	57.00^{**}	85.50^{**}
Singapore										
SP	2	-7.44^{**}	-7.41^{**}	-10.83^{**}	-127.59^{**}	57.55^{**}	-10.79^{**}	-127.61^{**}	37.68^{**}	56.53^{**}
GNP	12	-2.93^{*}	-3.51^{*}	-7.17^{**}	-116.41^{**}	44.87^{**}	-8.75^{**}	-99.84^{**}	35.48^{**}	86.54^{**}
CPI	0	-12.46^{**}	-12.77^{**}	-12.44^{**}	-155.29^{**}	77.07^{**}	-12.76^{**}	-154.04^{**}	53.40^{**}	80.09^{**}
MON	1	-12.61^{**}	-12.56^{**}	-23.71^{**}	-194.01^{**}	156.61^{**}	-23.62^{**}	-194.01^{**}	186.58^{**}	279.86^{**}
INT	1	-10.68^{**}	-10.65^{**}	-12.75^{**}	-137.47^{**}	136.28^{**}	-12.70^{**}	-137.45^{**}	52.60^{**}	78.89^{**}
EX	0	-12.51^{**}	-12.46^{**}	-12.49^{**}	-152.53^{**}	80.09^{**}	-12.44^{**}	-152.51^{**}	50.77^{**}	76.13^{**}

Table 1 (*Continued*)

	Log length	ADF test		PP test						
		Model 1	Model 2	Model 1			Model 2			
		t_{α^*}	$t_{\alpha^\sim}$	$Z(t_{\alpha^*})$	$Z(\alpha^*)$	$Z(\Phi_1)$	$Z(t_{\alpha^\sim})$	$Z(\alpha^\sim)$	$Z(\Phi_2)$	$Z(\Phi_3)$
Thailand										
SP	0	-10.03^{**}	-10.20^{**}	-10.03^{**}	-119.72^{**}	51.03^{**}	-10.18^{**}	-120.20^{**}	33.38^{**}	50.07^{**}
GNP	12	-2.92^{*}	-2.92^{*}	-9.11^{**}	-107.20^{**}	67.86^{**}	4.90^{**}	-76.37^{**}	15.45^{**}	26.65^{**}
CPI	11	-3.03^{*}	-3.56^{*}	-9.95^{**}	-102.72^{**}	102.36^{**}	-10.13^{**}	-101.44^{**}	32.68^{**}	48.99^{**}
MON	12	-2.85	-2.87	-10.44^{**}	-124.39^{**}	53.40^{**}	-10.41^{**}	-124.47^{**}	34.99^{**}	52.48^{**}
INT	2	-9.09^{**}	-9.13^{**}	-12.89^{**}	-123.93^{**}	130.20^{**}	-12.90^{**}	-123.45^{**}	54.01^{**}	81.02^{**}
EX	5	-6.52^{**}	-6.85^{**}	-13.97^{**}	-173.82^{**}	110.06^{**}	-14.40^{**}	-171.29^{**}	68.69^{**}	103.01^{**}
Critical values for $T = 100$										
95%		-2.89	-3.45	-2.89	-13.70	4.71	-3.45	-20.70	4.88	6.49
99%		-3.51	-4.04	-3.51	-19.80	6.70	-4.04	-27.40	6.50	8.73

Note: model 1 is the model with non-zero mean, while model 2 represents the model with non-zero mean and linear trend. The optimal lag length for each of the autoregressive process of ADF test is settled by Akaike Information Criterion (AIC). The lag lengths used in the PP tests are determined by Schwert (1987) formula: $l_{144} = \mathrm{Int}\{4(T/100)^{0.25}\}$ to be four. The adjusted Z-test statistics are given in detail in Perron (1988, pp. 308–309), (∗) and (∗∗) indicate the rejection of the corresponding null hypothesis at the 1% significance levels.

Table 2
Tests for deterministic components in the cointegration model: λ_{trace} statistics

Null	Indonesia (6)			Malaysia (7)			Philippines (8)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
$r = 0$	144.92*	133.13*	162.12*	171.49*	162.40*	192.72*	188.07*	165.64*	209.41*
$r = 1$	98.25*	86.71*	113.50*	94.75*	85.81*	116.02*	127.86*	105.93*	149.67*
$r = 2$	59.01*	47.64*	72.17*	59.40*	50.66*	80.70*	81.87*	63.73*	93.94*
$r = 3$	36.89*	27.45	44.41	31.47	24.01	47.43	45.06*	26.92	56.79
$r = 4$	16.81	9.39	26.02	11.95	5.82	20.78	21.24	8.70	25.56
$r = 5$	7.42	0.02	9.18	5.37	0.45	3.18	7.46	0.04	8.11
	Singapore (3)			Thailand (5)			Critical value		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
$r = 0$	140.70*	131.76*	153.81*	180.08*	166.36*	184.50*	102.14	94.13	114.90
$r = 1$	84.05*	75.72*	97.63*	119.77*	106.07*	120.52*	76.07	68.52	87.31
$r = 2$	55.57*	47.80*	66.14*	77.42*	65.29*	78.09*	53.12	47.21	62.99
$r = 3$	32.10	24.39	42.32	49.50*	38.41*	50.96*	34.91	29.68	42.44
$r = 4$	15.78	8.45	21.43	24.67*	14.27	26.12	19.96	15.41	25.32
$r = 5$	6.42	0.15	7.60	6.21	2.25	11.95	9.24	3.76	12.25

Model 1: an intercept is restricted to the cointegrating space (the long run model). Model 2: deterministic trends in the levels and no intercept in the cointegrating vectors. Model 3: model with a linear trend in the cointegration vectors. The numbers in the parenthesis are the lag lengths selected by the likelihood ratio test. The test procedure is to go from the most restrictive model (model 1) to the less restrictive model (model 3). At each stage, the λ_{trace} test statistic is compared to its critical value. The deterministic component is then determined where the null hypothesis is not rejected for the first time. Critical values are obtained from Osterwald-Lenum (1992), (∗) indicates rejection of the null hypothesis at 5% significant level.

signs consistent with our *a priori* hypotheses. Hence, we premise our long run and short run analysis on the first cointegrating vector. After normalizing the coefficients of stock price indices to one, the restricted long run relationships between stock prices and macroeconomic variables for ASEAN countries can be expressed as

Indonesia $SP = 28.486GNP - 12.214CPI - 19.404MON + 4.699INT + 0.463EX$
Malaysia $SP = 4.823GNP - 0.047CPI + 3.991MON + 0.779INT + 0.581EX - 35.596$
Philippines $SP = 37.691GNP - 44.553CPI - 4.827MON - 4.524INT + 17.459EX$
Singapore $SP = 0.998GNP - 3.947CPI + 2.442MON - 0.057INT - 1.104EX - 20.563$
Thailand $SP = 21.165GNP - 676.182CPI + 192.698MON - 7.003INT - 23.201EX$

Next, by using likelihood ratio (LR) test statistics proposed by Johansen (1991) we test the significance of the goods market variables, i.e., GNP and CPI; of the money market variables, i.e., money supply and interest rates and the exchange rate separately. From Table 5, the LR tests indicate that coefficients of goods and money markets variables are statistically significant. This observation is consistent with the macroeconomic theories established by the classical, Keynesian, and real business cycle schools of thought that goods and money markets are fundamental determinants of share price values. Moreover, the LR

Table 3
Tests for the number of cointegrating vectors between stock prices and selected macroeconomic variables

Null	Deterministic series: unrestricted constant (or model 2)										
	Indonesia (6)			Philippines (8)			Thailand (5)			Critical value at 95% quantile	
	Eigenvalue	Test statistics		Eigenvalue	Test statistics		Eigenvalue	Test statistics		Test statistics	
		λ_{max}	λ_{trace}		λ_{max}	λ_{trace}		λ_{max}	λ_{trace}	λ_{max}	λ_{trace}
$r = 0$	0.2856	46.42*	133.13*	0.3554	59.71*	165.64*	0.3519	60.29*	166.36*	39.37	94.15
$r = 1$	0.2465	39.06*	86.71*	0.2667	42.20*	105.93*	0.2542	40.77*	106.07*	33.46	68.52
$r = 2$	0.1361	20.19	47.65*	0.2371	36.81*	63.74*	0.1758	26.88	65.30*	27.07	47.21
$r = 3$	0.1227	18.06	27.46	0.1254	18.22	26.92	0.1595	24.15	38.42*	20.97	29.68
$r = 4$	0.0657	9.37	9.39	0.0616	8.65	8.70	0.0828	12.01	14.27	14.07	15.41
$r = 5$	0.0001	0.02	0.02	0.0004	0.05	0.05	0.0161	2.26	2.26	3.76	3.76

Null	Deterministic series: constant restricted to coint. space (or model 1)							
	Malaysia (7)			Singapore (3)			Critical value at 95% quantile	
	Eigenvalue	Test statistics		Eigenvalue	Test statistics		Test statistics	
		λ_{max}	λ_{trace}		λ_{max}	λ_{trace}	λ_{max}	λ_{trace}
$r = 0$	0.4288	76.73*	171.49*	0.3308	56.64*	140.70*	40.30	102.14
$r = 1$	0.2274	35.35*	94.76*	0.1829	28.49	84.06*	34.40	76.07
$r = 2$	0.1845	27.93	59.41*	0.1533	23.47	55.57*	28.14	53.12
$r = 3$	0.1328	19.52	31.47	0.1093	16.32	32.10	22.00	34.91
$r = 4$	0.0469	6.59	11.96	0.0642	9.36	15.78	15.67	19.96
$r = 5$	0.0384	5.37	5.37	0.0446	6.43	6.43	9.24	9.24

Note: the number in parentheses are the lag lengths selected by likelihood ratio test. The deterministic term included in the model is statistically selected by the procedure suggested by Johansen (1992). Critical values are obtained from Osterwald-Lenum (1992), (∗) indicates rejection of the null hypothesis at 5% significant level.

Table 4
Tests for serial correlation in residuals

	LM (1)		LM (4)	
	Chi-square (36)	*P*-value	Chi-square (36)	*P*-value
Indonesia	30.610	0.72	54.077	0.03
Malaysia	33.824	0.94	29.970	0.75
Philippines	40.699	0.27	39.809	0.30
Singapore	28.468	0.81	33.952	0.57
Thailand	31.906	0.66	44.254	0.16

Note: Lagrange multiplier or LM(k) tests the null hypothesis of no serial correlation up to order k in the residuals.

tests reject the null hypothesis that the foreign exchange rates do not belong to the corresponding cointegrating space for Philippines, but fail to reject the same null hypothesis for other ASEAN countries. We conjecture that the independent floating exchange rate policy adopted by Philippines facilitates a long run relationship between the exchange rate and stock prices. Philippines adopted the independent floating exchange rate policy for the entire study period, while other ASEAN foreign exchange rates are managed or pegged to major currencies (IFS, June 1999).

Table 5
Likelihood ratio statistics to test restrictions in the cointegrating vectors

Country	Null hypothesis	LR statistics	*P*-value
Restriction on the goods market			
INDO	$\Re_1$: $\beta = H_{1\mathrm{IN}}\varphi$	$Q(2) = 7.21$	0.03
MALA	$\Re_1$: $\beta = H_{1\mathrm{MA}}\varphi$	$Q(2) = 30.40$	0.00
PHIL	$\Re_1$: $\beta = H_{1\mathrm{PH}}\varphi$	$Q(2) = 14.03$	0.00
SING	$\Re_1$: $\beta = H_{1\mathrm{SI}}\varphi$	$Q(2) = 11.01$	0.00
THAI	$\Re_1$: $\beta = H_{1\mathrm{TH}}\varphi$	$Q(2) = 17.94$	0.00
Restriction on the money market			
INDO	$\Re_2$: $\beta = H_{2\mathrm{IN}}\varphi$	$Q(2) = 13.06$	0.00
MALA	$\Re_2$: $\beta = H_{2\mathrm{MA}}\varphi$	$Q(2) = 38.70$	0.00
PHIL	$\Re_2$: $\beta = H_{2\mathrm{PH}}\varphi$	$Q(2) = 11.88$	0.00
SING	$\Re_2$: $\beta = H_{2\mathrm{SI}}\varphi$	$Q(2) = 20.50$	0.00
THAI	$\Re_2$: $\beta = H_{2\mathrm{TH}}\varphi$	$Q(2) = 28.44$	0.00
Restriction on the foreign exchange rate			
INDO	$\Re_3$: $\beta = H_{3\mathrm{IN}}\varphi$	$Q(1) = 0.20$	0.89*
MALA	$\Re_3$: $\beta = H_{3\mathrm{MA}}\varphi$	$Q(1) = 0.70$	0.40*
PHIL	$\Re_3$: $\beta = H_{3\mathrm{PH}}\varphi$	$Q(1) = 16.92$	0.00
SING	$\Re_3$: $\beta = H_{3\mathrm{SI}}\varphi$	$Q(1) = 0.80$	0.35*
THAI	$\Re_3$: $\beta = H_{3\mathrm{TH}}\varphi$	$Q(1) = 0.02$	0.89*

Note: (*) indicates the rejection of the null hypothesis at the 5% significance, $\Re_1$ tests the exclusion of the goods market variables (GNP, CPI) from the cointegrating vector, $\Re_2$ tests the exclusion of the money market variables (MON, INT) from the cointegrating vector, $\Re_3$ tests the exclusion of the foreign exchange rate (EX) from the cointegrating vector.

The signs of the coefficients of GNP and CPI are as anticipated. Growth in output and stock price indices are positively related in the long run; an increase in output increases expected future cash flow, corporate profitability, and, thereby, raises stock prices, while the opposite outcome is likely to occur in a recession. Furthermore, we observe a negative effect of CPI on SP in all the countries considered which is also consistent with our *a priori* hypotheses. An increase in price level, raises the production cost, which in turn becomes a threat to profitability. The above findings are consistent for Japan (Mukherjee & Naka, 1995) and for the United States (Fama & Schwert, 1977; Chen et al., 1986, etc.). Regarding the money market variables, the signs of MON on SP are observed positive in Malaysia, Singapore, and Thailand, and consistent with those of Mukherjee and Naka (1995) for Japan, and Bulmash and Trivoli (1991), and Dhakal et al. (1993) for the United States. Conversely, the money growths in Indonesia and Philippines negatively influence their stock market performances. In the first group of countries the positive effect on the stock prices *via* augmented corporate earnings and economic stimulus provided by money growth overpowers the negative effect resulting from increased prices. On the other hand, the negative impacts through higher prices in Indonesia and Philippines seem to dominate the favorable effect from the money supply. Next, the negative relation between INT and SP is observed in Philippines, Singapore, and Thailand. This indicates that in these countries the short term interest rate represents alternative investment opportunities. As the interest rate rises, investors tend to switch out of stocks, causing stock prices to fall. The reverse would be true for falling rates. The negative effect of INT on SP also holds for the U.S. stock market (Chen et al., 1986; Dhakal et al., 1993, etc.). In contrast, the long run effect of INT on SP is observed positive for Indonesia and Malaysia. One possible explanation may be that for these countries the long term bond rate serves as a better approximation than the short term interest rate as the discount rate in the basic stock price valuation model. According to Cole, Scott and Wellons (1995), Indonesia and Malaysia had unique reference interest rates, namely the Singapore Interbank Offer Rate (SIBOR) with Singapore's interest rate. Hence, the negative INT-SP effect in these countries could be suppressed. Bulmash and Trivoli (1991) also observe a negative relation between the long term bond rate and stock prices for the United States. Finally, the effect of EX on SP in Indonesia, Malaysia, and Philippines is observed positive, consistent with the Japanese stock market observed by Mukherjee and Naka (1995). The depreciation of the Indonesian rupiah, the Malaysian ringgit, and Philippine peso against the U.S. dollar strengthens their domestic competitiveness in the world exporting market and positively influences their stock market performance. On the other hand, the negative long run relation between stock prices and exchange rates is observed in Singapore and Thailand. This could be justified through the asset view of the exchange rate that the demand and value of local currencies are driven by foreign investors' willingness to hold local assets (Ajayi & Mougoue, 1996).

4.2. Causal analyses

In a cointegrated set of variables, Granger (1988) suggests that the short term causal relations between these variables should be examined within the framework of the vector error correction model (VECM).[3] The system of the short run dynamic of the stock price series can be written as

$$\Delta \mathrm{SP}_t = \alpha_1 + \beta_1 \,\mathrm{EC}_{t-1} + \sum_{i=1}^{K} \delta_{1i}\, \Delta \mathrm{SP}_{t-i} + \sum_{i=1}^{K} \theta_{1i}\, \Delta \mathrm{GNP}_{t-i} + \sum_{i=1}^{K} \xi_{1i}\, \Delta \mathrm{CPI}_{t-i} + \sum_{i=1}^{K} \rho_{1i}\, \Delta \mathrm{MON}_{t-i} + \sum_{i=1}^{K} \omega_{1i}\, \Delta \mathrm{INT}_{t-i} + \sum_{i=1}^{K} \tau_{1i}\, \Delta \mathrm{EX}_{t-i} + \varepsilon_t^{\mathrm{SP}} \quad (2)$$

where EC_{t-1} is the error correction term obtained from the cointegration vector[4] and β, δ, θ, ξ, ρ, ω and τ are parameters to be estimated, K is the lag length,[5] $\varepsilon_t^{\mathrm{SP}}$ are stationary random processes with mean zero and constant variance. The VECM for other variables can be written similarly.

Granger (1988) notes that a VECM provides two channels through which the causality can be detected. For example, exchange rates Granger-cause stock prices if either τ_{1i} are jointly significant (i.e., H_0: $\tau_{11} = \tau_{12} = \cdots = \tau_{1k} = 0$ is rejected) or the error term coefficient β_1 is significant. The joint significance of the lags of each variable is tested by the F-statistics and the coefficient of the lagged error correction term is tested by the t-statistics. Similarly, CPI Granger-causes SP if either values of ξ_{1i} are jointly significant, or β_1 is significant. The causal test statistics are reported in Table 6, and the causal relations are qualitatively summarized in Table 7.

The first causal relationship is hypothesized to test whether historical values of economic activities can predict current and future stock price movements. From Table 7, we observe that the macroeconomic variables Granger-cause SP in all five ASEAN countries. This evidence suggests that the values of ASEAN-5 stock prices are functions of past and current values of macroeconomic variables since they constitute the information set used to generate a flow of expected future income. The predictive power of economic factors over the share prices is also observed by Abdullah and Hayworth (1993), Dhakal et al. (1993), and Pesaran and Timmermann (1995).

Next, the possibility that stock prices Granger-cause macroeconomic variables is investigated. ASEAN-5 stock prices seem to have predictive power in both goods and money markets. The null hypotheses that stock prices do not Granger-cause goods market variables (GNP and CPI) are rejected in all five ASEAN countries. We also find evidence of causalities from stock prices to money market variables (MON and INT) in Indonesia, Malaysia and Thailand. A similar pattern of causality in the U.S. stock market was observed by Abdullah and Hayworth (1993), and Dhakal et al. (1993). Moreover, the F-statistics in Table 6 indicate that the lagged stock price values are significant for the exchange rate equations in Philippines and Singapore, implying that Granger causality from SP to EX is observed in both countries. The results from this reverse causality suggest that past values of stock price variations can be perceived as a good indicator for their macroeconomic performance as a whole.

It is worth noting that feedback relationships are observed between SP and GNP, and between SP and CPI for all five ASEAN countries; between SP and MON and between SP and INT in Indonesia, Malaysia and Thailand; between SP and EX in Philippines and Singapore. The statistical significance of causal relations and feedback relationships verify

Table 6
Granger causality tests based on vector error correction model (VECM)

Country	Dependent variable	Excluded variable: F-statistics						t-Statistics
		ΔSP	ΔGNP	ΔCPI	ΔMON	ΔINT	ΔEX	EC_{t-1}
Indonesia	ΔSP	NA	1.16	0.51	2.45*	0.79	0.32	−3.58*
	ΔGNP	4.62*	NA	NA	NA	NA	NA	1.62
	ΔCPI	0.43	NA	NA	NA	NA	NA	1.76**
	ΔMON	1.72	NA	NA	NA	NA	NA	2.24*
	ΔINT	0.72	NA	NA	NA	NA	NA	3.30*
	ΔEX	0.09	NA	NA	NA	NA	NA	0.77
Malaysia	ΔSP	NA	4.46*	1.66	3.55*	4.97*	1.03	−5.21*
	ΔGNP	2.54*	NA	NA	NA	NA	NA	0.62
	ΔCPI	0.71	NA	NA	NA	NA	NA	−1.95**
	ΔMON	0.72	NA	NA	NA	NA	NA	2.96*
	ΔINT	5.66*	NA	NA	NA	NA	NA	2.79*
	ΔEX	1.40	NA	NA	NA	NA	NA	−0.91
Philippines	ΔSP	NA	2.14*	1.78**	2.80*	1.29	1.70	−2.19**
	ΔGNP	1.86**	NA	NA	NA	NA	NA	−1.65
	ΔCPI	1.93**	NA	NA	NA	NA	NA	−6.18*
	ΔMON	1.77	NA	NA	NA	NA	NA	−1.08
	ΔINT	1.00	NA	NA	NA	NA	NA	0.25
	ΔEX	2.73*	NA	NA	NA	NA	NA	0.78
Singapore	ΔSP	NA	0.11	1.07	1.51	0.11	0.97	−3.63*
	ΔGNP	1.21	NA	NA	NA	NA	NA	−3.19*
	ΔCPI	0.33	NA	NA	NA	NA	NA	1.93**
	ΔMON	0.15	NA	NA	NA	NA	NA	1.51
	ΔINT	0.03	NA	NA	NA	NA	NA	−0.02
	ΔEX	7.19*	NA	NA	NA	NA	NA	−4.59*
Thailand	ΔSP	NA	0.58	1.69	1.07	0.83	0.14	−1.87**
	ΔGNP	1.01	NA	NA	NA	NA	NA	−2.71*
	ΔCPI	1.40	NA	NA	NA	NA	NA	−2.17*
	ΔMON	0.77	NA	NA	NA	NA	NA	4.09*
	ΔINT	1.18	NA	NA	NA	NA	NA	−2.17*
	ΔEX	0.94	NA	NA	NA	NA	NA	1.56

Note: (∗) and (∗∗) indicate the null hypothesis of no causality is rejected at the 5% and 10% level of significance. NA: not applicable.

the fundamental and theoretical linkages between stock prices and macroeconomic variables in ASEAN countries.

4.3. Innovation accounting analyses

The innovation accounting analyses is likely to be sensitive to the ordering of the variables. The variables are arranged as follows: stock price is placed first since it is the primary variable of the study, followed by GNP, CPI, MON and INT. As most of ASEAN-5 foreign exchange rates are managed or pegged to major currencies, the exchange rate is

Table 7
Causal relations between stock prices and macroeconomic variables

Country	GNP ⇒ SP	CPI ⇒ SP	MON ⇒ SP	INT ⇒ SP	EX ⇒ SP
Indonesia	Yes	Yes	Yes	Yes	Yes
Malaysia	Yes	Yes	Yes	Yes	Yes
Philippines	Yes	Yes	Yes	Yes	Yes
Singapore	Yes	Yes	Yes	Yes	Yes
Thailand	Yes	Yes	Yes	Yes	Yes
	SP ⇒ GNP	SP ⇒ CPI	SP ⇒ MON	SP ⇒ INT	SP ⇒ EX
Indonesia	Yes	Yes	Yes	Yes	No
Malaysia	Yes	Yes	Yes	Yes	No
Philippines	Yes	Yes	No	No	Yes
Singapore	Yes	Yes	No	No	Yes
Thailand	Yes	Yes	Yes	Yes	No

Note: (⇒) represents the Granger causality.

considered exogenous and is placed last. Naka and Tufte (1997) consider this the most common ordering found in the literature. While the present placement may reflect our priors, it should be noted that changes in this sequence did not affect results significantly.[6]

An impulse response analysis for a horizon of 4 years illustrating the response of the stock price to a one standard deviation shock to all macroeconomic variables, and *vice versa* is reported in Table 8.[7] ASEAN-5 stock price indices seem to be sensitive to shocks from the stock prices themselves as well as from their own macroeconomic variables. Initially, stock prices respond intensively to a shock in itself. Over the 4-year period, the effect remains substantial for Indonesia, Malaysia and Philippines, but decreases in Singapore and Thailand. For innovations in macroeconomic variables, stock prices react primarily to INT and MON, while GNP, CPI and EX seem to produce less response. The discussion does not hold for Philippines where one standard deviation shock in EX and CPI cause the first and second largest response in SP. The impulse response analysis also suggests the impact of SP innovations on macroeconomic variables. INT in all five ASEAN countries respond to one standard deviation shock in SP, while SP innovations influence variations of GNP in Malaysia and Singapore, MON in Malaysia, and EX in Philippines. The substantial role of EX in the impulse response analysis for Philippines supports the significance of the exchange rate in its long run cointegrating relation.

The decomposition of the forecast error variance (FEV) of stock prices due to a shock in macroeconomic variables, and *vice versa* is reported in Table 9.[8] The variance decomposition analysis seems to reinforce the results of the impulse response analysis. Not surprisingly, at short horizons, the variances in all five ASEAN stock prices are mainly attributed to SP itself. However, the effect drops as the horizon lengthens. At the 4-year horizon, the portion of FEV explained by SP itself remains large in Malaysia and Philippines, but becomes less than 25% in other countries. For Indonesia, Singapore and Thailand, about 50% or more of the variance of SP can be attributed largely to innovations in INT, and slightly to MON. Moreover, about 40% of FEV of SP in Malaysia can be equally split between GNP and MON, while in Philippines the FEV of SP can be distributed among

Table 8
Impulse response analysis

Country	Steps ahead	Response of stock prices (to one standard deviation shock in)					
		SP	GNP	CPI	MON	INT	EX
Indonesia	10	0.0593	−0.0043	0.0235	−0.0476	0.0490	0.0176
	30	0.0320	0.0174	−0.0169	−0.0408	0.0902	0.0143
	48	0.0508	0.0098	0.0033	−0.0301	0.0709	0.0127
Malaysia	10	0.0348	0.0181	0.0065	0.0364	0.0053	0.0340
	30	0.0305	0.0244	−0.0012	0.0198	0.0075	0.0202
	48	0.0363	0.0397	0.0018	0.0337	0.0024	0.0336
Philippines	10	0.0373	−0.0258	−0.0301	−0.0187	−0.0442	0.0099
	30	0.0447	−0.0209	−0.0255	−0.0066	0.0039	−0.0470
	48	0.0414	−0.0089	−0.0259	−0.0007	−0.0029	−0.0532
Singapore	10	0.0259	0.0085	−0.0147	0.0183	−0.0385	−0.0232
	30	0.0208	0.0186	−0.0156	0.0133	−0.0412	−0.0298
	48	0.0158	0.0264	−0.0160	0.0152	−0.0466	−0.0310
Thailand	10	0.0089	0.0255	−0.0181	−0.0060	−0.0262	−0.0103
	30	−0.0080	0.0032	−0.0256	−0.0390	−0.0599	−0.0265
	48	−0.0211	−0.0134	−0.0276	−0.0462	−0.0454	−0.0175
		Response of macroeconomic variables (to one standard deviation shock in SP)					
		GNP	CPI	MON	INT	EX	
Indonesia	10	0.0024	0.0001	0.0063	0.0150	0.0007	
	30	0.0054	0.0005	0.0043	0.0096	0.0010	
	48	0.0043	0.0005	0.0045	−0.0045	0.0007	
Malaysia	10	0.0042	0.0001	0.0083	−0.0100	0.0010	
	30	0.0096	0.0014	0.0110	0.0269	0.0028	
	48	0.0143	0.0029	0.0183	0.0258	0.0021	
Philippines	10	−0.0016	−0.0046	−0.0005	−0.0090	−0.0111	
	30	−0.0031	−0.0067	−0.0012	−0.0258	−0.0137	
	48	−0.0028	−0.0064	−0.0010	−0.0252	−0.0144	
Singapore	10	−0.0031	0.0005	0.0059	−0.0412	−0.0047	
	30	−0.0087	−0.0016	−0.0021	−0.0534	−0.0015	
	48	−0.0230	−0.0032	−0.0087	−0.0499	0.0041	
Thailand	10	0.0015	0.0000	0.0031	0.0430	−0.0016	
	30	0.0018	0.0011	0.0001	0.0220	0.0007	
	48	−0.0014	0.0006	−0.0019	−0.0056	0.0005	

GNP, CPI, and INT. Lastly, an innovation in EX can explain the FEV of SP from a high of about 30% in Philippines, 20% in both Malaysia and Singapore, 10% in Thailand, and to a low of only 3% in Indonesia. For the variance of macroeconomic variables due to a shock in SP, a substantial portion (ranging from 10% to 40%) of FEV of GNP and INT in all ASEAN countries, with the exception of Thailand, are accounted for by SP innovations. Also, about 18% and 10% of GNP variance can be explained by SP innovations in Indonesia and

Table 9
Variance decomposition analysis

Country	Steps ahead	Forecast error variance of stock prices (explained by innovations)					
		SP	GNP	CPI	MON	INT	EX
Indonesia	10	63.01	2.89	1.97	10.40	17.56	4.16
	30	25.30	1.47	1.58	19.53	48.23	3.89
	48	22.70	1.75	1.51	15.97	55.13	2.94
Malaysia	10	49.38	9.57	0.56	27.29	1.33	11.87
	30	41.50	13.44	2.13	22.82	3.13	16.98
	48	35.56	20.02	1.12	22.30	1.82	19.17
Philippines	10	55.56	13.69	6.63	4.22	15.66	4.24
	30	48.09	7.27	14.27	2.97	9.75	17.64
	48	41.74	5.37	13.19	1.82	5.52	32.35
Singapore	10	63.98	0.54	2.39	11.44	16.72	4.93
	30	30.79	4.04	5.38	7.02	35.89	16.88
	48	21.54	7.51	5.61	6.21	40.17	18.96
Thailand	10	64.85	12.61	4.80	4.93	11.43	1.37
	30	18.58	6.33	8.09	12.56	43.30	11.13
	48	11.39	3.63	9.74	21.58	44.09	9.56
		Forecast error variance of macroeconomic variables (explained by innovations in SP)					
		GNP	CPI	MON	INT	EX	
Indonesia	10	17.73	1.57	7.12	1.88	0.76	
	30	33.01	0.86	18.81	8.73	0.54	
	48	28.98	1.09	17.73	7.42	0.62	
Malaysia	10	14.03	0.75	16.92	2.14	2.78	
	30	10.63	2.66	10.53	9.76	3.43	
	48	9.66	4.62	9.50	13.57	6.56	
Philippines	10	12.26	19.81	4.59	10.12	21.08	
	30	13.66	22.52	3.11	17.60	29.26	
	48	13.13	20.29	2.76	21.23	30.57	
Singapore	10	6.66	4.66	11.65	5.91	17.39	
	30	14.90	3.17	3.18	34.35	6.51	
	48	17.16	3.32	2.35	41.22	4.24	
Thailand	10	7.14	2.11	3.59	11.38	13.72	
	30	6.84	4.26	2.99	17.98	11.21	
	48	2.20	4.81	2.50	15.60	13.41	

Malaysia, respectively. Moreover, one standard deviation shock to SP in Philippines contribute to 20% of FEV in CPI, and 30% of FEV in EX, while in Thailand, a similar shock causes about 15% of the variance in INT and EX.

The innovation analyses reveals that all the five ASEAN stock markets drive, and are driven by their macroeconomic variables providing further evidence concerning the causal relationships between macroeconomic variables and the share prices in these countries. GNP, MON and INT are the most active variables in association with the stock price movements, while EX is an auxiliary agent in Philippines.

5. Conclusion and policy implications

The concurrence of growth in ASEAN stock markets and their economies in the last two decades raises empirical questions regarding these economic phenomena. This study investigates the linkage between stock prices and a set of selected macroeconomic variables, i.e., GNP, the consumer price index, the money supply, the short term interest rate, and the exchange rate in the short and long run.

We observe that in the long run, the stock prices are positively related to growth in output, and negatively to the aggregate price level. A negative long run relationship between stock prices and interest rates is observed in Philippines, Singapore and Thailand. However, a positive relation is observed in Indonesia and Malaysia. The better approximation of the long term over the short term interest rate as the discount rate justifies this positive relation. High inflation in Indonesia and Philippines influences the long run negative relation between stock prices and the money supply, while the money growth in Malaysia, Singapore and Thailand provokes the positive effect for their stock markets. Lastly, the exchange rate variable is positively related to stock prices in Indonesia, Malaysia, and Philippines, yet negatively in Singapore and Thailand. 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 ASEAN's share price values, while the long run relationship between the exchange rate and stock prices in Philippines is facilitated by the adopted independent floating exchange rate policy.

The Granger causality tests detect the causal relationships from the macroeconomic variables to stock prices in all five ASEAN stock markets. The findings indicate that the past values of macroeconomic variables in these ASEAN countries are able to predict future changes in their stock price indices. We find evidence of causalities from SP to macroeconomic variables in a number of cases: from SP to GNP and CPI in all five ASEAN countries, from SP to MON and INT in Indonesia, Malaysia, and Thailand, and from SP to EX in Philippines and Singapore. The observed reverse causalities support the typical view that the stock market is an important factor among leading economic indicators. The findings of unidirectional causality and feedback relationships verify the fundamental and theoretical linkages between stock prices and macroeconomic variables in the ASEAN region.

The innovation analyses tend to suggest that ASEAN-5 stock markets dynamically interact with their own key macroeconomic factors. Most of the variations in SP can be captured by innovations in INT, MON and GNP, while the reverse also holds. The substantial role of EX in the analysis for Philippines signifies its existence in the long run cointegrating relation. Therefore, the causal relationships that macroeconomic variables Granger-cause and are Granger-caused by stock prices are quantitatively supported by innovation accounting analyses.

(A) Response of stock prices due to one standard deviation shock in:

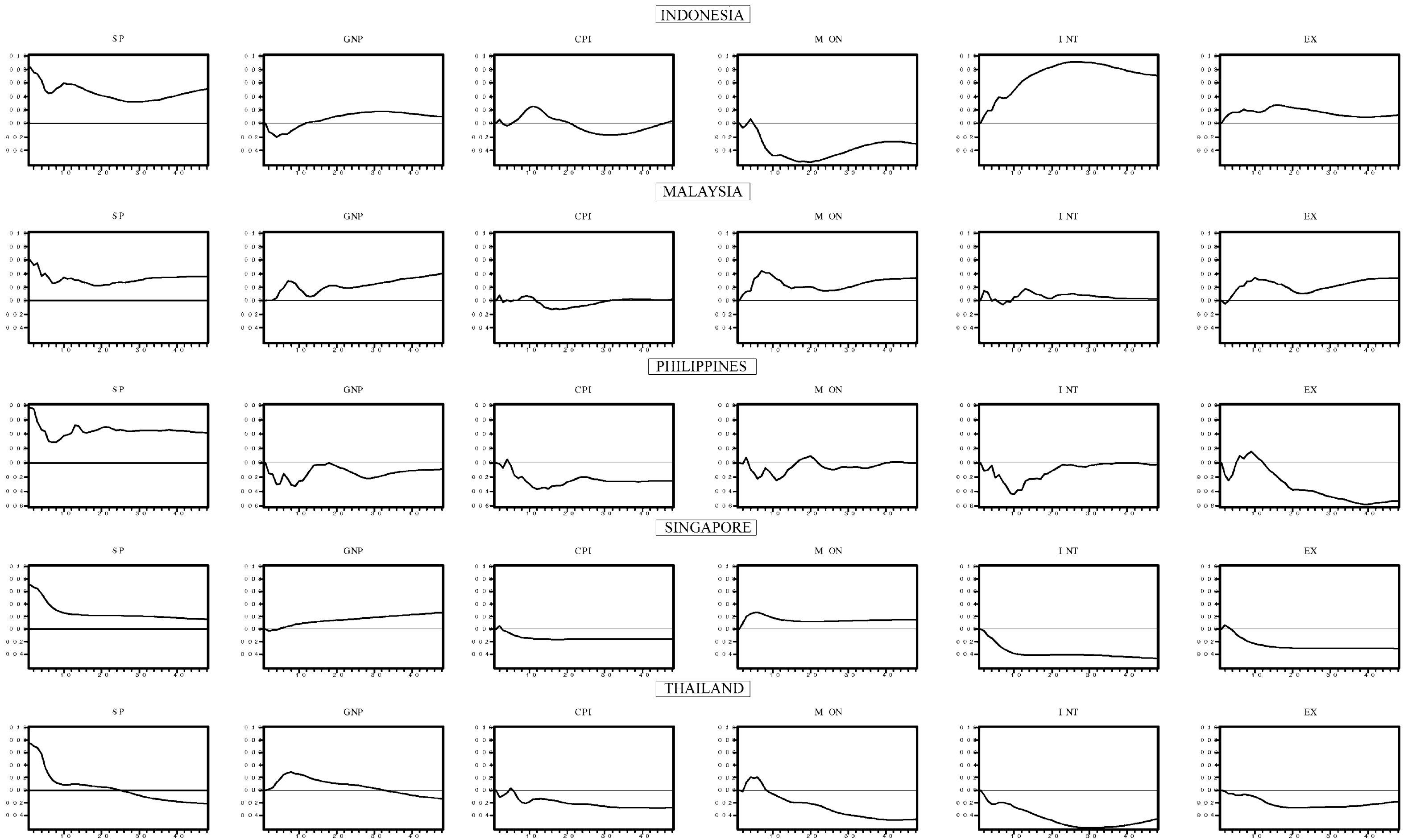

Fig. 1. Impulse response function.

(B) Response of macroeconomic variables due to one standard deviation shock in stock prices

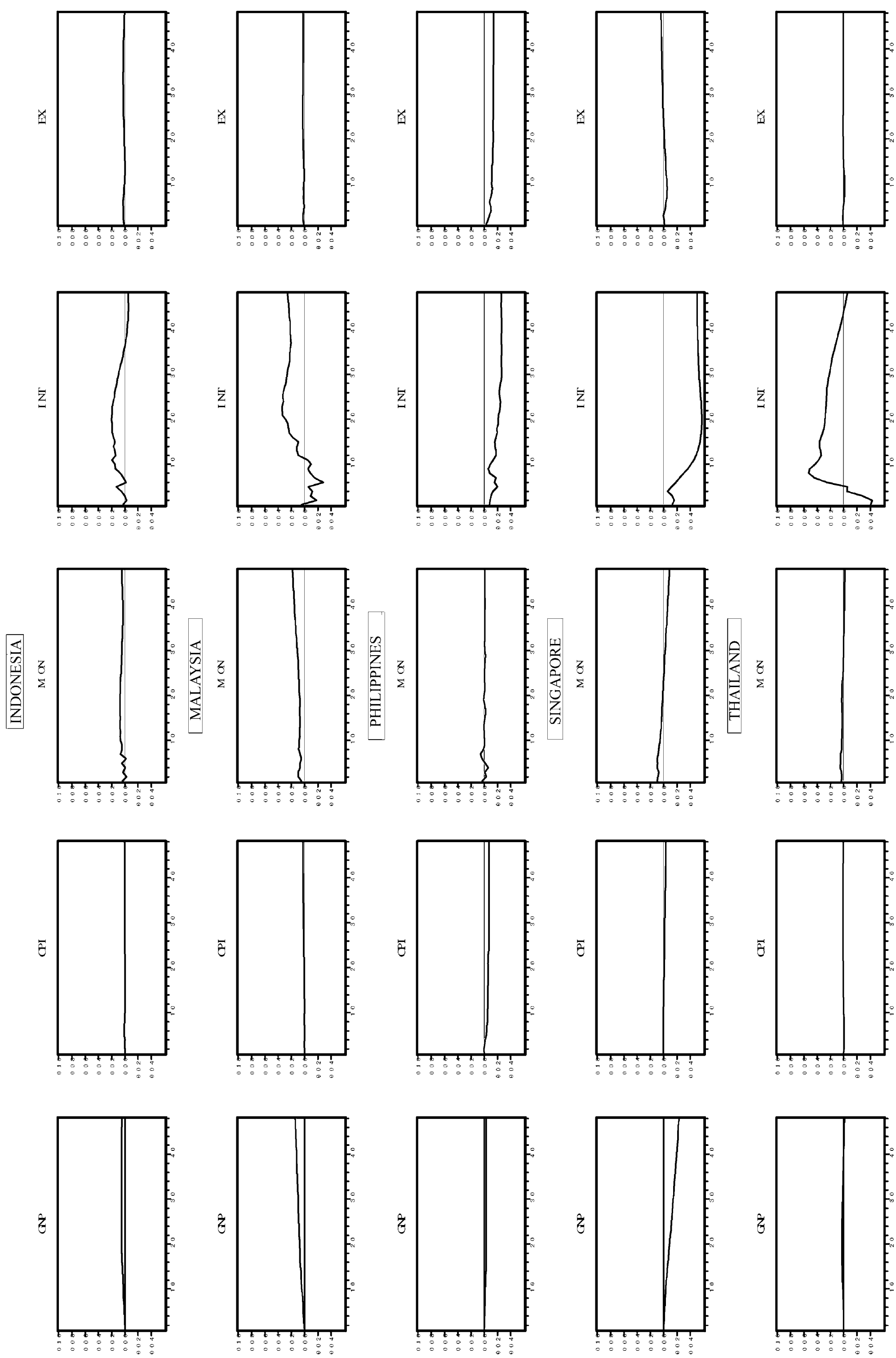

Fig. 1. (*Continued*)

(A) Forecast error variance of stock prices explained by innovations in:

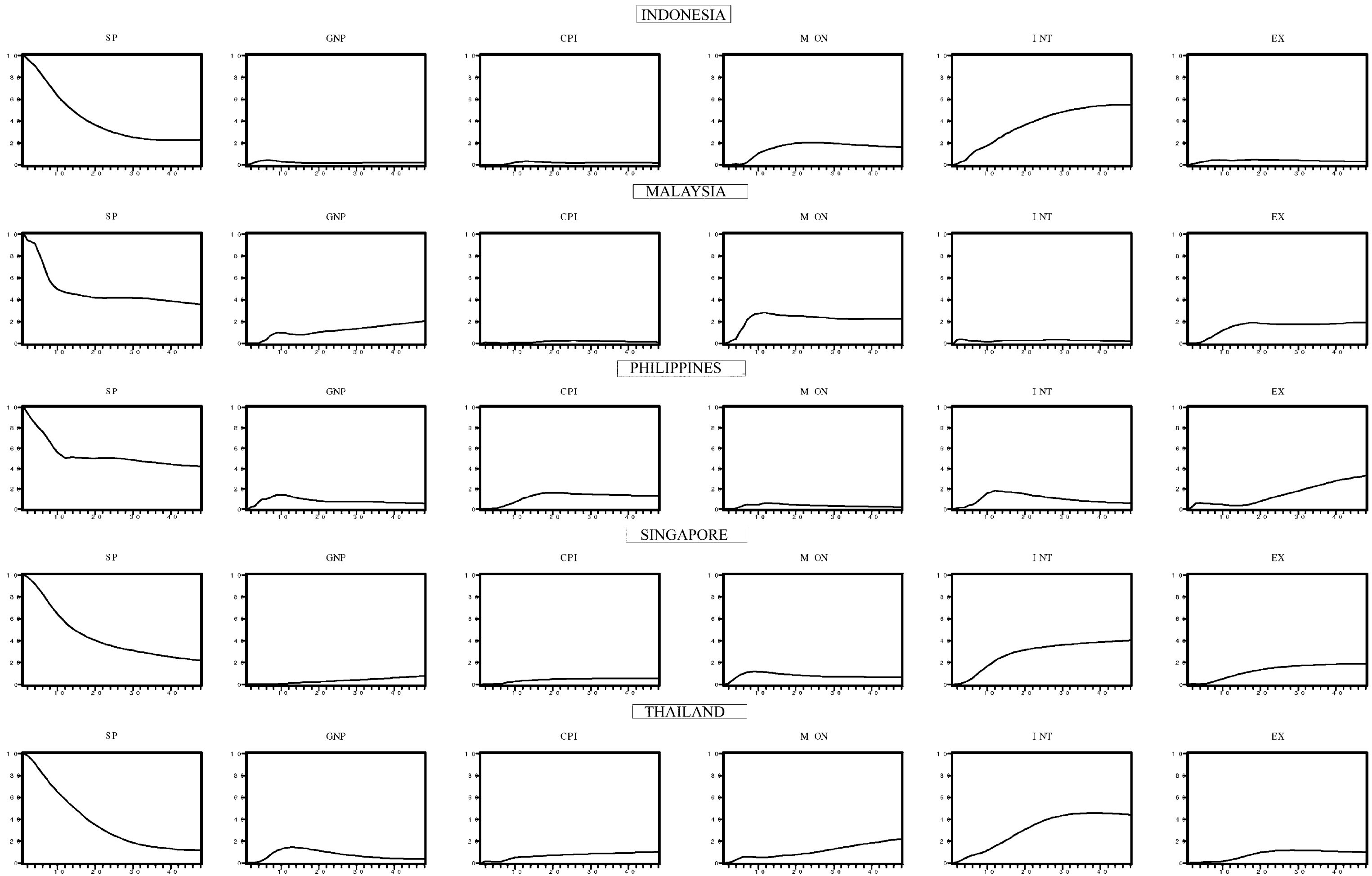

Fig. 2. Variance decomposition.

(B) Forecast error variance of macroeconomic variables explained by innovations in stock prices

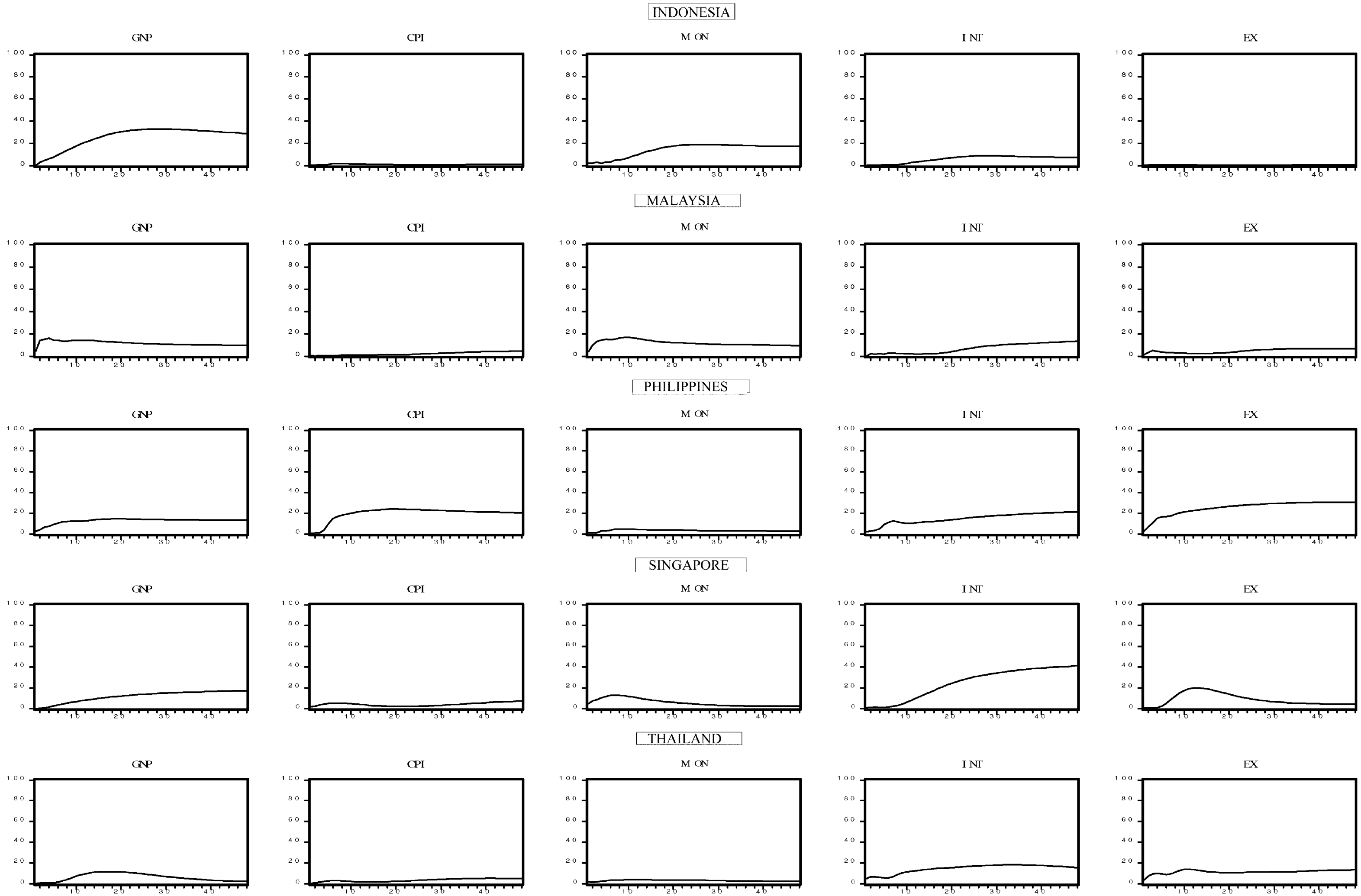

Fig. 2. (*Continued*)

Notes

1. Note that for consistency, we have logged all the series, i.e., including interest and exchange rates. However, in applied research some authors do not log the interest and exchange rate series.
2. A systematic test procedure is used to specify the model. This yielded different models for some countries. Thus, estimating the same model for all countries would have led to a misspecification in the model.
3. In the applied work, the researchers have extensively used the error correction model to test for Granger causality. This methodology is also used in this study. However, testing of Granger causality in the context of non-stationary variables has advanced considerably since Granger (1988). Toda and Yamamoto (1995) showed that even if the time series may be integrated or cointegrated of an arbitrary order, the vector autoregressive (VAR) model can be estimated in levels and one can test the general restrictions (linear or nonlinear) on the parameter matrices, by using the Wald statistics proposed by them. Their method can also be used to test for Granger causality in non-stationary variables.
4. In applied work, it is a common practice to interpret the cointegrating vector which explains the economics theory the most. Generally, this is the first cointegrating vector since it corresponds to the largest eigenvalue, but not always. In this study, since we have interpreted the results of the first cointegrating vector, thus, it is appropriate to include the error correction term from first cointegrating vector only.
5. The lag length is obtained by using the likelihood ratio statistics after including the error correction term in the model $K = 5$, 6, 7, 2 and 4 for Indonesia, Malaysia, Philippines, Singapore and Thailand, respectively.
6. Eviews is used for the innovation analyses. Innovation analyses can be obtained either by using one cointegrating vector in the VECM or by using all the significant number of cointegrating vectors in the VECM. Since only one cointegrating vector is used (in the VECM) in testing Granger causality, to investigate the robustness of causal results all significant cointegrating vectors are used in the innovation analyses.
7. The corresponding impulse response functions (IRF) are plotted in Fig. 1.
8. The decomposition of forecast error variances are plotted in Fig. 2.

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