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ABSTRACT

Most governments of affected economies during the Asian financial crisis tend to gravitate towards a self-fulfilling expectations story of multiple equilibria, *i.e.* macroeconomic fundamentals are sound and that their economies were simply affected by the spillover effects of the Thai, Indonesian and even the Korean crises. In this paper, we examine the nature and extent of contagion during the Asian financial turmoil using evidence from movements in the national stock markets. In particular we determine the extent of stock price movements in the crisis-affected countries on those of other countries. Also, this paper highlights the difference in co-movements of stock prices before and after the crisis. This study confirms the contagion effect during the Asian financial crisis using a vector error correction model, and impulse response functions and variance decomposition of a daily VAR model.

The issue of the international transmission of financial crises has again re-emerged with the onset of the Asian financial crisis. What started as a major currency realignment in Thailand led to a series of corporate and banking bankruptcies not only within the Thai economy but also across Asia and to some extent shook a few Latin American and transition economies.

At the forefront of the debate is whether the affected economies had sound macroeconomic fundamentals only to be brought down by the herding behavior of investors. In line with this, some argue that the regime in place prior to the crisis was an equilibrium based on sound fundamentals and could have been sustained. It was only the change in expectations on the sustainability of the existing policy that moved the economy from a “good” equilibrium towards a “bad" equilibrium, which was the crash. Others contend that the rapid growth in the Asian economies masked the inherent fragilities in the financial system, only to be revealed when the inevitable currency adjustments had to be done.

Most governments of affected economies during the Asian crisis tend to gravitate towards a self-fulfilling expectation story of multiple equilibria, i.e., macroeconomic fundamentals are sound and that their economies were simply affected by spillover effects of the Thai crisis. In short, they imply that the crisis was brought to their shores by herding behavior in the strictest sense. This makes the study of contagion effects and herding behavior interesting. In this paper, we examine the nature and extent of contagion during the Asian financial turmoil using evidence from movements in the national stock markets. In particular, we determine the extent to which stock price movements in a crisis country affect the stock price movements in other countries. Also, the paper highlights the difference in the co-movements of stock before and during financial crises.

The second section of the paper summarizes the literature on currency crises and contagion effects. Section 3 provides the framework for studying contagion effects. Section 4 shows the empirical results using various statistical and time-series techniques. The last section gives the concluding remarks.

2. Currency Crises, Stock Markets and Contagion

Since the seminal work on balance of payments crises and speculative attacks of Krugman (1979), the literature on currency crises has evolved over time. The first generation models (for example, Krugman, 1979; Flood and Garber,1984) dealt on the unsustainability of the peg due to the inconsistency between money creation to finance the budget deficit and the defense of the currency.

Aware of this, rational agents will implement a speculative attack of the exchange rate that triggers an adjustment of the exchange rate. These models were premised on the existence of weaknesses in macroeconomic fundamentals. An element missing in the first generation models is contagion.

The second generation models of currency crises focused on the existence of multiple equilibria as an explanation for currency crises. Obstfeld (1986) introduced the notion that currency crises can be explained by a movement from one equilibrium towards one which can be alluded to as a "bad" equilibrium. This can be triggered by changes in expectations. Under each equilibrium situation, the same set of fundamentals would lead to contrasting outcomes, one desirable and the other, undesirable.[1] This literature spawned the possibility of herding behavior as a cause of currency and financial crises. An example most often cited as a manifestation of multiple equilibria is the ERM crash in 1992. Obstfeld (1994) and Eichengreen, Rose and Wyplosz (1995) pointed out that there may be nothing fundamentally wrong with the ERM countries. What triggered the crisis was the expectation that the government would no longer sustain the exchange rate peg due to rising unemployment. This change in expectations of future government actions led to collapse of the peg. In this sense, they suggest that fundamentals can hardly explain the collapse, but rather it can be anchored on the change in sentiment that spread across the ERM countries. The second generation models introduced the notion of a herding behavior among investors which causes similar investor action across economies perceived to be similar. They also introduce the possibility of machinations by a large agent (which Krugman (1996) refers to as a "Soroi").

Gerlach and Smets (1994) explain contagious currency crises from the perspective of competitive exchange rate adjustments. Drawing from the Finnish and Swedish experiences, they propose that when two countries are linked together by trade in both merchandise and financial assets, a real depreciation in one country results in an increase in its competitiveness vis-a-vis the other country. This causes a trade deficit for the other country which then experience a loss in reserves. Ultimately, the currency will come under speculative attack. Another channel is via the lowering of the import prices faced by the non-depreciating second country. Lower import prices translate to a lower general price level. Consequently, there is a lower demand for domestic currency. This puts pressure on the foreign exchange reserves of the central bank. This shifts the no-attack equilibrium to a situation of a speculative attack. Huh and Kasa (1997) use a game-theoretic model of competitive exchange rate adjustments as explanation for simultaneous devaluations that occurred in Asia.

[1] It is also possible that the movement is from one good equilibrium to another good equilibrium.

Goldfajn and Valdes (1995) introduce the role of financial intermediaries to propagate currency crises across countries. Since foreign investors are unwilling to undertake long-term investment, financial intermediaries offer liquid assets, e.g. deposits, to the former. If for some exogenous reason, foreign investors decide to withdraw their deposits, financial intermediaries having difficulty in providing liquidity face the possibility of failure. The bank run spills over as a currency crisis as the foreign investor convert their deposits to foreign currency, putting pressure on foreign exchange reserves. The international transmission occurs when the foreign investors facing a financial crisis in one country respond by liquidating their positions in other countries.

To empirically test contagion effects during currency crises, Eichengreen, Rose and Wyplosz (1996) apply probit analysis to the pooled sample of twenty industrial countries. They find that a speculative attack elsewhere in the world increases the probability of a currency crisis within the domestic economy by around eight percent. However, their test does not distinguish the propagation mechanism of the crisis.

The Mexican crisis and its effects on Latin American and Asian countries spawned empirical interests on the economics of contagion effects in emerging markets. Prior to this, not much empirical work had been done to examine contagion in such markets (e.g., Doukas (1989) and Hardouvelis, La Porta and Wizman (1994)). Calvo and Reinhart (1996) examine the contagion effects of capital flows by analyzing the cross-country correlations among emerging market stock returns. By breaking the sample period into three sub-samples, with the first sub-period being described as having heavy capital inflows, the second sub-period as having moderate capital and the third period as being the crisis period, they found that stock return correlations tended to be higher during the crisis period. Likewise the application of principal components analysis also points to greater co-movement during the crisis period.

Frankel and Schmukler (1996) study the contagion effects of the Mexican crisis by using data on country funds. They use country fund data to capture the contagion effects arising from the self-fulfilling expectations of investors.[2] By testing the Granger causality of the net asset values (NAV) and prices of closed-end country funds, they are able to analyze the nature and channel of the contagion from both intra-regional and inter-regional perspectives. Their main finding is that the Mexican shocks affected Latin American NAVs directly, while the transmission to Asian NAVs seem to "pass through" New York. They also find that shocks tend to have a greater effect on countries with weak fundamentals.

[2] A discussion of the different types of contagion follows in the next section.

Valdes (1996), using country credit ratings and secondary market debt prices, finds that fundamentals cannot account for cross-co-movement of credit worthiness. In contrast, Wolf (1996), using stock returns, finds no significant evidence of contagion in Latin America. He, however, finds a higher degree of contagion among the Asian economies.

Another area of interest is the link between stock market changes during crisis periods. Rogers (1994) examines the linkages between international stock markets prior, during and after the October 1987 crash. His main interest though, is to examine the effect of barriers to entry on the transmission of stock market shocks. One of his findings is that, for stock markets without stiff entry barriers, the October 1987 shock resulted in higher volatility and increased price spillover. He also found that the change in behavior was only temporary and returned to normal levels after the crisis ended. Cashin, Kumar and McDermont (1995) study contagion of a global shocks and domestic shocks. They find that domestic shocks dissipate with a few weeks while global shocks take 24 weeks before the market returns to its long-run equilibrium.

3. Contagion Effects: Explanation and Measurement

A framework for explaining contagion effects

Contagion is defined as the herding behavior which occurs when expectations cause investors to simultaneously pullout of markets as a response to a shock that hits a perceived similar market. The expectations become self-fulfilling when the herding behavior causes a collapse of the market despite sound fundamentals. The mechanism for contagion can be drawn from Calvo and Mendoza (1996), who derive the following two propositions:

> Proposition 1. As opportunities for diversification rise, the impact of 'news' on the allocation of investment funds in a single country relative to initial allocation grows without bound.

and,

> Proposition 2. If information on asset return [r] can be acquired at a cost, the benefit derived from knowing r eventually declines as the number of diversification opportunities [J] rises.

Consider investors who have exposure in international stock markets, including emerging stock markets. Proposition 2 implies that as diversification opportunities increase, investors have less incentive to learn more about individual emerging markets. Suppose an adverse shock occurs in one of the emerging markets. From Proposition 1, with more opportunities for diversification, the investors will sell their claims in that market and move their funds to another market. With their lack of information in other emerging markets, any news linking the other emerging markets with the emerging market experience will likewise make the same investor reallocate their portfolio away from these markets. This is when contagion happens. The propagation of crisis might have been more limited had the investors acquired more information on the each individual stock market. But with more opportunities for diversification, there is less incentive to acquire costly information. Thus, with greater opportunities for diversification, during periods of shock, expectations formed by agents, perhaps based on "news," matter more than fundamentals. In this sense, expectations can become self-fulfilling. The outcome of the contagion is the co-movement of stock returns across affected markets.

Measuring contagion effects

The estimation of correlation coefficients among stock returns is the most common method used in estimating contagion effects, *e.g.*, Calvo and Reinhart (1996). However, the presence of high correlation coefficients may have different interpretations. While it can be herd behavior, the co-movements may also be a manifestation of what Frankel and Schmukler (1996) refers to as fundamentals contagion. Fundamentals contagion arises from either high cross-country correlations among domestic fundamentals or shared external fundamentals.[3]

An alternative approach to assess the extent of contagion is to test cross-country stock prices for cointegration and specify the appropriate model to capture short-term effects, *i.e.*, estimate a vector error correction model (VECM).[4] The vector error correction model may be the appropriate representation of fundamentals and herding behavior contagion. The error correction term captures the deviations from long-run equilibrium which may be representative of fundamentals contagion. On the other hand, the first differenced components of the VECM can be interpreted as the short-term effects of other country stock price movement and may be represent herding behavior.

Upon specification of a vector error correction model, dynamic simulations can be done to evaluate the extent to which shocks are propagated across countries through stock prices. To illustrate, suppose, in a three-country case (countries A, B, and C), we want to measure the extent of contagion from country A to countries B and C. We first generate a dynamic simulation using the

[3] Bordo, Mizrach and Schwartz (1995) refer to this type of contagion as "pseudo-international systemic risk."

[4] The presence of cointegration only suffices to show long-term co-movement among variables. Similar to Kasa (1992), we do not infer any notion of economic integration from the cointegration test results.

VECM containing all three countries. The second step is to generate another dynamic simulation using the same VECM with the coefficients for the first differenced country A stock prices in the equations for countries B and C zeroed out. The zeroing out of coefficients will remove the short-run effects of country A stock prices on the other countries. The larger the difference between the two, more, the more likely there is contagion.

Another approach to determine herding behavior is to estimate vector autoregressions, analyze its impulse response functions, and conduct innovation accounting.[5] As Rogers (1994) points out, the impulse responses and variance decompositions tend to change during periods of crisis. Impulse response functions and innovation accounting can then be undertaken to assess the change in behavior. Contagion effects during a crisis can be established when there is an abrupt change in impulse responses compared to normal periods. Likewise, innovation accounting gives information on the extent to which innovations in the stock price in one market explain the variation in another. Contagion effects manifest themselves when the percentage of variation explained by own innovations decline while that of innovations in other stock markets increase.

4. Empirical Analysis

The data

The set of Asian emerging markets consists of Indonesia, Malaysia, Philippines, Singapore, Thailand, Hong Kong, Korea and Taiwan. The basic data for the monthly stock price indices in US dollars were obtained from Morgan Stanley Capital International. The monthly indices were deflated using the US Consumer Price Index - Urban with December 1987 as the base month. Monthly data is from January 1991 to February 1998.

Daily stock price (local currency) and exchange rate data were obtained from Fame International. The daily stock indices were converted into US dollars with June 1, 1995 as the base day.[6] Daily data starts from June 1, 1995 to March 27, 1998.

All estimation procedures utilize the natural logarithmic transformation of the US dollar stock price indices.

[5] Vector error correction models can be used if cointegrating relationships are established.
[6] For missing daily data, the most recent available data were used.

Correlation coefficients

Table 1 and Table 2 show the correlation coefficients of the log first difference of stock prices in the selected Asian emerging markets for the sub-periods June 1, 1995 to July 1, 1997 and July 2, 1997 to March 27, 1998.[7] The first sub-period denotes the normal (pre-crisis) period while the second sub-period covers the crisis period. Except for the correlation coefficient of Hong Kong and Korea, all correlation coefficients are substantially higher during the crisis period. This indicates increased co-movement among stock returns. However, the correlation coefficient cannot provide information of the extent that contagion can explain the crisis. Likewise, no inference on causality can be made.

Table 1
Correlation Matrix of Log First Differences: 6/1/95 - 7/1/97

	Hong Kong	Indonesia	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
Hong Kong	1.00	0.24	0.10	0.35	0.24	0.34	0.11	0.23
Indonesia		1.00	0.05	0.21	0.17	0.20	0.07	0.14
Korea			1.00	0.03	0.04	-0.03	0.05	0.05
Malaysia				1.00	0.24	0.39	0.07	0.19
Philippines					1.00	0.24	0.06	0.07
Singapore						1.00	0.05	0.20
Taiwan							1.00	0.00
Thailand								1.00

Table 2
Correlation Matrix of Log First Differences: 7/2/97 - 3/27/98

	Hong Kong	Indonesia	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
Hong Kong	1.00	0.39	0.07	0.37	0.41	0.60	0.29	0.31
Indonesia		1.00	0.15	0.45	0.48	0.51	0.16	0.41
Korea			1.00	0.19	0.17	0.03	0.10	0.21
Malaysia				1.00	0.37	0.57	0.35	0.50
Philippines					1.00	0.57	0.25	0.44
Singapore						1.00	0.41	0.53
Taiwan							1.00	0.00
Thailand								1.00

Testing for cointegration

Using the natural logarithm of the deflated US dollar monthly data, the Johansen procedure was applied to test for cointegration among the stock prices. The cointegration tests were applied to

[7] The Thai Baht was floated on July 2, 1997.

the sample from January 1991 to February 1998. The choice of the sample period is based on the notion that the massive of portfolio capital in the early nineties, might have caused the internationalization of the emerging stock markets, thus may have established cointegrating relationships. All variables were found to be I(1) process.

A cointegration test for the Indonesia, Malaysia, Philippines, Singapore, Thailand, Korea, Hong Kong and Taiwan (we refer to this group as EA-8) was conducted. The optimal lag length was chosen based on the Schwarz -Bayes Information Criterion. Residual tests were also conducted to ensure that residuals were white noise. A two-month lag was found to be optimal.

Table 3 shows that the stock prices of the eight countries are cointegrated indicating long-term relationships exist between the stock prices. This also suggests that an error correction representation can be estimated for the relationship among the stock prices.

Table 3
Cointegration Test for EA-8
Sample: Jan 1991 - Feb 1998

H_0: No. of cointegrating eqns.	Likelihood Ratio
None	217.62**
At most 1	151.92**
At most 2	103.57**
At most 3	68.38
At most 4	40.53
At most 5	18.14
At most 6	4.79
At most 7	0.00

*(**) denotes rejection of H_0 at 5%(1%) significance level

Vector error correction model (VECM) estimation

Having established cointegating relationships among the Asian stock markets, we can model short-term behavior using a vector error correction representation. The objective of the exercise is to generate dynamic simulations which allows us to determine the extent of contagion during the Asian financial crisis. The analysis using the vector error correction model proceeds in three stages. First, the total contagion effect per country is estimated. Second, the contagion effects attributable to Thailand are quantified. Third, the contagion effects arising from Indonesia are likewise isolated. The sample period for estimation covers January 1991 to February 1998. Dynamic simulations are generated from January 1997 to February 1998.

The vector error correction regression system is given by:

$$\Delta x_t = \pi_0 + \pi x_{t-1} + \pi_1 \Delta x_{t-1} + \ldots + \pi_p \Delta x_{t-p} + \mu_t$$

where x is the vector consisting of natural logarithm of the real stock prices in US dollars of Indonesia, Malaysia, Philippines, Singapore, Thailand, Korea, Hong Kong and Taiwan. To estimate the contagion effect, two dynamic simulations are generated. Suppose we want to estimate the contagion arising from Thailand. A baseline simulation which uses the vector error correction model specified above, is generated. A second simulation is generated by using the same equation with all the coefficients of the first differenced stock price of the contagion emanating country, in this example, Thailand, set to zero (except in the Thai equation). The difference between the first and second simulations is the contagion effect. By using January 1997 as the starting period for the simulation, the degree of contagion before and during the crisis can be compared.

The estimation results for the vector error correction modelare given in Table 4. As indicated by the test for cointegration there are three possible cointegration vectors.[8] The error correction terms is the correction for deviations from long-run equilibrium while the (first differenced) vector autoregressive terms represent the short-run movements in stock prices.

Table 4
Vector Error Correction Model: Jan 1991 – July 1998

Cointegrating Equations			
	CE1	**CE2**	**CE3**
HONG KONG$_{-1}$	1.00	0.00	0.00
INDONESIA$_{-1}$	0.00	1.00	0.00
MALAYSIA$_{-1}$	0.00	0.00	1.00
PHILIPPINES$_{-1}$	2.31	27.36	10.37
	(6.94)	(63.86)	(25.97)
SINGAPORE$_{-1}$	-3.77	-29.98	-12.19
	(7.58)	(69.76)	(28.36)
TAIWAN$_{-1}$	-0.44	-6.72	-2.50
	(1.67)	(15.38)	(6.25)
KOREA$_{-1}$	2.79	19.87	7.60
	(5.18)	(47.71)	(19.40)
THAILAND$_{-1}$	-1.76	-16.17	-6.06
	(4.19)	(38.57)	(15.68)
C	1.11	37.21	14.50

[8] All three cointegrating vectors are used the estimation. Banerjee *et al.* (1993) states that both the under- and over-specification of cointegrating vectors has potentially adverse consequences for estimation, iνference and forecasting.

Error Correction								
	D(HK)	**D(IND)**	**D(MAL)**	**D(PHI)**	**D(SIN)**	**D(TAI)**	**D(KOR)**	**D(THA)**
CE1	-0.12	0.04	-0.22	0.02	0.07	-0.06	-0.44	-0.19
	(0.10)	(0.14)	(0.10)	(0.11)	(0.07)	(0.13)	(0.10)	(0.12)
CE2	-0.01	-0.23	0.02	-0.13	-0.01	0.00	0.04	0.13
	(0.06)	(0.08)	(0.06)	(0.06)	(0.04)	(0.08)	(0.06)	(0.07)
CE3	0.04	0.59	0.00	0.30	0.00	0.03	0.03	-0.28
	(0.14)	(0.19)	(0.15)	(0.16)	(0.09)	(0.18)	(0.15)	(0.17)
D(HONG KONG$_{-1}$)	-0.11	-0.36	-0.12	-0.51	-0.30	0.09	0.65	-0.29
	(0.18)	(0.24)	(0.18)	(0.19)	(0.11)	(0.22)	(0.18)	(0.21)
D(HONG KONG$_{-2}$)	0.21	0.07	0.16	0.09	0.09	-0.02	0.44	0.24
	(0.22)	(0.29)	(0.22)	(0.23)	(0.14)	(0.27)	(0.22)	(0.26)
D(INDONESIA$_{-1}$)	-0.09	0.02	-0.06	0.03	-0.06	-0.22	-0.54	-0.54
	(0.11)	(0.15)	(0.11)	(0.12)	(0.07)	(0.14)	(0.11)	(0.13)
D(INDONESIA$_{-2}$)	0.07	-0.19	-0.20	-0.16	-0.03	0.10	-0.30	-0.34
	(0.12)	(0.17)	(0.13)	(0.13)	(0.08)	(0.16)	(0.13)	(0.15)
D(MALAYSIA$_{-1}$)	-0.02	0.06	-0.04	-0.02	0.05	-0.05	0.55	0.85
	(0.23)	(0.31)	(0.23)	(0.25)	(0.15)	(0.29)	(0.23)	(0.28)
D(MALAYSIA$_{-2}$)	0.39	0.09	0.49	0.19	0.46	0.11	0.01	0.60
	(0.23)	(0.31)	(0.23)	(0.25)	(0.15)	(0.29)	(0.23)	(0.28)
D(PHILIPPINES$_{-1}$)	0.17	0.44	0.15	0.39	0.18	0.51	-0.46	0.11
	(0.16)	(0.21)	(0.16)	(0.17)	(0.10)	(0.20)	(0.16)	(0.19)
D(PHILIPPINES$_{-2}$)	-0.19	-0.08	0.00	0.07	-0.14	-0.13	-0.04	-0.19
	(0.18)	(0.24)	(0.18)	(0.19)	(0.11)	(0.22)	(0.18)	(0.21)
D(SINGAPORE$_{-1}$)	0.01	0.36	0.11	0.24	0.03	-0.55	-0.09	0.19
	(0.27)	(0.37)	(0.28)	(0.29)	(0.18)	(0.35)	(0.28)	(0.33)
D(SINGAPORE$_{-2}$)	-0.67	-0.25	-0.30	-0.17	-0.43	-0.12	0.53	0.40
	(0.28)	(0.37)	(0.28)	(0.30)	(0.18)	(0.35)	(0.28)	(0.33)
D(TAIWAN$_{-1}$)	-0.02	-0.29	-0.16	-0.27	-0.09	0.00	0.21	-0.05
	(0.11)	(0.15)	(0.12)	(0.12)	(0.07)	(0.14)	(0.12)	(0.14)
D(TAIWAN$_{-2}$)	-0.04	-0.02	0.04	-0.12	-0.02	0.00	0.03	-0.04
	(0.10)	(0.13)	(0.10)	(0.11)	(0.06)	(0.13)	(0.10)	(0.12)
D(KOREA$_{-1}$)	0.14	0.18	0.23	0.19	0.01	-0.12	-0.15	0.03
	(0.13)	(0.17)	(0.13)	(0.14)	(0.08)	(0.16)	(0.13)	(0.15)
D(KOREA$_{-2}$)	-0.16	-0.29	-0.32	-0.18	-0.24	-0.06	0.10	-0.06
	(0.13)	(0.17)	(0.13)	(0.14)	(0.08)	(0.16)	(0.13)	(0.15)
D(THAILAND$_{-1}$)	-0.06	-0.06	0.04	-0.11	0.10	0.17	0.06	-0.03
	(0.13)	(0.18)	(0.13)	(0.14)	(0.09)	(0.17)	(0.13)	(0.16)
D(THAILAND$_{-2}$)	0.17	0.39	0.11	0.16	0.27	0.24	0.09	0.14
	(0.13)	(0.17)	(0.13)	(0.14)	(0.08)	(0.16)	(0.13)	(0.16)
C	0.01	-0.02	-0.01	0.01	0.01	0.00	-0.03	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
R-squared	0.36	0.47	0.50	0.40	0.54	0.28	0.64	0.49
Adj. R-squared	0.18	0.32	0.36	0.23	0.41	0.07	0.54	0.35

Note: The numbers in parentheses are standard errors.

Measuring total contagion effects using the VECM

We begin by measuring the "total contagion effect" for each country. "Total contagion effect" refers to movements in stock prices other than those explained by the error correction and own lagged first difference. This is done by setting to zero the coefficients of all lagged first differenced stock prices, except for own lags, and comparing it with the simulations using the full VECM. This procedure can be interpreted as purging the short-term effects of the stock prices of other countries. The total contagion effects are measured by the difference between simulations the full VECM and the VECM with "zeroed out" coefficients. The two simulations for real stock prices are shown in Panel A of Figures 1 to 8.

It can be observed that had there been no contagion effects, Singapore, Hong Kong and Taiwan would have exhibited increasing real stock prices (See Figures 1(a), 2(a) and 3(a). On the other hand, Thailand and Korea which were heavily hit by the crisis exhibited smaller gaps between the contagion and no-contagion cases (See Figures 6(a) and 8(a). This indicates that the problem in both countries may be more fundamental in nature. Figures 4(a) and 5(a) show that while there may be fundamental reasons for the declines in real stock prices in Malaysia and the Philippines (as indicated by the initial dip in their stock prices), these were exacerbated by the contagion effects. The case of Indonesia is quite interesting. Figure 7(a) indicates that had there been no contagion, the real stock prices in Indonesia would have not fallen sharply as it did. Instead, real stock prices should have continued to increase until October, only declining in succeeding months. Contagion, however, caused the real stock prices to fall sharply. This may be evidence of the existence of multiple equilibria in Indonesia. Had there been no currency crisis in other countries, Indonesia would have been in a sustainable equilibrium and the decline in Indonesian real stock prices would have been minimal. However, the currency crisis abroad triggered a shift in equilibria making the existing situation a "bad" equilibrium.

The degree of contagion can be examined by studying the behavior of the mean absolute deviations between the simulated stock prices of the full VECM and the "zeroed out" VECM. These are shown in Table 5. Apparently, there has been an increase in the degree of contagion during the crisis since the ratios of the mean absolute deviations for the crisis period to those of the pre-crisis period are more than one. Also, there is an observed increase in the degree of contagion as the crisis deepened (the quarterly mean absolute deviations were increasing except, perhaps for the Korean case where there was a slight decline in the last period).

Comparing the Thai and Indonesian contagion effects

Panels (b) and (c) of Figures 1 to 6 show the contagion effects of Thailand and Indonesia on Hong Kong, Taiwan, Singapore, Malaysia, Philippines and Korea, respectively. Figure 7(b) show the effect of Thailand on Indonesia while Figure 8(b) show the effect of Indonesia on Thailand. Noticeably, for most countries the contagion effects coming from Indonesia are generally greater than Thailand's (except for Hong Kong and Singapore). It is also interesting to compare the degree of contagion prior to the crisis and during the crisis. Table 5 shows the mean absolute deviations of the simulated real stock prices.

In the case of Hong Kong, it is seen the Thai contagion has a greater effect than the Indonesian contagion. Also, Table 5, indicates there is no significant difference between the pre-crisis and crisis Indonesian contagion effects. From these observations is can be surmised that Hong Kong is more sensitive to developments in Thailand than in Indonesia.

With regard to Taiwan, Figures 2(b) indicates that the contagion effects from Thailand caused the Taiwanese real stock prices to decline. If there was no contagion from Thailand, there would been no dip in stock prices. On the other hand, Figure 2(c) shows that the Indonesian contagion effects aggravated the fall in stock prices. Table 5 shows that there is an increase in the degree of contagion in the crisis period.

Singapore is similar to the Taiwan–Singaporean real stock prices would have not declined had the contagion effects from Thailand been absent (see Figure 3(b)). Also, contagion effects from Indonesia added to the decline of the stock prices (see Figure 3(c)). Likewise, a comparison of the pre-crisis and crisis contagion effects indicates that an increase in the degree of contagion (see Table 5).

Moving to the case of Malaysia, it is seen that even with the contagion effects, Malaysian real stock prices were really declining, and the collapses of Thailand and Indonesia aggravated the situation (see Figures 4(b) and 4(c)). There too is an increase in the degree of contagion during the crisis period (see Table 5).

Figure 5(b) indicates that the Philippines would still have had a fall its real stock prices had there been no Thai contagion effects. Also it can be seen that that there would be a correction in early 1998. However, the Thai and the Indonesian declines pulled it down. This suggests that while there are fundamental problems in the economy (which caused the fall in prices) but these would not be that grave to result in a sustained fall in real stock prices. Instead, the contagion effects from the

Thailand and Indonesia aggravated and contributed to the fall the stock prices. This may also be a manifestation of a multiple equilibria where adverse events cause a shift to a "bad" equilibrium.

Korea exhibit a trend decline in its real stock prices with or without the contagion effects of the Thailand and Indonesian (see Figures 6(b) and 6(c)). This means that the problem in Korea is really fundamental and the Thai and Indonesia crises only aggravated it. Table 5 also shows that the contribution of Indonesia to the fall in Korean real stock prices declined as the Asian financial crisis deepened.

The interaction between Thailand and Indonesia is interesting. Figure 7(b) and Table 5 indicates that the contagion effect of Thailand on Indonesia has not changed much in the pre-crisis and crisis periods. In fact, the degree of contagion has declined toward the latter part of the Asian financial crisis. A similar story can be said on the impact of Indonesia on Thailand (see Figure 8(b) and Table 5).

Figure 1

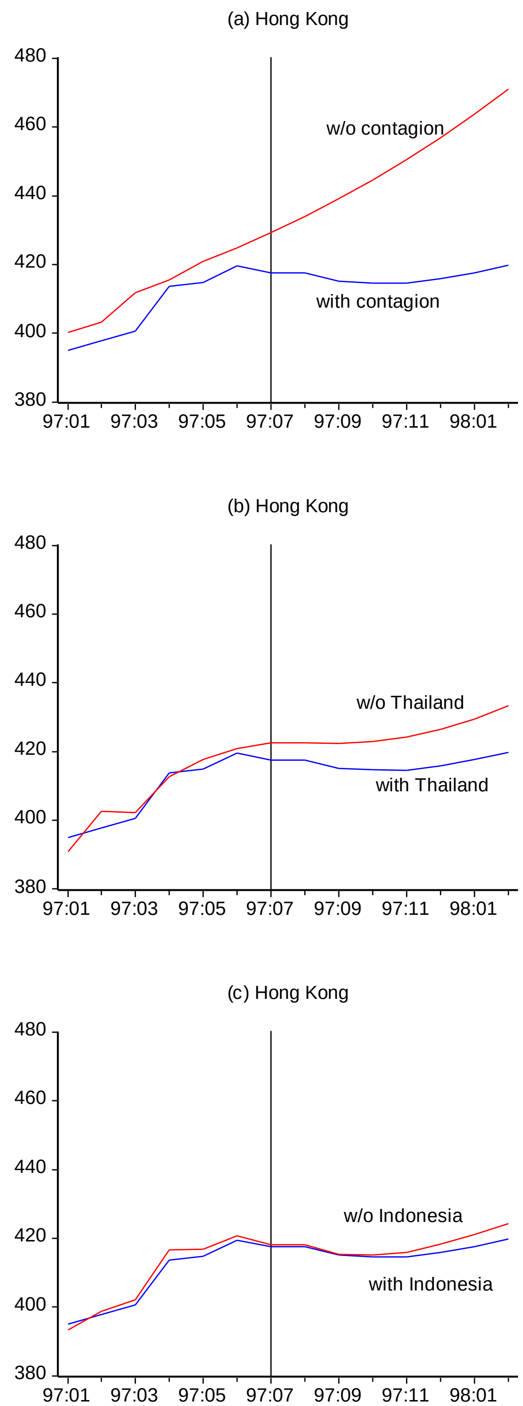

(a) Hong Kong
480
460
440
420
400
380
97:01
97:03
97:05
97:07
97:09
97:11
98:01
w/o contagion
with contagion
(b) Hong Kong
480
460
440
420
400
380
97:01
97:03
97:05
97:07
97:09
97:11
98:01
w/o Thailand
with Thailand
(c) Hong Kong
480
460
440
420
400
380
97:01
97:03
97:05
97:07
97:09
97:11
98:01
w/o Indonesia
with Indonesia

Figure 2

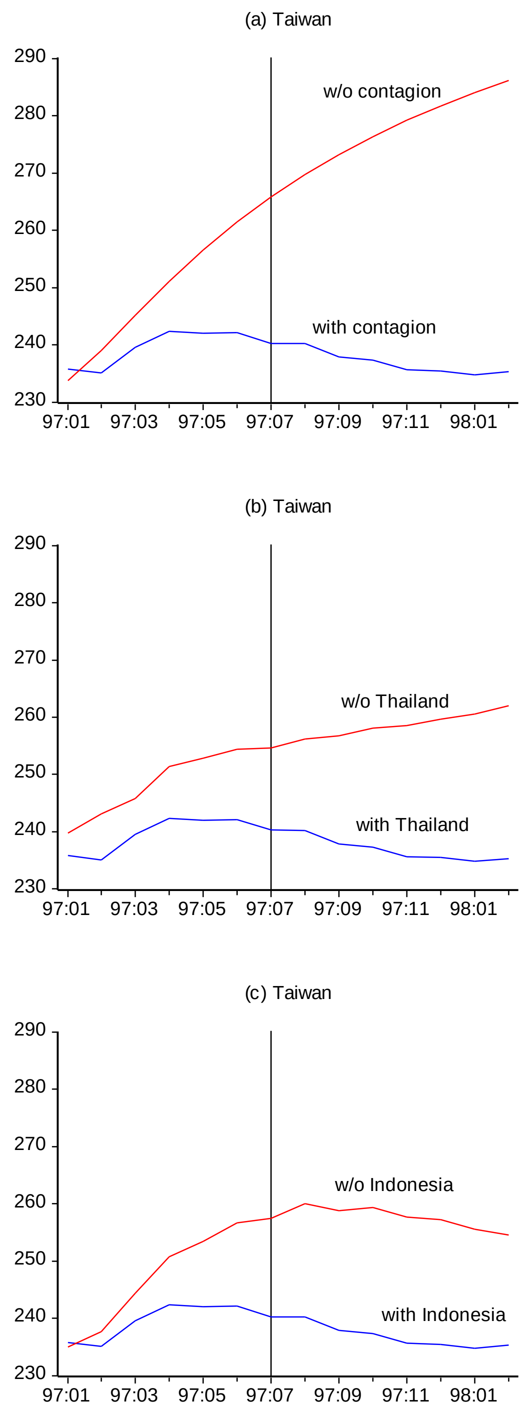

(a) Taiwan
w/o contagion
with contagion
(b) Taiwan
w/o Thailand
with Thailand
(c) Taiwan
w/o Indonesia
with Indonesia
290
280
270
260
250
240
230
97:01
97:03
97:05
97:07
97:09
97:11
98:01

Figure 3

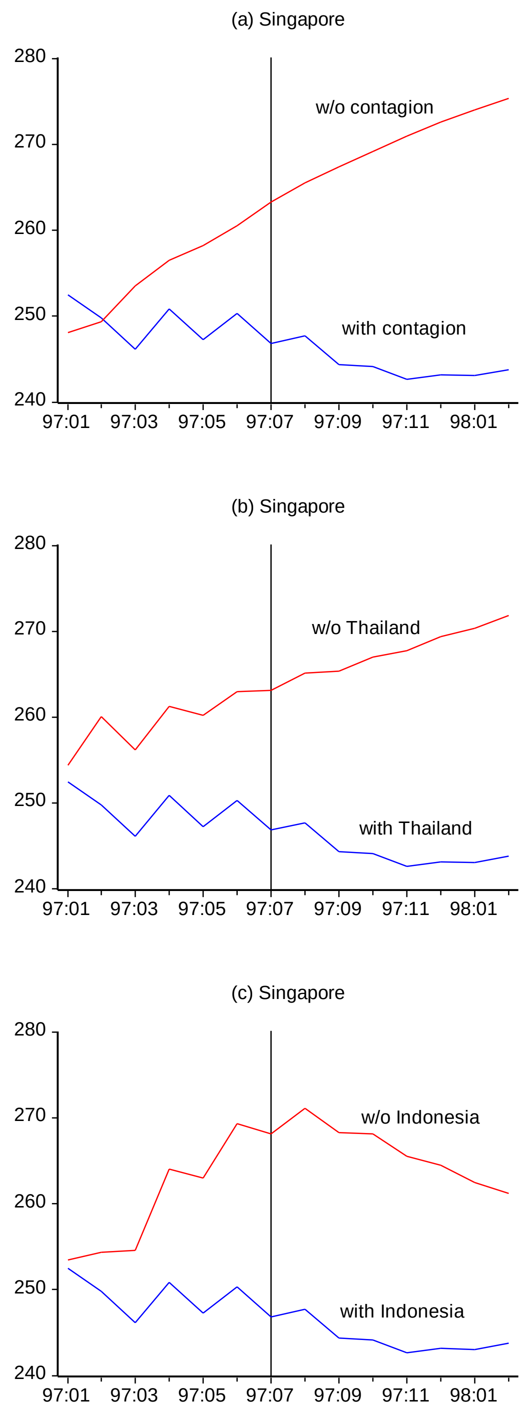
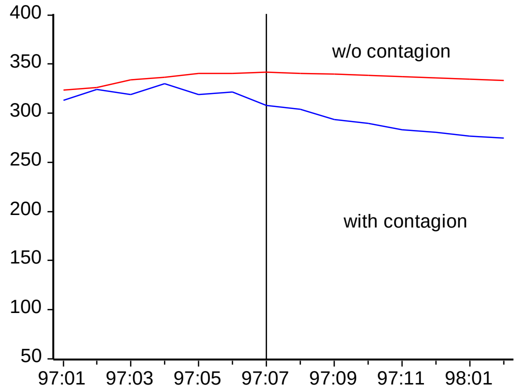
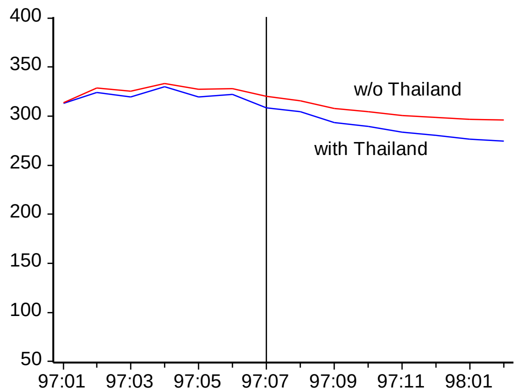

(a) Singapore
280
270
260
250
240
w/o contagion
with contagion
97:01
97:03
97:05
97:07
97:09
97:11
98:01
(b) Singapore
280
270
260
250
240
w/o Thailand
with Thailand
97:01
97:03
97:05
97:07
97:09
97:11
98:01
(c) Singapore
280
270
260
250
240
w/o Indonesia
with Indonesia
97:01
97:03
97:05
97:07
97:09
97:11
98:01

Figure 4

(a) Malaysia



(b) Malaysia



(c) Malaysia

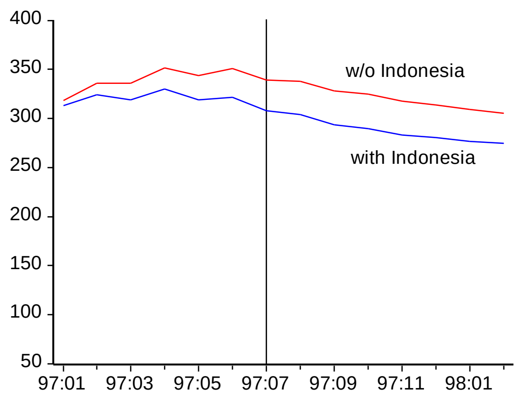


Figure 5

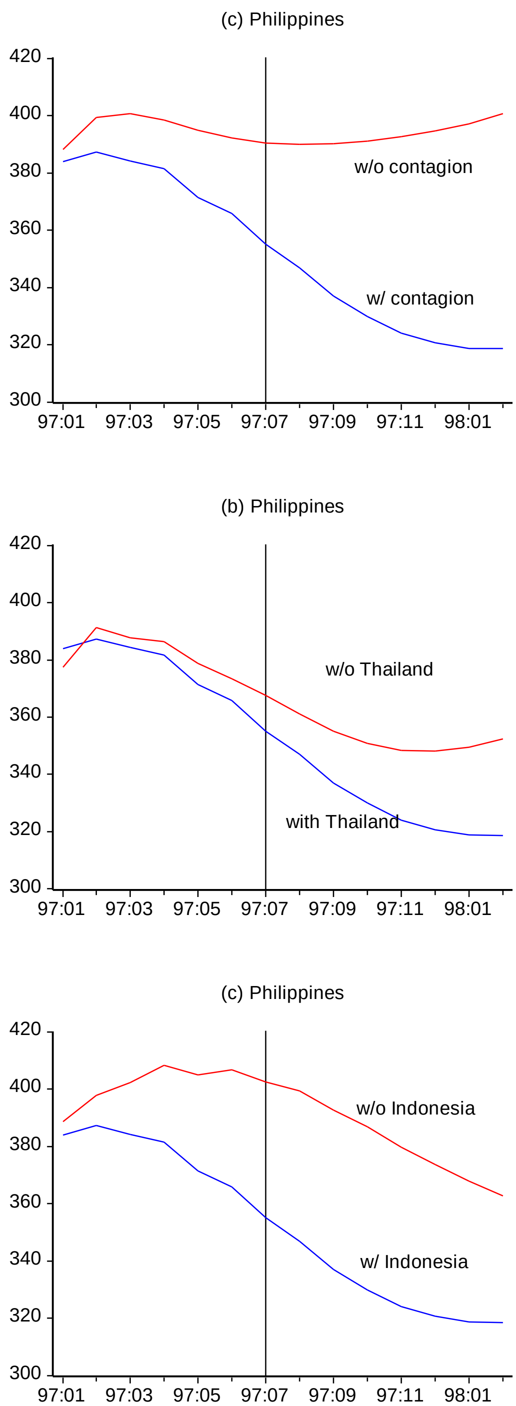
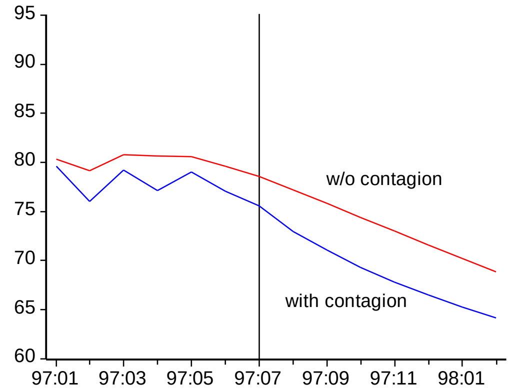
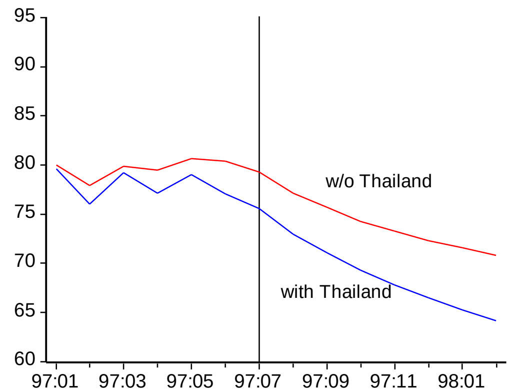

(c) Philippines
420
400
380
360
340
320
300
97:01
97:03
97:05
97:07
97:09
97:11
98:01
w/o contagion
w/ contagion
(b) Philippines
420
400
380
360
340
320
300
97:01
97:03
97:05
97:07
97:09
97:11
98:01
w/o Thailand
with Thailand
(c) Philippines
420
400
380
360
340
320
300
97:01
97:03
97:05
97:07
97:09
97:11
98:01
w/o Indonesia
w/ Indonesia

Figure 6

(a) Korea



(b) Korea



(c) Korea

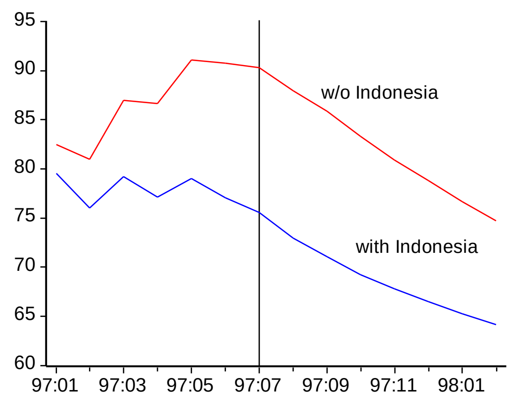
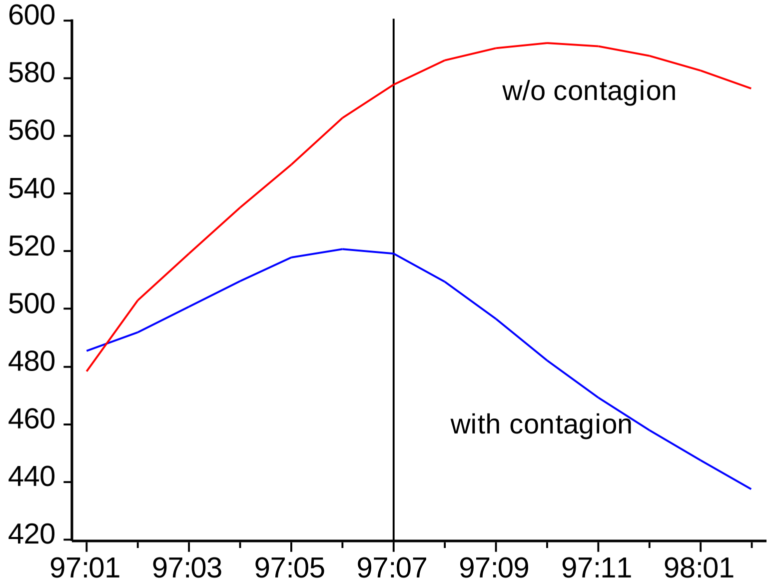


Figure 7

(a) Indonesia



(b) Indonesia

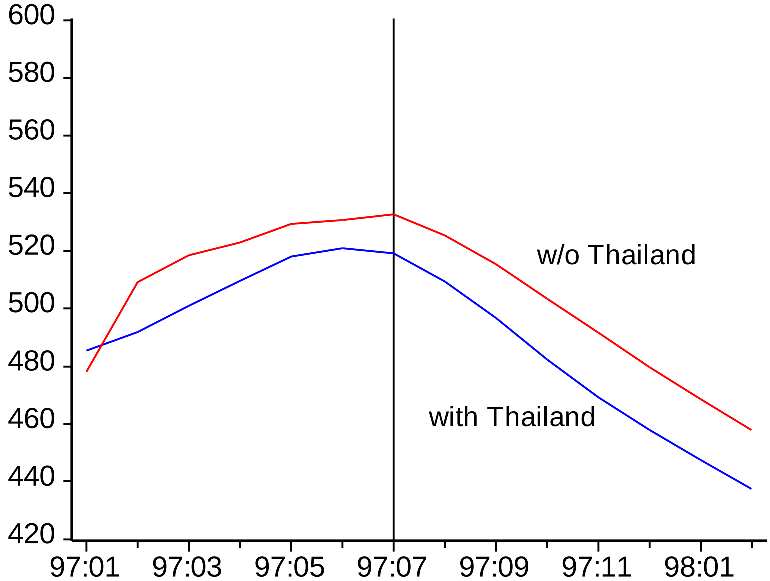
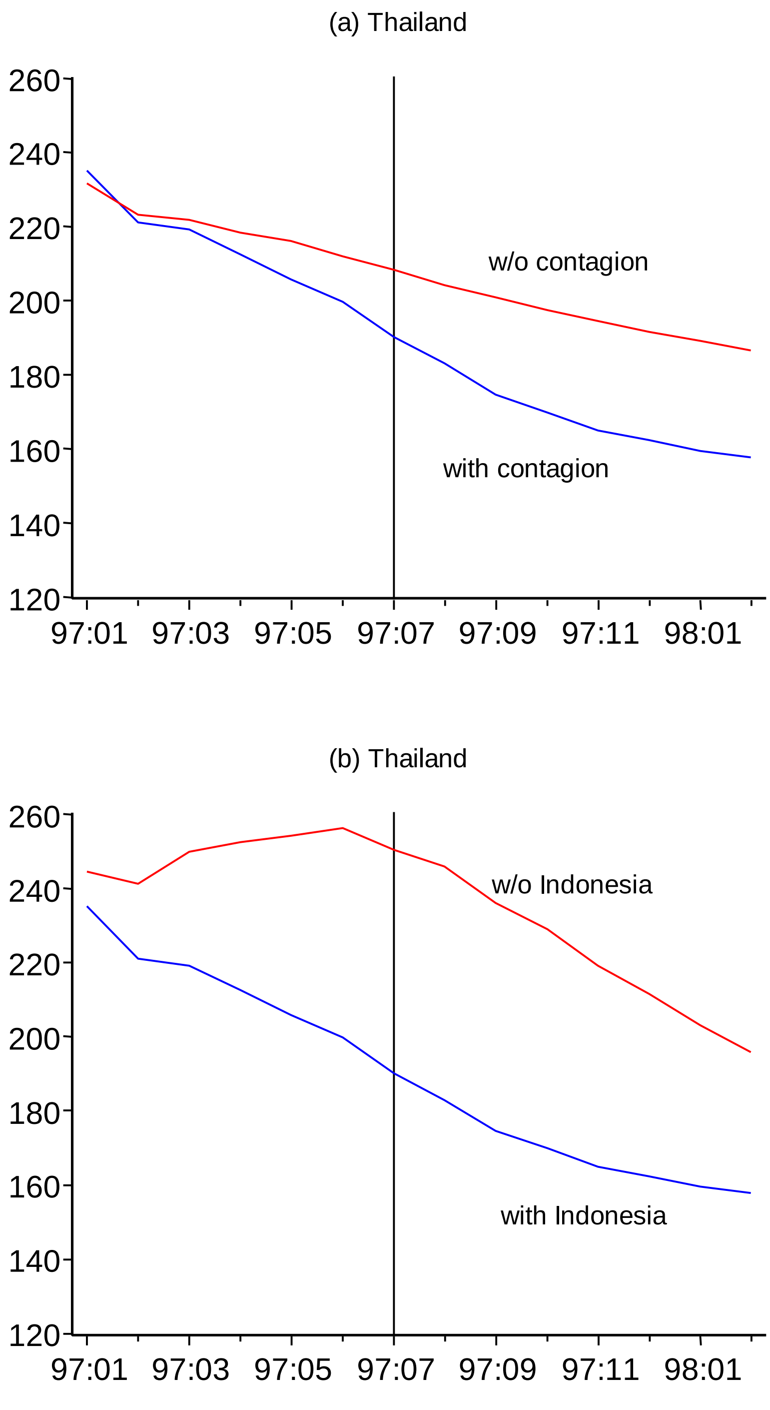


Figure 8



(a) Thailand
260
240
220
200
180
160
140
120
97:01
97:03
97:05
97:07
97:09
97:11
98:01
w/o contagion
with contagion
(b) Thailand
260
240
220
200
180
160
140
120
97:01
97:03
97:05
97:07
97:09
97:11
98:01
w/o Indonesia
with Indonesia

Table 5

Mean Absolute Deviations of Real Stock Prices

	Hong Kong			**Korea**			**Malaysia**		
Average	Thai Contagion	Indonesian Contagion	Total Contagion	Thai Contagion	Indonesian Contagion	Total Contagion	Thai Contagion	Indonesian Contagion	Total Contagion
1997-1Q	3.52	1.35	7.26	0.99	5.21	1.82	3.63	11.31	9.34
1997-2Q	1.74	2.01	4.36	2.45	11.77	2.55	5.85	25.11	15.60
1997-3Q	5.70	0.50	17.45	4.17	14.85	4.00	12.33	32.82	38.70
1997-4Q	9.46	1.41	35.68	5.44	13.18	5.17	16.73	34.28	52.57
1998-Jan/Feb	12.69	4.05	48.70	6.48	11.00	4.82	20.51	31.41	58.48
(A) Pre-crisis	2.63	1.68	5.81	1.72	8.49	2.19	4.74	18.21	12.47
(B) Crisis	8.86	1.73	32.10	5.22	13.26	4.64	16.02	33.02	48.85

	Philippines			**Singapore**			**Taiwan**		
Average	Thai Contagion	Indonesian Contagion	Total Contagion	Thai Contagion	Indonesian Contagion	Total Contagion	Thai Contagion	Indonesian Contagion	Total Contagion
1997-1Q	4.67	11.15	10.96	7.41	4.66	4.07	6.09	2.76	3.85
1997-2Q	6.55	33.79	22.30	11.99	15.98	8.97	10.74	11.50	14.21
1997-3Q	14.92	51.85	43.86	18.24	22.86	19.09	16.39	19.32	30.18
1997-4Q	24.23	55.22	67.93	24.73	22.76	27.61	22.61	21.96	42.98
1998-Jan/Feb	32.22	46.63	80.27	27.69	18.45	31.29	26.23	19.99	50.03
(A) Pre-crisis	5.61	22.47	16.63	9.70	10.32	6.52	8.41	7.13	9.03
(B) Crisis	22.74	51.81	61.99	23.04	21.72	25.33	21.18	20.48	39.94

	Thailand		**Indonesia**	
Average	Indonesian Contagion	Total Contagion	Thai Contagion	Total Contagion
1997-1Q	20.05	2.69	14.02	12.08
1997-2Q	48.24	9.47	11.51	34.32
1997-3Q	61.52	21.94	16.10	76.47
1997-4Q	54.07	28.82	21.73	120.64
1998-Jan/Feb	40.86	29.13	20.72	137.09
(A) Pre-crisis	34.14	6.08	12.76	23.20
(B) Crisis	53.56	26.32	19.37	108.19

Evidence of herding behavior from VARs on daily data

Using the daily stock price data, vector autoregressions were estimated to determine the change in the behavior of stock prices prior to and during the Asian financial crisis. To keep the system parsimonious, only six stock markets were included, namely, Indonesia, Malaysia, Philippines, Thailand, Singapore and Korea. Similar to the previous analysis, the sample period was divided into two sub-periods with observations prior to July 2, 1997 comprising the non-crisis sub-sample while those commencing on July 2, 1997 constituting the crisis sub-sample. Unit root tests reveal that the stock prices followed an I(1) process. The Johansen cointegration test indicates that there are no cointegrating relationships among the stock prices.[9] These results suggest that it is appropriate to use a VAR in first differences.[10] We specify a VAR in standard form given by:

$$\Delta x_t = A_0 + A_1 \Delta x_{t-1} + e_t$$

where x is a vector of the natural logarithm of the stock market prices in US dollars of Indonesia, Malaysia, Philippines, Thailand, Singapore, and Korea, A_0 and A_1 are matrices of coefficients and e is the random error term.

The VAR estimation results for the two sample periods are given in Appendix Tables 1 and 2. An interesting result is the change in the optimal lag length for the two sample periods. It is found that the optimal lag increase from three days during the normal period to nine days during the crisis period. This indicates that the effects of lagged stock returns have more persistence during the crisis period.

The chosen ordering for the VAR is Indonesia, Thailand, Korea, Philippines, Malaysia and Singapore. The first three are widely recognized as having been most severely affected by the crisis, having suffered disruptions in domestic and external credit. Figures 9A, 10A, 11A, 12A, 13A and 14A plot the impulse response functions prior to the most recent crisis, while Figures 9B, 10B, 11B, 12B, 13B, and 14B show those for the crisis period.

To facilitate the analysis of the impulse responses, let us label Thailand, Indonesia and Korea as the "crisis-originating markets," and the Philippines, Malaysia and Singapore as the "infected markets."

[9] The inability to reject the null hypothesis of no cointegration may be due to the short span of the sample period.

[10] A VAR model in log first differences, to be more exact.

It is noticeable that there is an abrupt and substantial increase in the Day 1 impulse responses during crisis periods. This is true for all markets being studied. This means that shocks in one market affect other markets on the same day. This indicates that there are international contagion effects immediately upon the impact of the crisis in a domestic market.

The impulse responses also indicate that the flow of contagion is not limited from a crisis-originating market to an infected market. However, the contagion within the infected markets is much milder than that arising from the crisis-originating markets (in fact, some impulse responses of an infected market to another infect market of are not significantly different from zero).

Another observation is that, during the crisis period, the response of the Southeast Asian stock markets to innovations in Korea is smaller compared to the reaction to Indonesian and Thai innovations (compare Figures 9B and 10B with Figure 11B). In fact, the responses of the infected markets not significantly different from zero.

The persistence of innovations also differs depending on its source. Apparently, the impulse responses after the onset of the crisis show a slightly longer persistence of innovations if they come from the crisis-originating markets. After the onset of the crisis, the impulse responses to innovations from crisis-originating markets are significant for 2 to 3 days. In contrast, the impulse responses to innovations from infected markets are either significant only during Day 1 or not significant at all.

Figure 9A
Response to One S.D. Innovations ± 2 S.E.

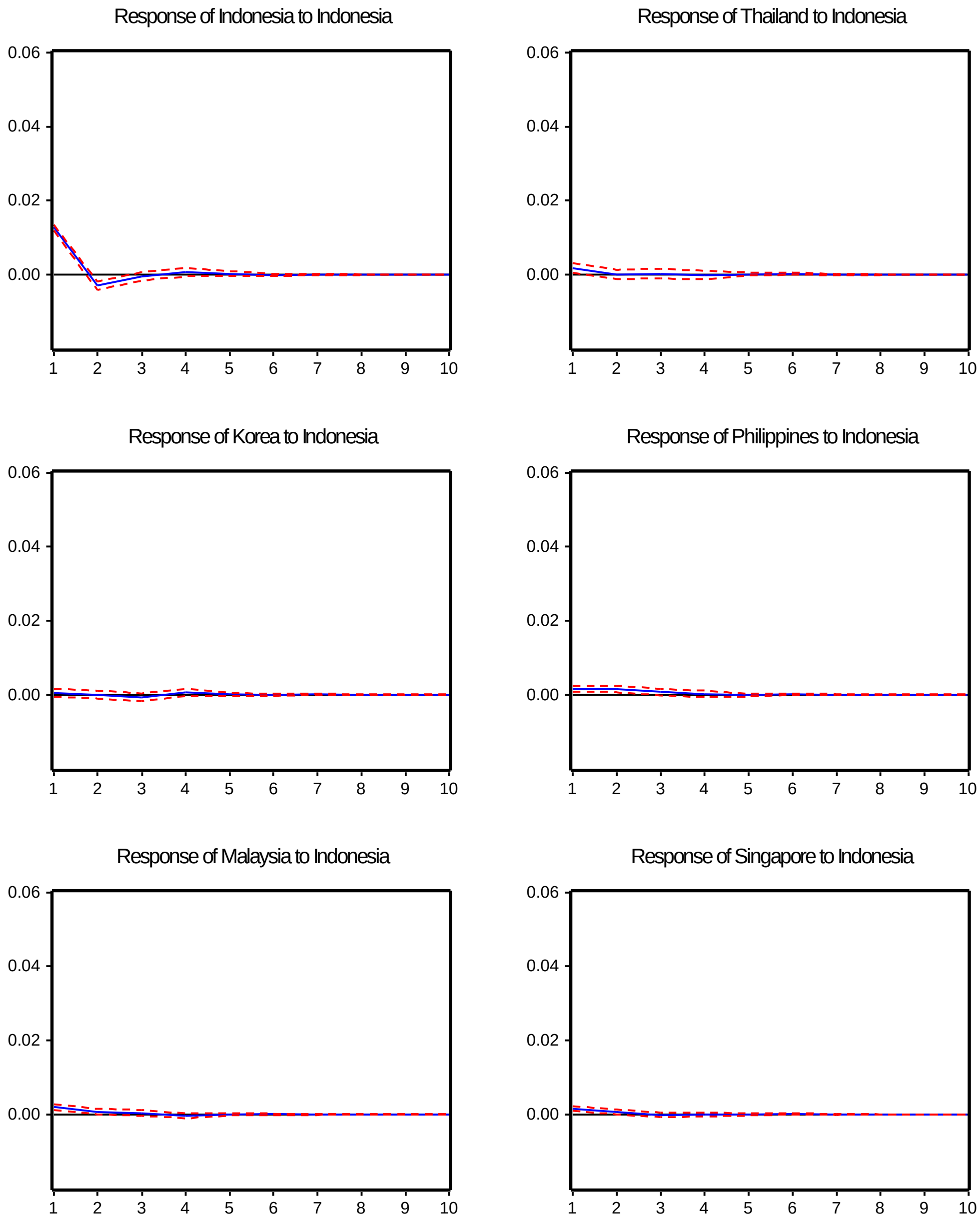


Figure 9B
Response to One S.D. Innovations ± 2 S.E.

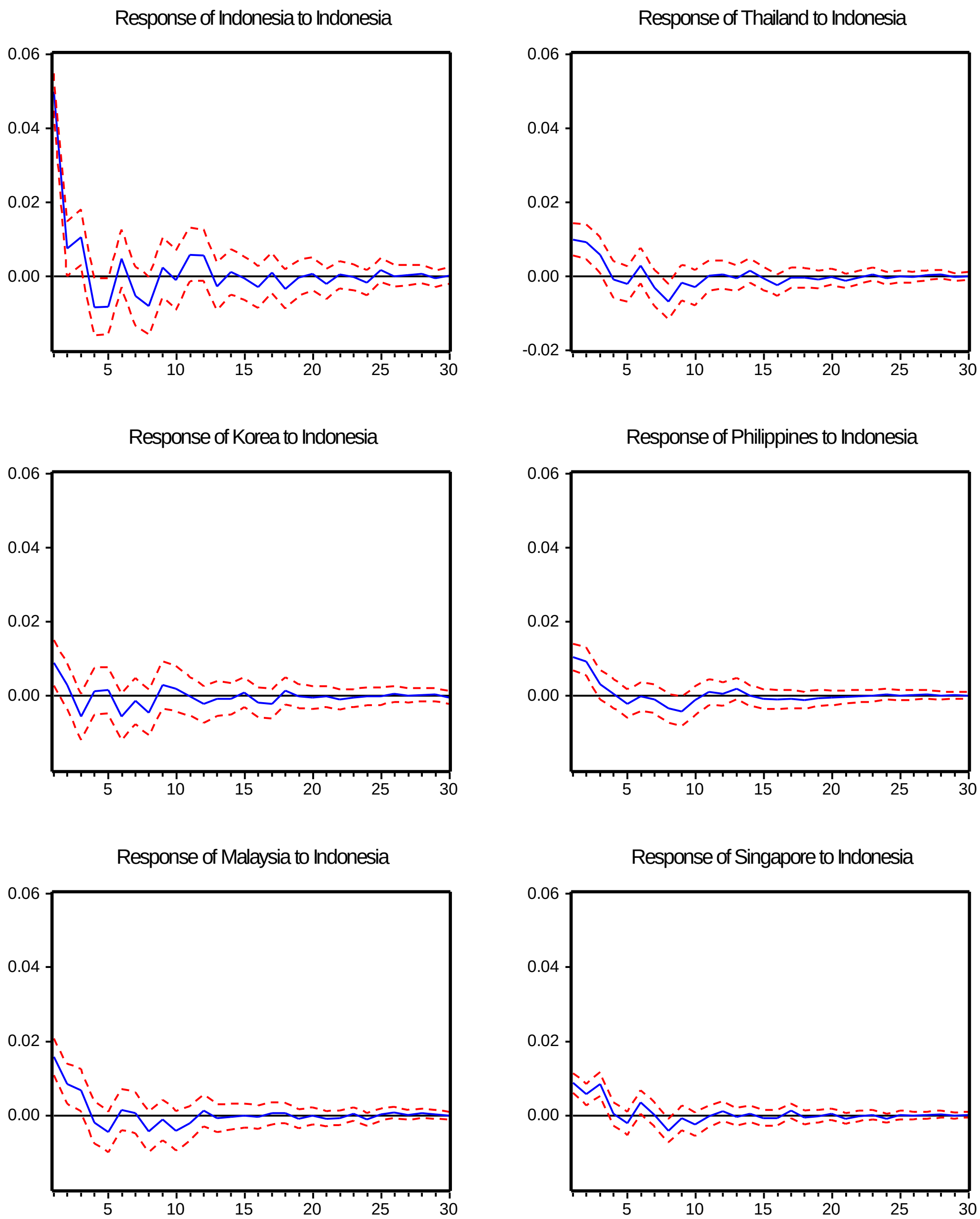


Figure 10A
Response to One S.D. Innovations ± 2 S.E.

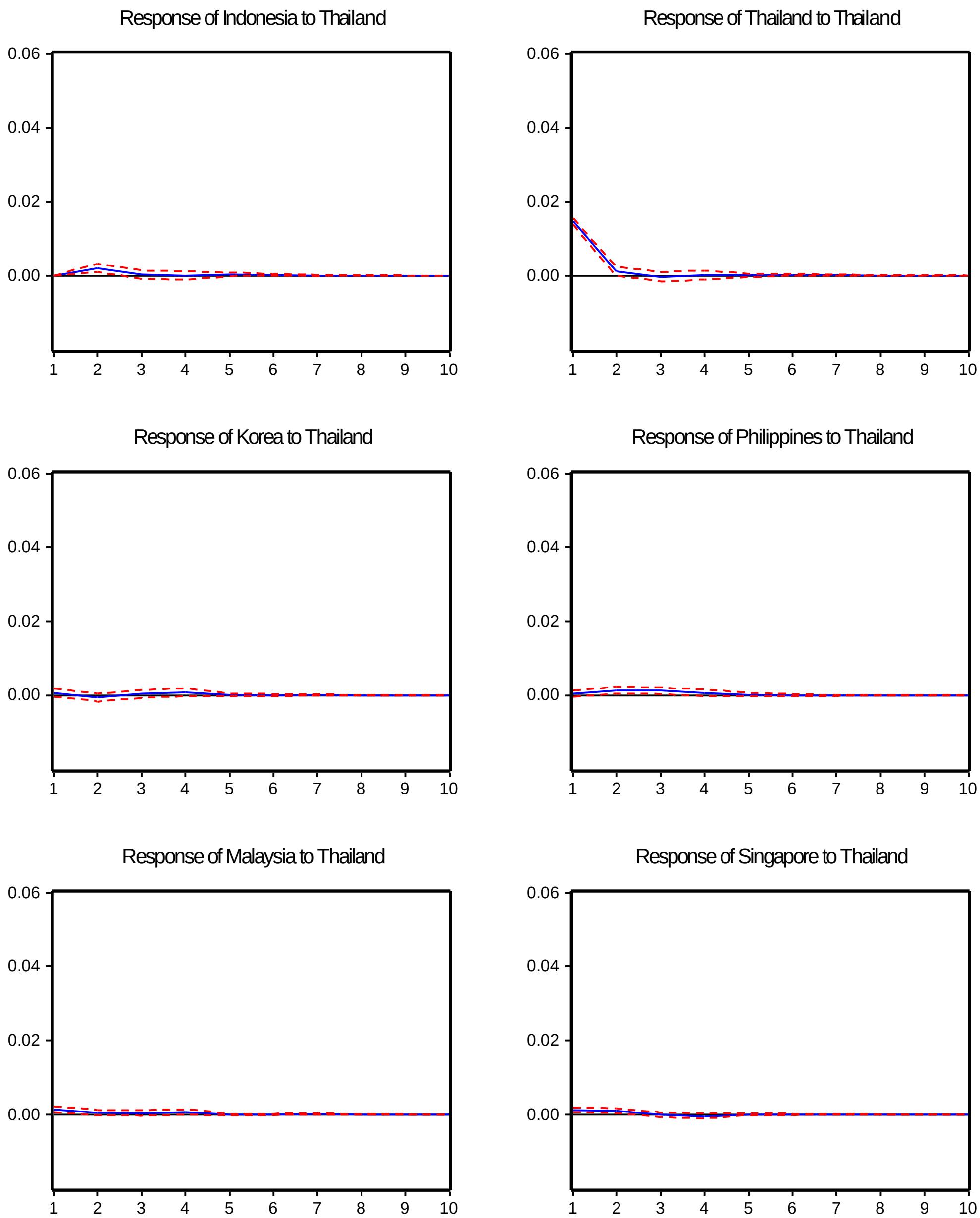


Figure 10B
Response to One S.D. Innovations ± 2 S.E.

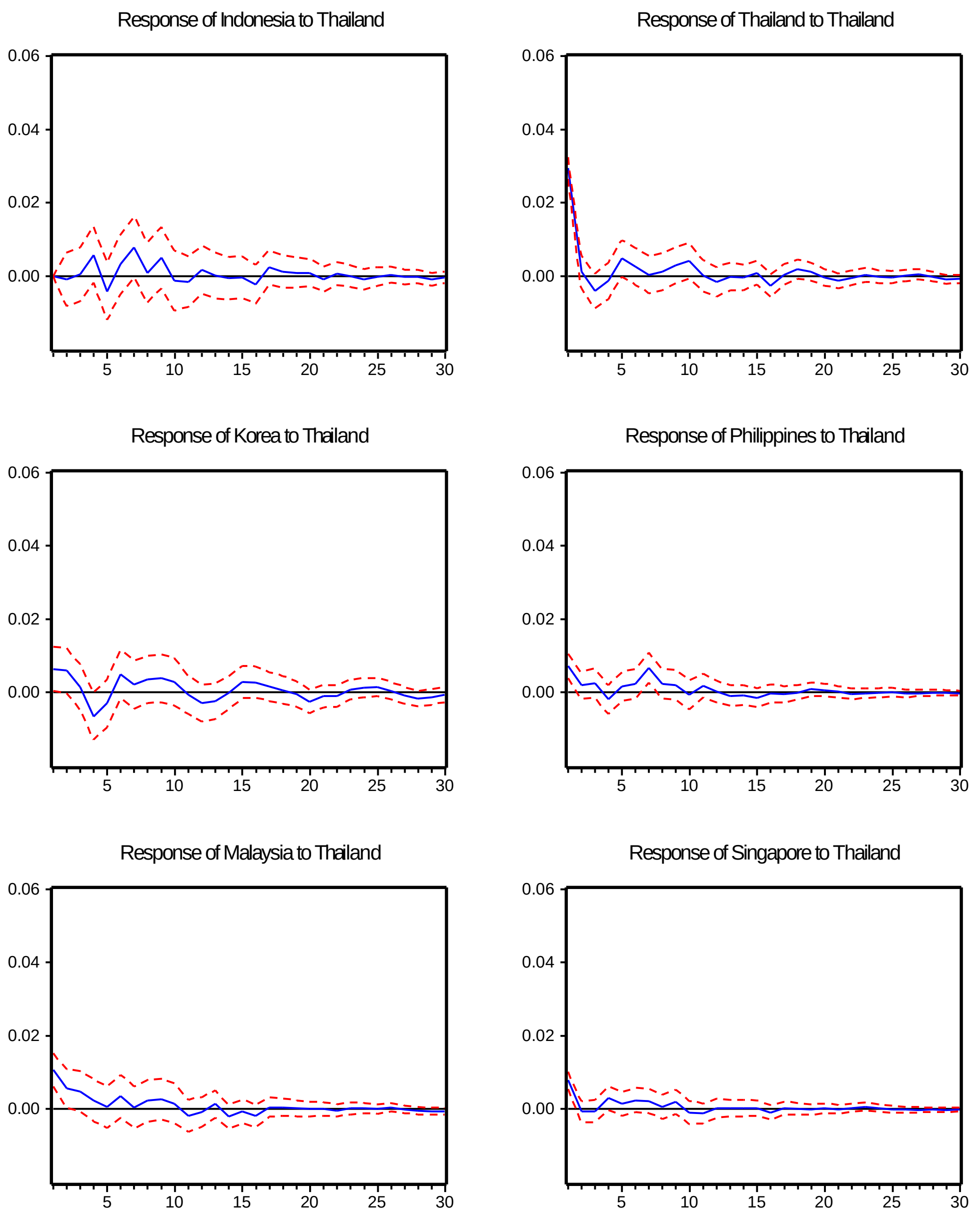


Figure 11A
Response to One S.D. Innovations ± 2 S.E.

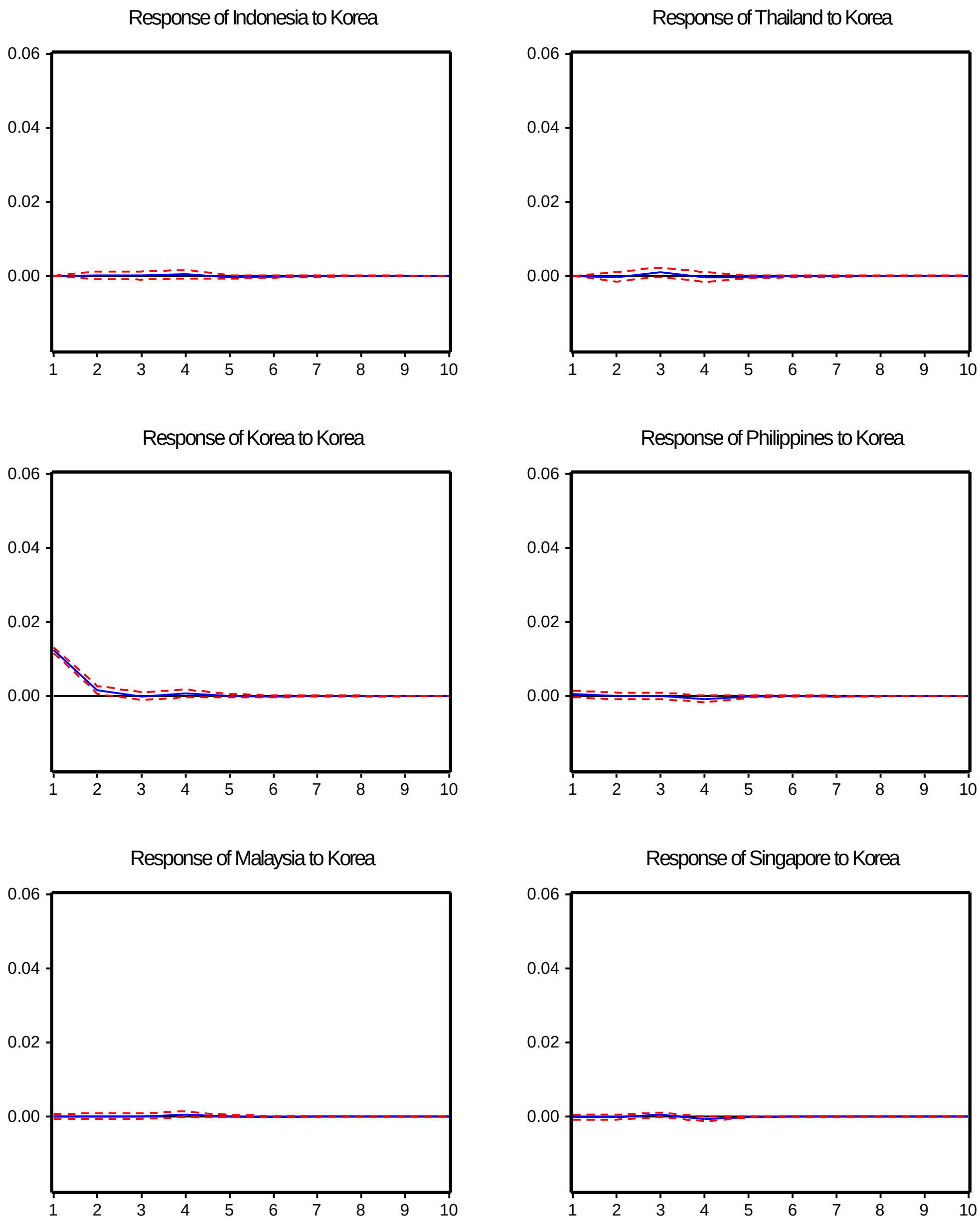


Figure 11B
Response to One S.D. Innovations ± 2 S.E.

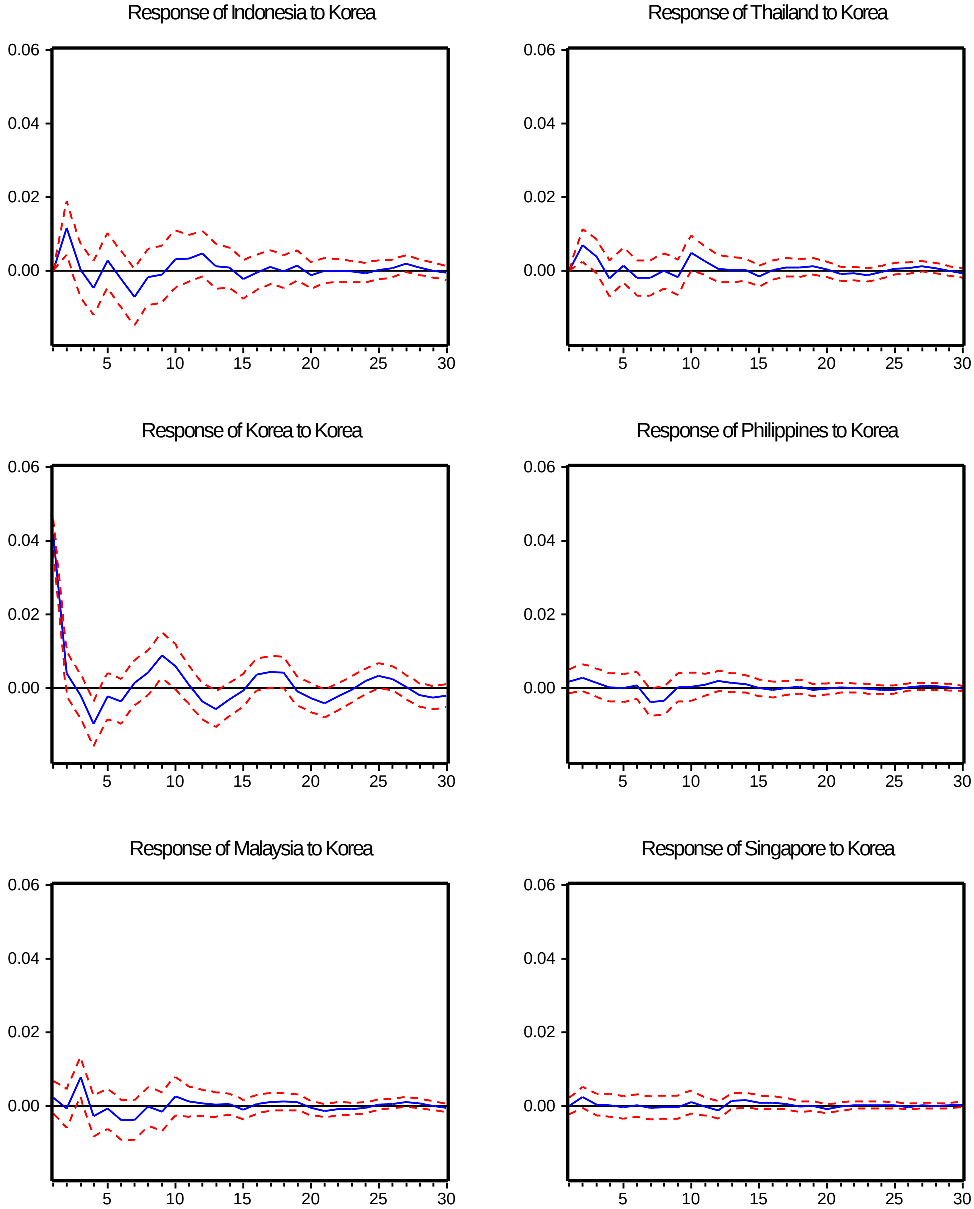


Figure 12A
Response to One S.D. Innovations ± 2 S.E.

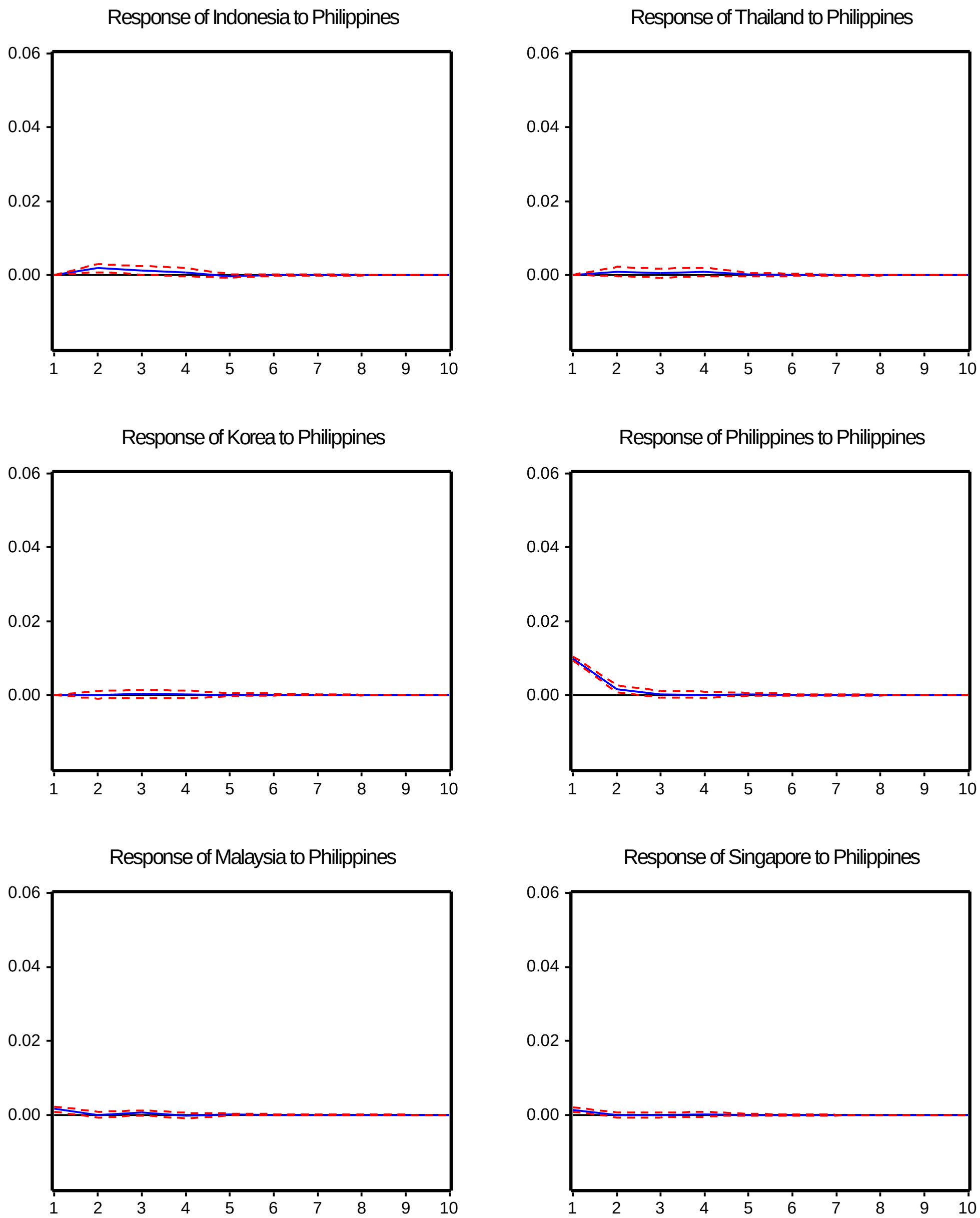


Figure 12B
Response to One S.D. Innovations ± 2 S.E.

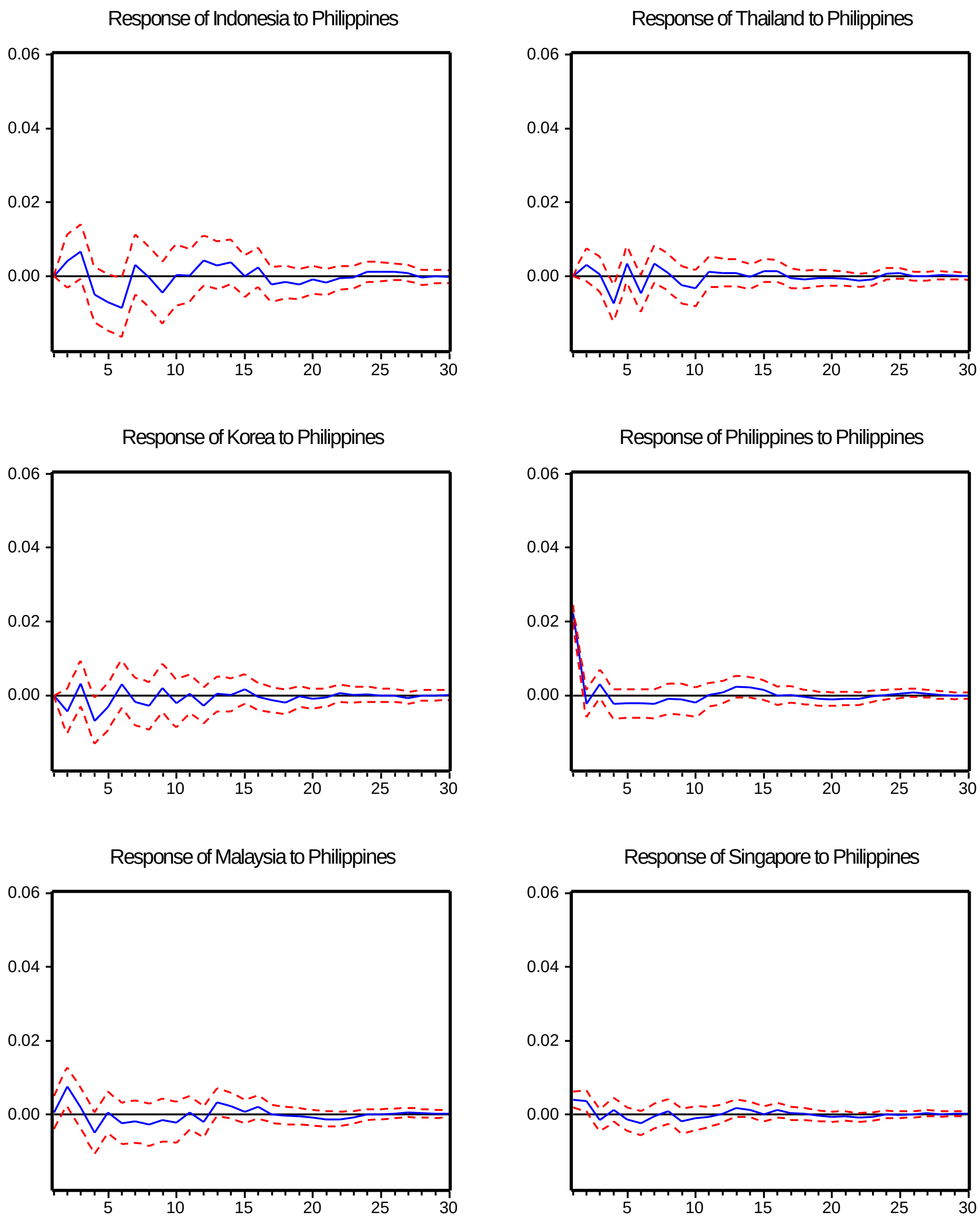


Figure 13A

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

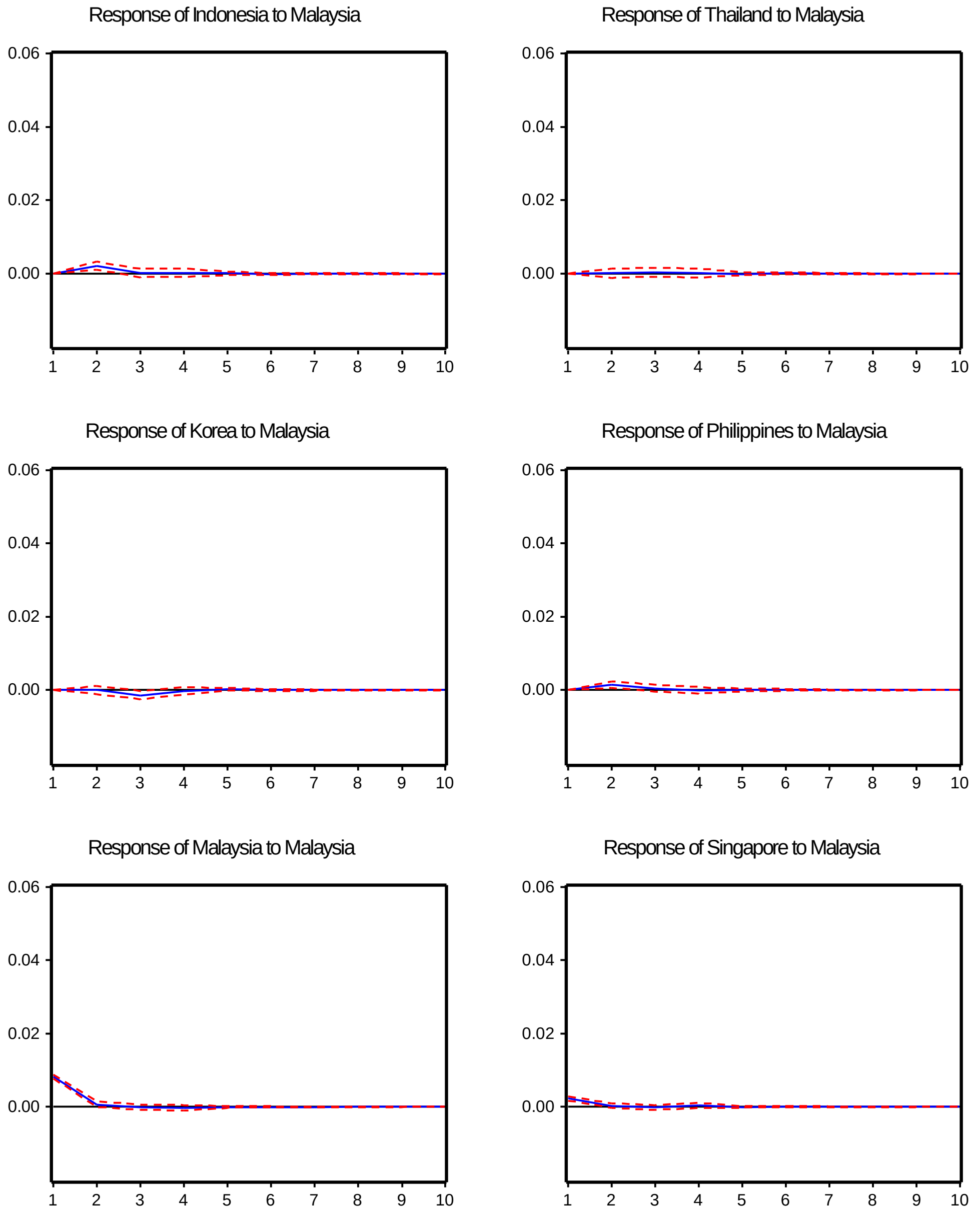


Figure 13B
Response to One S.D. Innovations ± 2 S.E.

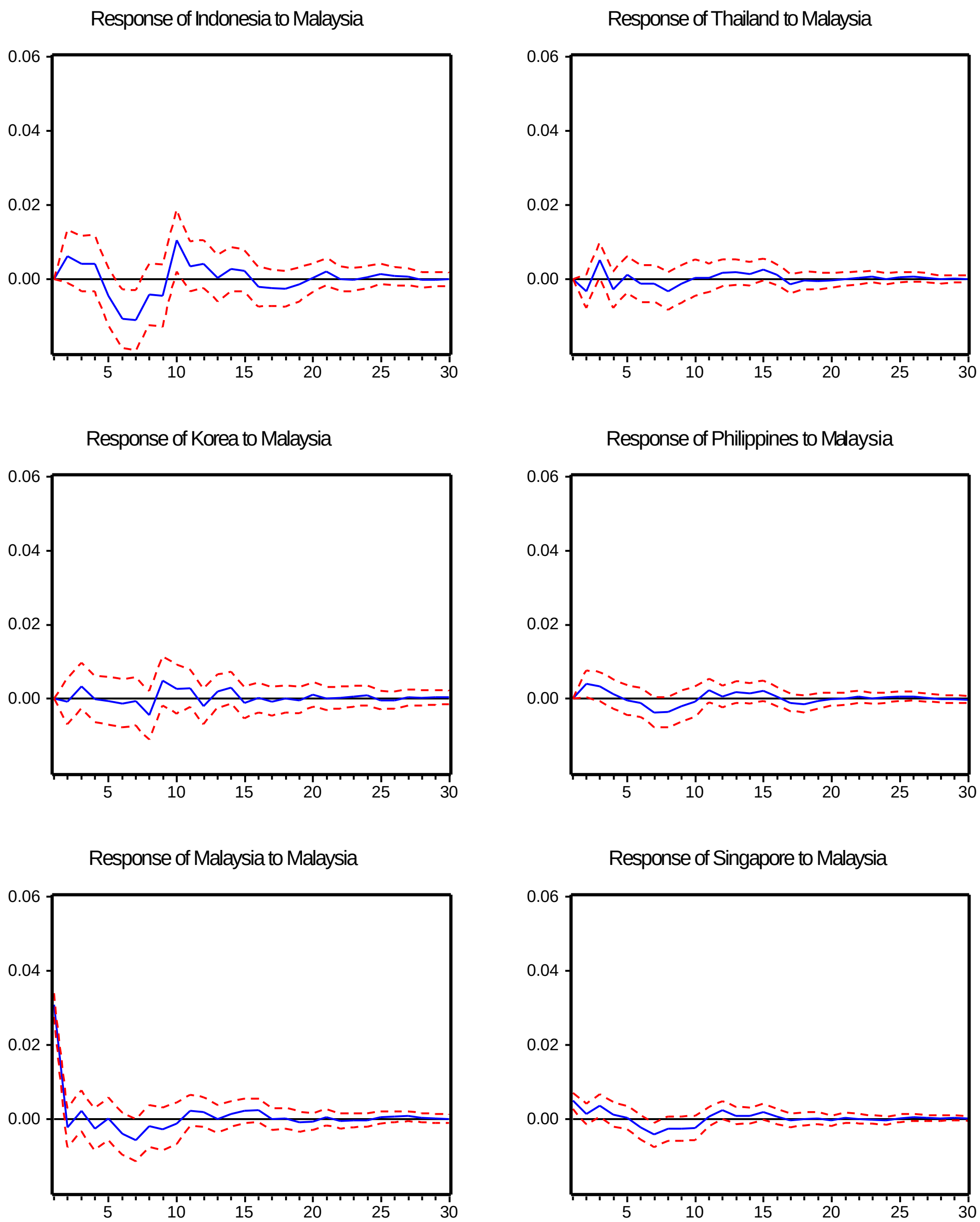


Figure 14A

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

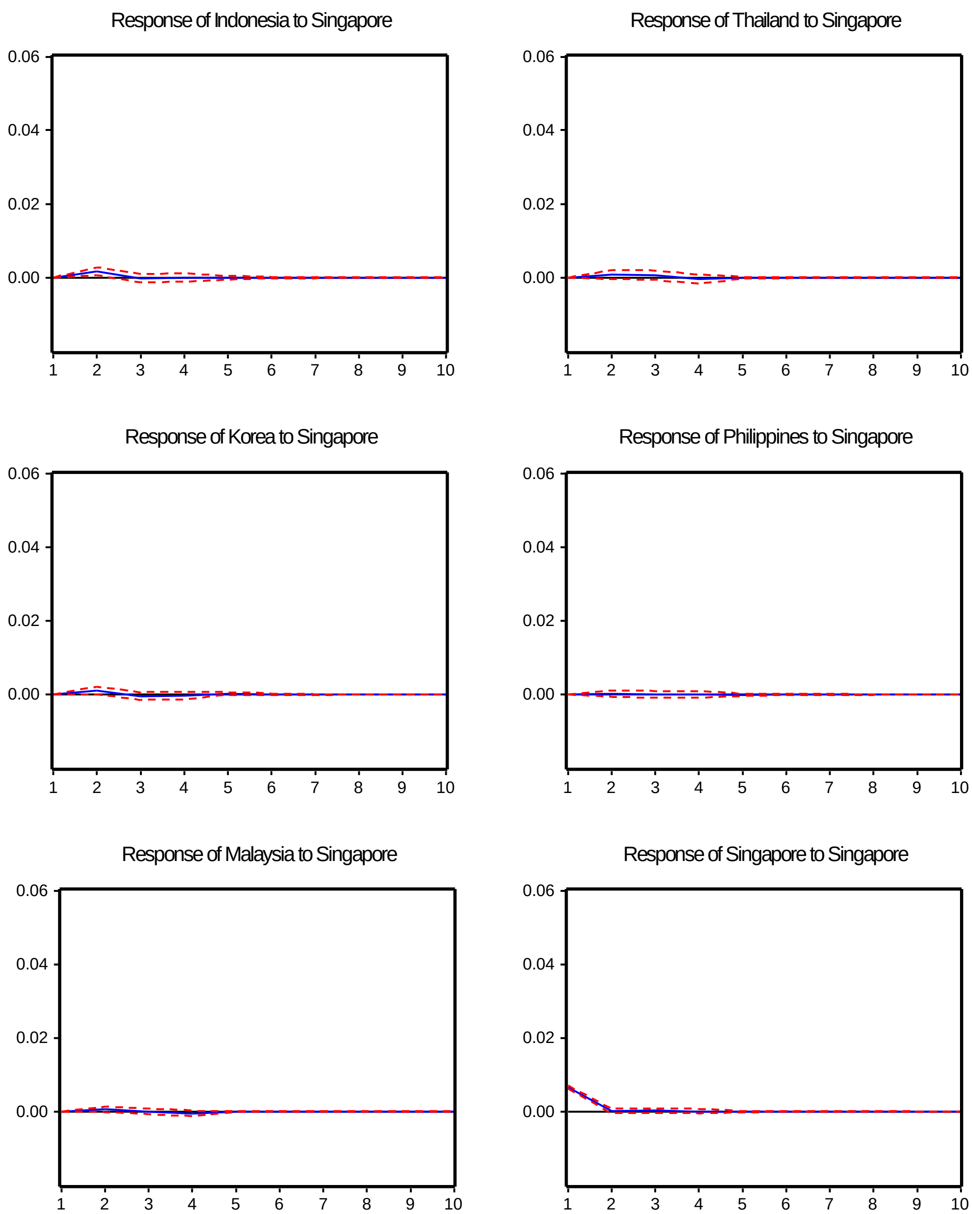
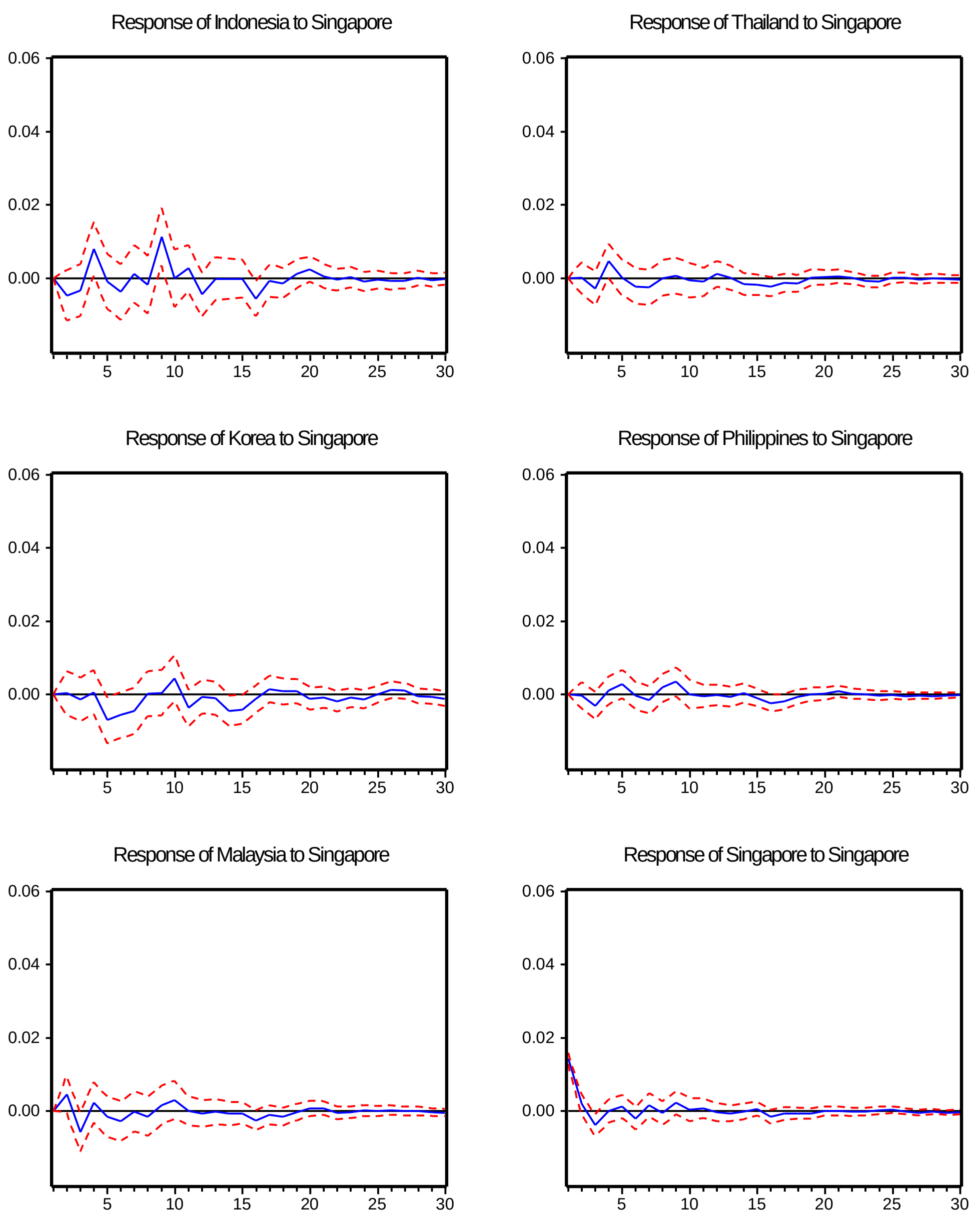


Figure 14B
Response to One S.D. Innovations ± 2 S.E.



Variance decomposition likewise indicates that variations during crisis tend to be explained more by innovations of other stock markets. At the same time, the percentage of variation explained by own innovations decline (see Tables 3 and 4). For instance, in the case of the Philippines during the normal period, in Day 1, own innovations account for more than 97 percent of the variation. However during the crisis period, this falls to 75 percent while the variation explained by Indonesian and Thai innovations rise from 2 percent to 16 percent and from 0.12 percent to 8 percent, respectively. After 20 days, own innovation account for less than 50 percent while innovations in other stock markets show substantial increase. This is the general trend for the variance decompositions.

Table 6

June 1, 1995 - July 1, 1997

Variance Decomposition of D(INDONESIA)							
Period	S.E.	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.01	100.00	0.00	0.00	0.00	0.00	0.00
2	0.01	91.87	2.30	0.01	1.89	2.49	1.43
10	0.01	90.53	2.37	0.18	3.00	2.48	1.44
20	0.01	90.53	2.37	0.18	3.00	2.48	1.44
Variance Decomposition of D(THAILAND)							
Period	S.E.	D(Indonesia)	D(Thai-land)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.01	1.49	98.51	0.00	0.00	0.00	0.00
2	0.01	1.47	97.85	0.03	0.41	0.01	0.23
10	0.02	1.50	96.55	0.54	0.82	0.07	0.52
20	0.02	1.50	96.55	0.54	0.82	0.07	0.52
Variance Decomposition of D(KOREA)							
Period	S.E.	D(Indonesia)	D(Thai-land)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.01	0.15	0.33	99.52	0.00	0.00	0.00
2	0.01	0.15	0.61	98.54	0.01	0.00	0.70
10	0.01	0.67	1.06	95.97	0.13	1.23	0.94
20	0.01	0.67	1.06	95.97	0.13	1.23	0.94

Variance Decomposition of D(PHILIPPINES)							
Period	S.E.	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.01	2.38	0.12	0.23	97.27	0.00	0.00
2	0.01	4.26	1.77	0.21	91.78	1.95	0.02
10	0.01	4.62	3.39	0.78	89.00	2.17	0.04
20	0.01	4.62	3.39	0.78	89.00	2.17	0.04

Variance Decomposition of D(MALAYSIA)							
Period	S.E.	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.01	5.19	2.62	0.00	3.40	88.78	0.00
2	0.01	5.82	2.84	0.01	3.33	87.60	0.40
10	0.01	6.05	3.46	0.42	3.67	85.59	0.82
20	0.01	6.05	3.46	0.42	3.67	85.59	0.82

Variance Decomposition of D(SINGAPORE)							
Period	S.E.	D(Indonesia)	D(Thai-land)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.01	4.44	2.83	0.10	3.71	10.01	78.91
2	0.01	5.08	4.43	0.15	3.62	9.93	76.79
10	0.01	5.06	4.72	1.30	3.58	10.06	75.28
20	0.01	5.06	4.72	1.30	3.58	10.06	75.28

Table 7

July 2, 1995 - March 27, 1998

Variance Decomposition of D(INDONESIA)							
Period	S.E.	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.05	100.00	0.00	0.00	0.00	0.00	0.00
2	0.05	92.37	0.02	4.88	0.59	1.35	0.78
10	0.07	68.27	3.60	5.51	5.59	11.32	5.71
20	0.07	65.24	3.76	6.05	6.47	11.76	6.73

Variance Decomposition of D(THAILAND)							
Period	S.E.	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.03	10.22	89.78	0.00	0.00	0.00	0.00
2	0.03	16.46	77.56	4.14	0.87	0.97	0.00
10	0.04	19.02	60.03	6.45	7.88	4.01	2.62
20	0.04	18.70	58.03	6.83	8.02	4.93	3.48

Variance Decomposition of D(KOREA)

Period	S.E.	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.04	4.23	2.21	93.56	0.00	0.00	0.00
2	0.04	4.49	3.97	90.57	0.93	0.03	0.01
10	0.05	7.09	7.24	74.48	4.25	2.41	4.53
20	0.05	7.05	7.92	71.46	4.42	3.13	6.02

Variance Decomposition of D(PHILIPPINES)

Period	S.E.	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
1	0.03	16.52	8.00	0.48	74.99	0.00	0.00
2	0.03	24.94	7.29	1.46	64.27	2.03	0.00
10	0.03	22.98	12.55	3.91	50.99	5.93	3.65
20	0.03	22.36	12.49	4.42	49.08	7.27	4.38

Variance Decomposition of D(MALAYSIA)

Period	S.E.	D(Indonesia)	D(Thai-land)	D(Korea)	D(Philip-pines)	D(Malaysia)	D(Singapore)
1	0.04	19.03	8.83	0.39	0.03	71.73	0.00
2	0.04	21.42	9.85	0.38	3.85	63.11	1.39
10	0.04	21.97	10.44	5.79	5.61	51.97	4.22
20	0.05	21.47	10.70	5.87	6.68	50.72	4.56

Variance Decomposition of D(SINGAPORE)

Period	S.E.	D(Indonesia)	D(Thai-land)	D(Korea)	D(Philip-pines)	D(Malaysia)	D(Singapore)
1	0.02	19.97	15.94	0.00	4.31	6.12	53.66
2	0.02	24.58	14.01	1.19	6.86	5.66	47.70
10	0.03	32.04	12.96	1.05	6.82	12.37	34.75
20	0.03	30.98	12.66	2.08	7.48	13.28	33.51

The above results support the notion that there were contagion effects during the Asian financial crisis.

5. Concluding Remarks

This paper sheds light on the extent of contagion effects during the Asian crisis. A caveat for the paper is its inability to directly deal with herding behavior contagion and fundamentals contagion. An approach taken is to specify a vector error correction model and defining the error correction terms as depicting the behavior of fundamentals and the lagged first differenced terms as depicting the short-term contagion effects.

This study finds that there really are contagion effects during the Asian financial crises. These are substantiated by the dynamic simulations using the Vector Error Correction Model. Similar findings are also reached using the impulse response functions and variance decomposition of the daily Vector Autoregression Model.

Among the major findings is that Hong Kong, Singapore and Taiwan would not have experienced the fall in real stock prices had there been no contagion effects. The simulations also suggest that grave fundamental problems characterized Thailand and Korea since their real stock price would still have fallen sharply even with the absence of contagion effects. Also, there appears to be some slight fundamental problems in Malaysia and Philippines since their real stock prices would still have declined even if the crisis had not occurred. Lastly, the simulations suggest that the Indonesian crisis may be along the lines of multiple equilibria, *i.e.*, its situation would have been sustainable but the crisis triggered a shift in towards a “bad” equilibrium, causing the crash.

Appendix Table 1
Sample: June 1, 1997 - July 1, 1997
Three Lags

	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
ΣD(Indonesia)	-0.56	-0.07	-0.01	0.12	0.05	0.04
	(32.8)***	(0.6)	(0.0)	(2.4)	(0.6)	(0.4)
ΣD(Thailand)	0.21	0.09	-0.08	0.19	0.05	0.11
	(2.3)	(2.8)*	(0.3)	(7.8)***	(2.8)*	(0.2)
ΣD(Korea)	0.04	0.01	0.16	-0.07	0.05	-0.04
	(0.3)	(1.1)	(5.4)**	(1.8)	(3.4)*	(0.9)
ΣD(Philippines)	0.37	0.20	0.09	0.10	0.00	-0.03
	(16.6)***	(0.0)	(0.3)	(2.1)	(0.0)	(0.3)
ΣD(Malaysia)	0.28	0.02	-0.17	0.17	0.03	0.05
	(5.17)**	(0.1)	(2.0)	(2.9)*	(0.1)	(0.6)
ΣD(Singapore)	0.28	0.10	0.05	-0.03	-0.04	0.02
	(3.6)*	(0.2)	(0.1)	(0.6)	(0.2)	(0.0)
C	0.00	-0.00	-0.00	0.00	0.00	-0.00
	(2.14)	(-2.45)	(-0.68)	(0.30)	(0.36)	(-0.69)
R-squared	0.15	0.03	0.05	0.11	0.04	0.05
Adj. R-squared	0.12	-0.01	0.02	0.08	0.01	0.01

*F-ratios in parentheses except for the constant (t-ratio)

Appendix Table 2
Sample: July 2, 1997 - March 27, 1998
Nine Lags

	D(Indonesia)	D(Thailand)	D(Korea)	D(Philippines)	D(Malaysia)	D(Singapore)
ΣD(Indonesia)	-0.17	-0.02	-0.07	-0.15	0.02	0.14
	(0.2)	(0.0)	(0.0)	(0.6)	(0.0)	(0.9)
ΣD(Thailand)	0.70	0.25	0.81	0.53	1.09	0.19
	(1.4)	(0.5)	(2.4)	(2.9)*	(6.2)***	(0.6)
ΣD(Korea)	0.03	0.20	-0.02	-0.02	-0.28	0.01
	(0.0)	(0.9)	(0.0)	(0.0)	(1.2)	(0.0)
ΣD(Philippines)	-0.25	0.01	-0.59	-0.51	-0.03	0.09
	(0.1)	(0.0)	(0.9)	(2.0)	(0.0)	(0.1)
ΣD(Malaysia)	-0.22	-0.05	0.69	0.18	-0.42	-0.13
	(0.2)	(0.0)	(2.2)	(0.4)	(1.2)	(0.4)
ΣD(Singapore)	0.38	-0.16	-1.34	0.28	-0.32	0.05
	(0.2)	(0.1)	(3.1)*	(0.4)	(0.3)	(0.0)
C	-0.01	-0.00	-0.00	-0.00	-0.00	-0.00
	1.75	0.73	0.92	1.38	1.27	0.09
R-squared	0.46	0.42	0.39	0.41	0.37	0.47
Adj. R-squared	0.26	0.19	0.16	0.18	0.12	0.26

*F-ratios in parentheses except for the constant (t-ratio)

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