Crisis Spillovers among Financial Markets in Asia: High-frequency Contagion among the Exchange Rates and the Stock Prices

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Abstract

This paper analyzes the co-movement of the exchange rates and the stock prices among the eight countries in the region during the period of Asian currency crisis, 1997-1999. We have proposed in Ito and Hashimoto (2002), to define the crisis origin as the largest daily declines of the exchange rate in order to differentiate origins and affected in a high-frequency contagion process. This paper extends the analysis to the model including both the exchange rate and the stock prices. When a country defends the peg in the midst of currency crisis, the contagion may take a different form. One of the motivations is the following observation. Hong Kong successfully defended the dollar peg throughout the Asian currency crisis period. However, the Hong Kong stock market was severely affected by the decline in currencies of neighboring countries, most notably in October 1997. A Tobit model, and a friction model are employed to analyze the impact of a negative shock in one asset price to its own and others in other countries. It is found, among others, that contagion between the exchange rates and stock prices were observed; that the stock prices in Hong Kong were found to suffer from contagious effects from the depreciations of the Asian currencies; and that Indonesian, Korean and Thai currency depreciation and Hong Kong stock price declines had impacts on other currencies and stock prices in the region during the crisis period.

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1. Introduction

Frequent currency crises among the emerging market economies have become one of the most serious problems in the international financial markets in the 1990s. Highly visible crises occurred in Mexico in 1994; Thailand, Korea, and Indonesia in 1997; Russia in 1998; Brazil in 1999; and Argentina in 2001-2002. Among these crises, the Asian crisis stands out in its depth and breadth of crisis contagion in the region. Contagion, spillovers of large shocks to other asset prices in other countries, took several forms: In many crisis days, depreciation of one currency caused currency depreciation of neighboring countries; Depreciation of a currency sometimes caused stock prices of that country and other countries to decline; and a large stock price declines sometimes affected adversely stock prices and currencies in the region, as well as its own currency.

In examining the process of crisis contagion, we find several channels of spillovers among financial markets. The first is the interactions among financial markets within a country: the spillover effect from the exchange rate shock to stock prices, or vice versa. There are many empirical literatures that closely relate to this point. Pavlova and Rigobon (2003) shows that the exchange rates serve as a transmission channel of stock price movements. Khalid and Kawai(2003), for example, analyze the crisis contagion among 9 Asian countries based on VAR and conclude that there was no spillover effect between stock markets and foreign exchange markets during the 1997 crisis. The second channel is contagion among the currencies, which was the topic of Ito and Hashimoto (2002)[1], and others. The third channel is cross-border contagion among different stock markets. Rigobon (1999), for example, analyzes the crises contagion using vector-autoregressions (VAR), taking into account the omitted variables and heteroskedasticity to claim the evidence of stock market contagion during the Asian crisis. The final transmission channel originates from the third factor (other than shocks in foreign exchange market/stock market), e.g., Monetary policy. Kaminsky and Reinhart (2003) investigates the spillover effects of stock price returns using Logit estimation and find that US, Japan and Germany markets plays an important role in the spillover relationships in the case of Brazil, Thailand and Russian crises.

The most remarkable feature of the recent crisis is the simultaneous fall of currencies and stock prices in the region. Linkage among financial markets—between currency markets and stock markets—have been a popular topic of investigation: Corsetti, Pesenti and Roubini (1998a, b), Flood and Marion (1998), Radelet and Sachs (1998), Ito (1999), Ito and Hashimoto (2002), to name a few.

The simultaneous fall of stock prices and currencies, that is contagion of different asset prices, is by no means limited to the crisis period or crisis-hit countries. As is well known, the world-wide declines in stock prices occurred during the Depression and the Black Monday. Even during more stable periods, movements of the prices of different assets—currencies and equities, in

[1] Ito and Hashimoto (2002) first provide the methodology to demonstrate clear cause-and-effect relationship in exchange rate depreciation (stock price declines) spillover relationship. We also found a positive relationship between trade link indices and the contagion coefficients, implying that the bilateral trade linkage is an important crisis transmission channel in the exchange rate markets.

this case—are likely to influence directly each other in the major markets.[2] The comovement of asset prices is found to have become strengthened more during the unstable period in 1980s and 1990s. According to Rigobon (2003), the contemporaneous responses of daily return of stock prices from 1994 to 2001 in Latin American and Asian countries are found to have strengthened when markets are more volatile. See also Iwaisako (2002) on this topic. The contemporaneous interactions between stock prices and exchange rates in a crisis-hit country emerge on the presumption of the strong relationship between asset prices.

When the currency of one country depreciates sharply, or becomes a target of speculative attacks, the authorities are likely to raise interest rate in an attempt to reduce the capital outflow (or increase capital inflow) so that a further depreciation can be avoided. The higher interest rate, however, may put a downward pressure on its stock prices. Even if the country survives the speculative pressure on exchange rate, the financial market may suffer the negative shock by the decline in the stock price, as evidenced by the Hong Kong in October 1997 and the summer of 1998. In October 1997, the Hong Kong Monetary Authority (HKMA), that is, the equivalent of a central bank in the economy, has raised the interest rate to defend pressure on the currency, but that started the world-wide decline in the stock prices. It was a result of the so-called double-play—simultaneous attack, by selling short—on the currency and equity of Hong Kong. Did Hong Kong suffer the Asian currency crisis? No, in terms of exchange rate depreciation, but yes, in the sense of declines in stock price declines. The contagion effect can be said to have had a great impact even in Hong Kong. When a similar situation developed in August 1998, the HKMA purchased stocks, as well as raising the interest rate.

The decline in stock prices sometimes works as a leading indicator of crises. The slowdown of the economy affects stock prices, and investors pull their capital out of the country, putting a downward pressure on the currency. In the case of Thailand, the stock price was at its peak in mid-1990s and had fallen by more than half on the eve of crisis. The substantial decline in stock prices for three years led the weakened economy into another recession and finally plunged into a currency crisis. However, in other cases, such as in Indonesia, the stock prices only reacted to the currency crisis. The sharp depreciation triggered insolvency of corporations and banks that had currency mismatch on their balance sheets. The stock prices fell once the currency depreciated sharply.

This paper aims at analyzing high-frequency (i.e., daily) contagion among exchange rates and stock prices employing various methods. The first part use the origin-affected regression, namely, after controlling the large depreciations and stock price declines in one country, we identify the direction and degree of spillovers between stock and foreign exchange markets as well as spillovers from one country to another during the crisis period. That is, based on the concept of "origin" and "affected" in the spillover relationship developed in Ito and Hashimoto (2002), contagion causality within the day is identified across national boundaries and asset categories.

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[2] See, for example, Hung and Cheung (1995), Malliaropulos (1998), Ng (2000), Forbes and Rigobon (2002).

We first estimate the contagion threshold for the depreciations (and stock price declines), so that we can identify whether the change in exchange rate (and stock price) movements was due to contagion or a noise. Then, the model is estimated to identify the causes of contagion—which factor most likely affects economies of neighboring countries, the hard-hit (origin) country, the trend in the market, other countries. The model predicts that the exchange rates and stock prices are correlated internationally even at a high-frequency (daily) level, providing support to theoretical inferences in favor of financial contagion between foreign and domestic markets.

We also investigate the contemporaneous contagion effect on the daily changes of currencies (stock prices). In this estimation, the independent variable is not 1 or 0 variable, but the actual value of daily change of exchange rate (stock prices) of each country. Moreover, the level of threshold is allowed to be different for appreciation (rise in stock prices) and depreciation (fall in stock prices) in order to analyze asymmetric shocks. The levels of threshold also vary across countries as well.

Major findings of this paper are as follows. First, the Indonesian, Korean and Thai exchange rates had large impacts on the stock prices of other countries, while other currencies did not have impacts on stock prices of other countries. Second, the Hong Kong stock market was significantly affected by the Indonesian, Korean, and Thai depreciation. Therefore, the contagion effect of Asian crisis can be said to have a great impact even in Hong Kong. Third, the Indonesian and Korean, but not Thai, exchange rates had impacts on other currencies in the region. This may be contrary to casual observation that the currency crisis spread from Thailand to other countries in the second half of 1997. Fourth, contagion among stock markets was not significant for most pairs of the countries. Fifth, Hong Kong stock price was found to have substantial effects on Asian exchange rates in the midst of crisis. Sixth, Thai exchange rates were quite sensitive to shocks in stock prices of other countries. Seventh, other than Hong Kong stock price effects on other currencies, and any stock price shocks on the Thai currencies, the spillovers from the stock price shocks to the exchange rate were not significant.

The estimation results based on the Friction model for daily change of currencies (stock prices) show a little different picture. The Friction model provides the evidence that the Asian stock market was vulnerable to a negative shock at daily level. It is shown that the daily changes of stock prices of most of the countries suffer contemporaneous contagion effects form other countries, especially, from a decline in Hong Kong stock prices. The Asian exchange rate market was also found to suffer from negative shocks in Indonesian exchange rate and Malaysian stock prices.

The rest of the paper is organized as follows. In section 2, movements of the exchange rates and stock prices of the region during the crisis period are reviewed. In Section 3, we present the estimation methodology used in this paper. Section 4 shows the results of estimations based on the Tobit equation that include contagion terms. Section 5 concludes the paper.

2. Data and Empirical Evidence of Currencies and Stock Prices

The data set used in this paper consists of two time-series, the nominal exchange rates (vis-à-vis

US dollar) and stock price indices[3] of eight Asian countries; Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand. The data source of both series is Datastream. The sample period is from January 4, 1994 to July 7, 1999 for stock prices and from June 30, 1997 to July 7, 1999 for exchange rates.

Figure1-1 shows the exchange rates of eight currencies against the US dollar from June 30, 1997 to July 7, 1999. They are normalized at 100 at beginning of the sample period. As is well known, most of the Asian countries suffered the series of speculative attacks that led to the floatation (devaluation) of their currencies after July 1997, although the rate of devaluation and depreciation through the crisis period varied considerably across the countries and the sample period. Most Asian countries had recovered and stability of their currencies were restored by summer 1998.

The behavior of stock prices for the sample period does not show a pattern that is commonly found among currencies. As Figure 1-2 clearly shows, some stock price rose over a few years before the Asian currency crisis and others showed relatively stable behavior of stock prices. Overall, the stock prices of most of the East Asian countries did not show the consistent downward trend, except Thailand, until the onset of crisis. From October, 1996, Thailand frequently became an origin of a stock price decline in the region. In April and July 1997, the decline in stock prices contagiously spilled over to the Philippines and then Indonesia in August 1997. From September 1997, the stock prices fell more rapidly than othersin Malaysia, Indonesia, and South Korea. The magnitude of stock price declines was eased after December 1998. While the currency crisis in the summer of 1997 accelerated a drop in stock prices in each of the Asian countries, stock prices went back up again in the mid-1998 due to the recovery of macro economy in each country.

Figure1-1, and Figure1-2, inserted here

Examining these figures, the exchange rate devaluations of Thailand, the Philippines, and Indonesia seemed preceded by the stock price declines in 1997.[4] For example, the fall of stock prices in Thailand first appeared in late 1996 and continued in the first half of 1997, prior to the floatation of the currency on July 2. As for the Philippines, before it experienced a large devaluation in September 1997, the stock price showed a large fall in April and July in 1997. The Indonesian currency dragged down by Thai baht in mid-August and then slumped to a historic low after November, with preceding fall of stock prices in early August and in September.

[3] Hang Seng Price Index (Hong Kong), Jakarta SE Composite Price Index (Indonesia), Korea SE Composite Price Index (Korea), Kuala Lumpur Composite Price Index (Malaysia), Philippines SE Composite Price Index (Philippines), Singapore DBS 50 Price Index (Singapore),Taiwan Weighted Index (Taiwan), Bangkok Book Club (Thailand).

[4] The decline in stock prices in Asia in mid October, 1997, was considered to be a spillover from a sharp drop of Hong Kong stock prices.

3. The Model

3-1. Origin of Crisis

Following the concept of contagion by Ito and Hashimoto (2002) that a financial crisis appears to transmit from the hard-hit country to others, we first calculate the rate of depreciation (decline in stock prices) to identify the "origin", the hardest-hit country, and the "affected" on the same day.

First, daily percentage change of the exchange rate (or the stock price) is written as:

$$DR(t,j) = R(t, j) - R(t-1, j),$$

where R(t,j) is log of the nominal exchange rate with respect to the US dollar (or the stock price) of country j at date t. The weighted cumulative change, DRR(t,j), is computed as the weighted cumulative change with the declining weights of past DRs:

$$DRR(t,j) = 0.5DR(t,j) + 0.25DR(t-1,j) + 0.125DR(t-2,j) + 0.0625DR(t-3,j) + 0.0625DR(t-4,j).$$

Of course, the specification of the weighted cumulative change is admittedly *ad hoc*. The length of the lags and weights attached are chosen arbitrarily, although some sensitivity tests were conducted in Ito and Hashimoto (2002). The point of including longer than just one day is to smooth over volatile exchange rates and stock prices during a crisis. The exchange rate may post 5% decline one day, followed by 2% gain. The 2% gain in the second day may be correction after an overshooting, but does not mean the crisis was over. Another possibility is that the exchange rate depreciation may be 1% one day, which may not qualify as a crisis, followed by four days of 1% decline each, which may become a cumulatively large shock. Here, the largest DRR for day t among different countries is selected as an origin, if it exceeds 2% in depreciation (or declines) and denoted as DOR. In many days, there is no DOR because none of DRRs exceeds 2%.

Table 1-1, Table 1-2

Table 1-1 and Table 1-2 list the origins of exchange rate depreciation and stock price declines. The table makes it possible to pin down the crisis date in each country. Countries that experienced the hardest-hit was Thailand in July 1997, Indonesia in August-September 1997, Korea from October 1997 to January 1998, and again Indonesia after January 1998. As is clear from Table 1-2 that a large fall in stock prices was triggered by the currency crisis. The frequency of large declines (origin) soared after the Thai crisis and as the contagion of exchange rate depreciation spread in the region, the downward pressure on stock prices was further intensified in Malaysia, Korea, and Indonesia.

3-2. Threshold

Since the exchange rates and stock prices follow random walk, the error term in the daily rate of change may contain a nuisance noise in the data generating process. For example, the reaction of Asian foreign exchange market was too excessive following the floatation of 1997 in a reflection of the crisis as well as the exchange rate regime changes. Also, the stock prices were more volatile during that period. In many studies, the dummy variable(s) that represents the state of the economy, crisis or not, is used to focus on the behaviors during crises. Others set an arbitral threshold, e.g., a 3% or more of daily change, to define the contagion.

In this paper, we first estimate the level of threshold in order to classify the daily rate of change for the sample period into contagion or the noise. In the model, the rate of change (of exchange rates or stock prices) is specified by the following: contagious depreciation (stock price fall), no-significant contagion, and contagious appreciation (rise in stock prices). Then the impact of origin currency (stock price) on other currencies and/or stock prices is considered. The estimation model is written as following:

$$y^* = x'b + e$$

$$y^* < a_1 \qquad y < 0 \qquad (1)$$

$$a_1 \le y^* \le a_2 \qquad y = 0 \qquad (2)$$

$$a_2 < y^* \qquad y > 0 \qquad (3).$$

Here y* is the observed rate of change in exchange rates or stock prices; that is, y* = DRR(t)-DRR(t-1). In the equations above, a_1 and a_2 represent the level of threshold. We regard changes in the currency (stock prices) as spillover, or contagion, only when they exceed the threshold. That is, if the rate of change, y*, exceeds a_1 or falls below a_2, it is inferred as due to the spillover effect, not the noise, provided that there is a larger changes in the asset price of somewhere else.

Equation (1) is the case where either the exchange rate contagiously appreciates or the stock price contagiously rises. Equation (2) is the case of no significant change in exchange rates/stock prices, and equation (3) is the case either the depreciation or the fall in stock prices. The threshold is estimated using the log-likelihood of the regression model above.

3-3. Tobit estimation

In this section, the impact of the large devaluation (the fall of stock price) of one country to other countries is examined. The model incorporates the idea of contagion—when the five-day weighted average of devaluation (stock price fall) breaks the barrier, it may be due to the contagion. In the estimation, we examine whether the differences between the domestic stock prices and other Asian stock prices, (domestic exchange rate and other Asian exchange rates), and “Origin” country were statistically more likely to attribute the possibility of contagion. The dependent variable used in the

estimation was predicted using a previously estimated Friction model and is thus available for all countries, whether contagion exists or not.

The daily changes of the stock prices and exchange rates in one country may follow the process that contains two parts: the autoregressive part and non-linear response to large shocks. First, the small changes of day t-1 in the exchange rates and the stock prices in one country will have impacts on today's exchange rate (stock price). The path of exchange rate (stock price) is described by contemporaneous factors, disturbances, and its own past. As the time-series model will typically describe the path of a variable in terms of contemporaneous factors, disturbances, and its own past, we will incorporate the autoregressive term, the lagged exchange rate (stock price) in the model. Second, the large depreciations (or sharp declines in the stock prices) have non-linear effects on the exchange rate and stock prices of other countries as well as the country of origin. The nonlinearity and identification of origin countries is captured by including the largest declines beyond some threshold, when it occurred. Beyond the first part of exchange rate (stock price) process, the large shocks have cross-border implications. The shocks of the different origin countries may have different effects. The large changes in the exchange rates (or the stock prices) of different countries are separately used as the right-hand-side variables.

The regression model we employ in this section is the Tobit model. The general formulation of the model is given as follows:

$$y^* = x'b + e$$

$$\begin{aligned} y = y^* \qquad & if \quad y^* > a_1, \\ = 0 \qquad & if \quad y^* \le a_1, \end{aligned}$$

where a1 is the threshold.

The probability that y=0 is calculated as

$$\begin{aligned} & \Pr ob(y = 0) \\ & = \Pr ob(y^* \le 0) \\ & = \Pr ob(x'b + e \le 0) \\ & = \Pr ob(e \le -x'b) \\ & = \Phi(-x'b/\sigma). \end{aligned}$$

Then, the likelihood that y=y* can be rewritten as

$$\begin{aligned} & f(y = y^* \mid y^* > a_1) \\ & = \Pr ob(y^* > a_1) \\ & = f(y = y^*) \\ & = \varphi[(\frac{y - x'b}{\sigma})]\frac{1}{\sigma}. \end{aligned}$$

The log likelihood for this Tobit regression model is

$$\ln L = \sum_{i\in(y_i=0)} \ln \Phi[\frac{-x'b}{\sigma}] + \sum_{i\in(y_i=y^*)} \{\ln \Phi[(\frac{y-x'b}{\sigma})] - \ln \sigma\}.$$

where x= [DRRFX, DRRSP, FXORIGIN, SPORIGIN]'. In the model, the "DRRFX" and "DRRSP" variables are used to control for autoregressive impacts in those variables on today's exchange rate (or stock prices). Then, DRRFX and DRRSP are 8 by 1 vectors (Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand). FXORIGIN and SPORIGIN are dummy variables indicating whether the depreciation (stock price fall) is affected by the hard-hit country. FXORIGIN is a 6 by 1 vector because the (five-day averaged) exchange rates of Hong Kong and Singapore did not show depreciations over 2% and therefore these two countries were excluded from "origin", and SPORIGIN is a 8 by 1 vector.

The expected sign of parameters is as follows:
In SP equation
(i) DRRSP
The parameter is expected to be positive if the stock prices exhibit an autoregressive tendency (that is, loss of confidence in the stock market carries over to the next day).
(ii) DRRFX
The parameter is expected to be negative if depreciation in one day results in the stock price declines in the following day (that is, the depreciation does not result in trade competitiveness but loss of confidence in the country; or depreciation triggers the monetary tightening that affects adversely the stock market.)
(iii) FXORIGIN and SPORIGIN
The FXORIGIN and SPORIGIN are dummy variables taking either 1 or 0. Thus the parameter is expected to be positive when the large change is contagious, that is, the stock prices are adversely affected by the large declines in the value of currency or the stock prices at an origin country of previous day.

In FX equation
(i) DRRSP
The parameter is expected to be negative if the stock price declines result in depreciation in the following day (that is, the decline in stock prices come from loss of confidence in the country, rather than the common interest rate shock.)
(ii) DRRFX
The parameter is expected to be positive if depreciation in day t-1 results in depreciation in day t (that is, the loss of confidence in the exchange rate tends to show the autoregressive nature).
(iii) FXORIGIN and SPORIGIN

the FXORIGIN and SPORIGIN are dummy variables taking either 1 or 0. Thus the parameter is expected to be positive when the large change is contagious, that is, the exchange rates are adversely affected by the large declines in the value of currency or the stock prices at an origin country of previous day.

3.4. Friction Model

The exchange rate changes and stock price changes of one country on day t, may mostly depend on those changes in day t-1 in other countries in the region as well as those in that country, and contagion effect, namely the effects from the (largest) shock origins. In this section, we examine whether a daily change of currency (stock prices) suffers a contemporaneous (same day) contagion from a hard hit country. The estimation done in this section is different from that in previous section in that the independent variable is not 1 or 0 variable, but the actual value of daily change of stock prices (exchange rate) of each country. Moreover, asymmetric shocks are analyzed. That is, the magnitude of the impact to either appreciation (rise in stock price) or depreciation (fall in stock price) is not the same. Therefore, in estimating the impact of contagion, we include the contemporaneous, not lagged as in the previous section, "origin" in the regression. The stock prices (exchange rate) origin variable is included with a lag when the country's daily change of stock prices (exchange rate) is on the left hand side. We also include the autoregressive term of the domestic stock prices and the autoregressive term of the home exchange rate as control variables as well as the "Origin" of exchange rates and stock prices.

Then, the log-likelihood will be:

$$\ln L = \sum_{i\in(y^*_i<a_1)} \ln\{\phi[\frac{y^*+a_1-x'b}{\sigma}]\frac{1}{\sigma}\}$$

$$+ \sum_{i\in(a_1\le y^*_i\le a_2)} \ln\{\Phi[\frac{y^*+a_2-x'b}{\sigma}]-\Phi[\frac{y^*+a_1-x'b}{\sigma}]\}$$

$$+ \sum_{i\in(a_2<y^*_i)} \ln\{\phi[\frac{y^*+a_2-x'b}{\sigma}]\frac{1}{\sigma}\},$$

where a_1 and a_2 represent the level of threshold and x= [DRRFX, DRRSP, FXORIGIN, SPORIGIN]'. DRRFX and DRRSP are variables calculated in the previous section: DRR of home countries. FXORIGIN and SPORIGIN are dummy variables.
The expected sign of the parameters are the same as in section 3.3.

4. Results

There are several channels and factors that transmit a shock in exchange rates to stock prices and vise versa. Before findings are reported in details, several channels of high-frequency contagion among the exchange rates and stock prices are reviewed.

The first channel is the spillover effect from the exchange rate shock to stock prices. There are two competing effects through this channel. If the exchange rate depreciation is orderly and moderate, the depreciation boosts its trade competitiveness at least temporarily, in the presence of nominal domestic price rigidities and is expected to have a positive effect on the stock prices. This is the case of the Indonesian and Korean stock prices at the early stage of Asian currency crisis, where the exchange rates of these two countries were relatively stable and the stock prices were rather rising. On the other hand, a sharp and rapid depreciation will induce a fall in stock prices, due to the change in sentiment (confidence) of market participants and the monetary policy reaction to depreciation. Depreciation will increase in probability of corporate failures for those with foreign currency denominated liabilities. Moreover, depreciation likely prompts the central bank to raise the interest rate to defend the currency from falling sharply.[5] But, the higher interest rate will cause a decline in stock prices. Although the signs of spillover effects from the exchange rate to stock prices cannot be theoretically determined, the sharp depreciation, as opposed to moderate, orderly depreciation, tends to cause the stock prices to decline.

The second channel is the one from the stock prices to the exchange rate. From the perspective that the stock price reflects economic fundamentals, the news announcement of weak fundamentals causes economic growth slowdown, a smaller profit opportunity, and further, the currency depreciation. A fall in stock price may result in depreciation.

The third channel is contagion among the currencies. This was the topic of Ito and Hashimoto (2002), and other papers on the contagion of currency crisis.

The final transmission channel is cross-border contagion among different stock markets. From the market interdependence perspective, such as macroeconomic similarities and trade linkage, a fall in stock price contagiously spillovers to other countries. Regardless of macroeconomic fundamentals and other financial markets, a negative shock in one country spreads to another through real and financial linkages. There is a large literature on the co-movements of stock prices among industrialized countries. For example, a country with declining stock prices most likely experiences an economic slowdown, and that would reduce the import, negatively affecting the

[5] In October 1997, Hong Kong dollar was targeted by speculative attacks and the Currency Board system raised interest rate that resulted in a decline in stock prices. In order to avoid the financial market turmoil due to the stock price fall, several measures, a buying up stocks with public funds, to shore up the stock market were taken in the speculative attack in August 1998. Countries with fixed exchange rate regime, for example, People's Republic of China and Malaysia (from September 1998), experienced a rise in interest rate under a pressure of devaluation.

exporting countries in the medium run: even if it takes several months for this process to work through the export-import linkage, the impact of stock price declines, especially large ones, is immediate. Investors tend to downgrade their assessment of neighboring countries with trade linkage when a large stock price decline occurs in one country. Indeed, a change in sentiment of and risk assessment of an entire region serves as a transmission channel of stock price declines.

Table 2 shows the estimated threshold for both exchange rates and stock prices. It is found from our estimation that the change in exchange rate (stock price) exceeding 1% can be regarded as "significantly" different from the noise over the sample period. In the Tobit estimation below, we set the threshold at 1%.

Table2 inserted here

The Tobit estimates are reported in Tables 3-1 to 3-6. We run regressions for three sample periods: entire sample (July 1, 1997-July 7, 1999), first-half (July 1, 1997-June 18, 1998), and second-half (June 19, 1998-July 7, 1999) periods.

The dependent variable takes 1 if the fluctuations of exchange rates (stock prices) exceed 1% and 0 otherwise. A Tobit regression is estimated for all countries for the cases with the stock prices as a dependent variable. However, in the case where dependent variable is a change in exchange rates, Tobit estimates for Indonesia, Korea, Malaysia, Philippines and Thailand are reported for the full sample period and the first-half sample period, and Indonesia for the second-half sample period. This is due to the fact the rate of change in exchange rates above 1% are hardly observed after mid 1998, consistent with what we found in Table 1-1. Most of the Asian countries put the crisis behind by mid-1998 and the risk of further exchange rate instability was decreased by then.

Table3-1－3-3 inserted here

The estimates of the parameters on the exchange rate are shown in Table 3-1-Table 3-3. Table3-1 reports results of the entire sample period, Table 3-2 reports the first-half, and Table 3-3 reports the latter-half. None of the stock price of the previous day significantly affects the exchange rate during the first-half period, and 1 country (out of 1) for the latter-half period. The effect of the autoregressive–part exchange rate is significant in all countries in both of the first- and the latter-half period. As expected, the coefficient estimates are all positive, indicating that the decline in exchange rate accelerate its depreciation.

The effect on the ORIGIN coefficient estimates is relatively minor, but the most of parameters on the SPORIGIN estimates on the Thailand exchange rate are significant and positive. Given the devaluation of Thailand, the turndown of the stock market in the region weakened the exchange rate of Thailand. With this exception, it is found that the contagious impact on exchange rates was

relatively small from the stock price origin countries.

In contrast to the stock price origin, the impact of exchange rate origin is remarkable. The effect on the exchange rate origin of Indonesia and Korea coefficients appears to be significant in most countries.

In summary, the Asian exchange rates during the crisis were found particularly vulnerable to Hong Kong stock prices, Indonesia and Korea exchange rates.

Table3-4－3-6

The estimation results of contagious impact on stock prices are shown in Table 3-4 to Table 3-6. Table3-4 reports results of the entire sample period, Table 3-5 reports the first-half, and Table 3-6 reports the latter-half.

The effect on the DRRSP coefficients is significant in 8 countries (out of 8) during the first-half period, and 7(8) for the latter-half period. The parameter sign is as expected, indicating that the decreasing stock prices leads to a further decline. The effect of the DRRFX coefficients is significant in 5(8) countries during the first-half period, but 1(8) for the latter-half period.

The impact of SPORIGIN on stock prices behavior is noteworthy. The change in stock prices in many countries is significantly affected by the large stock price decline in origin country. As shown in the Tables, Hong Kong, Indonesia, Korea, Malaysia and Philippines are found to be the major origin countries in 1997 and 1998. Among them, the influence of Hong Kong stock price was remarkable: the coefficient of Hong Kong stock price origin is significant and its sign is correctly estimated in 8 countries (out of 8) during the crisis period. Hong Kong and Indonesia are estimated as major origin countries even after 1998. The coefficient estimates are significantly positive in 7(out of 8) countries and 5(8) countries in the case of the Hong Kong origin and Indonesia origin, respectively. This finding is consistent with casual observations at the time, in that Hong Kong Monetary Authority, in the course of defending the dollar-peg currency board, had to raise the interest rate sharply and that lowered the stock prices.

The estimation results of the exchange rate origin shows that Indonesia, Korea and Thailand are found to be the three main origin countries on stock prices of other countries during the crisis. The effect of the exchange rate origin on stock prices dramatically reduced for the latter-half sample period, reflecting the return of stability to the foreign exchange markets in the region.

In summary, our estimation results clearly show the evidence of contagion between an exchange rate and a stock price of the same country or of different countries during the crisis period. It is also shown that the contagious impact on exchange rates was mainly due to the stock price fall of

Malaysia as well as the Indonesian, Korean and Malaysian depreciations. In contrast to the impact on exchange rates, the stock prices are found to be more under influences of exchange rates and stock prices of other countries.

Table4-1, 4-2

Tables 4-1 and 4-2 summarize the estimation results. They provide the parameter signs and the significance level, with shaded areas are those with significant and correct signs. Focusing on the crisis period, the impact of exchange rates on exchange rates of other countries is as much as that on stock prices of other countries. In particular, Indonesian, Korean and Malaysian exchange rate fluctuations had considerable impacts on the foreign exchange markets and stock markets in Asia. Surprisingly, the impact of Thai depreciation on other currencies and stock prices is found to be insignificant in almost all cases. This suggesets that the depreciation of Thai baht in July and August 1997 was considered by the market, at the time, as a good thing to restore the balance in its macro-economy, and not a start of the currency crisis in the region.

In contrast, the contagious effect of stock price on other countries' stock prices seems relatively minor, compared to the stock price effect on exchange rates. As shown in the tables above, the contagious impact on stock prices and on exchange rates from other countries are asymmetric; we find contagion among exchange rates and from stock prices to exchange rates, but relatively small (minor) evidence of contagion among stock prices.

It is obvious from Table4-1 that the exchange rate of Thailand was affected by by other Asian stock price behaviors. One might conjecture a process of the collapse of exchange rates in Thailand as follows: The gradual deterioration of fundamentals led the stock price fall and finally triggered the currency crisis of July 1997. In addition, the battered stock markets in Asia accelerated the continuing fall of the exchange rates after August 1997. Surprisingly, stock prices of Asia had little contagious effect on Indonesian and Korean exchange rates.

By examining the stock price reactions, a new insight is obtained about the crisis contagion. From our estimation, the Hong Kong stock price was found to be affected by the Indonesian, Korean, Malaysian and Philippines stock price fall during the crisis. The Hong Kong was said to have survived the contagious effects during the crisis in terms of the exchange rate regime, but our finding was that the Hong Kong suffered the crisis in terms of contagion from currencies to stock prices.

Table5-1- 5-4

The estimation results of the Friction model with asymmetric responses (thresholds) are shown in Table 5-1 to Table 5-4. These tables show the magnitude of contemporaneous impact of a

negative shock in the origin countries on daily changes of stock prices (exchange rates) of other countries. Table 5-1 and Table 5-2 summarize the estimation results of stock prices for 1997-1998 and 1998-1999, respectively and Table 5-3 and Table 5-4 provide the results of exchange rates for 1997-1998 and 1998-1999, respectively. The shaded areas are coefficients of statistical significance with correct signs. Overall, the daily changes of stock prices suffer contemporaneous contagion effects from other countries. Focusing on the crisis period, the fall in Hong Kong stock prices is significantly estimated with correct signs to have an impact on other stock prices declines. It is also noteworthy that the Singapore stock market was vulnerable to the negative shocks in other Asian stock markets: during the crisis period, our estimation results show that five out of eight Asian stock markets had a negative impact on Singapore stock prices. Even after the crisis was over, the Singapore stock prices were sensitive to other stock price declines. This may be due to their openness to trade and investment with other countries. Also, Hong Kong stock prices have significant contagious effects on other stock prices even after the worst of the crisis was over.

As to the contagion effect on exchange rates, Indonesia (exchange rate) and Malaysia (stock prices) are found to be two of the key origin countries during the crisis period. In contrast to the contagion effects on stock prices, Hong Kong stock prices as well as Thai exchange rates are found to have no significant effect on other currencies.

In summary, the Hong Kong stock prices are found to have significant spontaneous contagion effect on other stock markets, while Indonesian exchange rate and Malaysian stock prices are found to have contagious effects on other currencies.

5. Concluding remarks

In this paper we analyze the co-movement of the exchange rates and the stock prices from the viewpoint of contagion among the eight countries in the region during the period of Asian currency crisis, 1997-1999. By examining the stock price reactions and exchange rate movements, a new insight with regard to the crisis contagion is obtained. In this paper we do not use the orthodox analytical method, VAR, to examine the contagion in financial markets. Instead, we use a friction model and a Tobit model to analyze the impact of a negative shock in one asset price to others. In estimation, we take into account the difference between mildly-affected countries and severely-affected countries, large declines in the exchange rates (or stock prices) and others, and the asset price trend in each country.

Our results show the evidence of contagion between an exchange rate and a stock price for selected pairs of countries during the crisis period. It is also shown that the contagious impact on exchange rates was mainly due to the Hong Kong and Malaysia stock price falls and Indonesia and Korean depreciations. In contrast to the impact on exchange rates, the stock prices are found to be more under influences of exchange rates and stock prices of other countries.

Major findings of this paper are as follows. First, the Indonesian, Korean and Malaysian exchange

rates had large impacts on the stock prices of other countries. Second, the Hong Kong stock market was significantly affected by stock price falls of other countries. Third, the Indonesian and Korean, but not Thai, exchange rates had impacts on other currencies in the region. This may be contrary to casual observation that the currency crisis spread from Thailand to other countries in the second half of 1997. Fourth, contagion among stock markets was significant for most pairs of the countries. Fifth, Hong Kong stock price was found to have substantial effects on Asian exchange rates in the midst of crisis. Sixth, Thai exchange rates were quite sensitive to shocks in stock prices of other countries. Seventh, the spillovers from the stock price shocks to the exchange rate were not significant.

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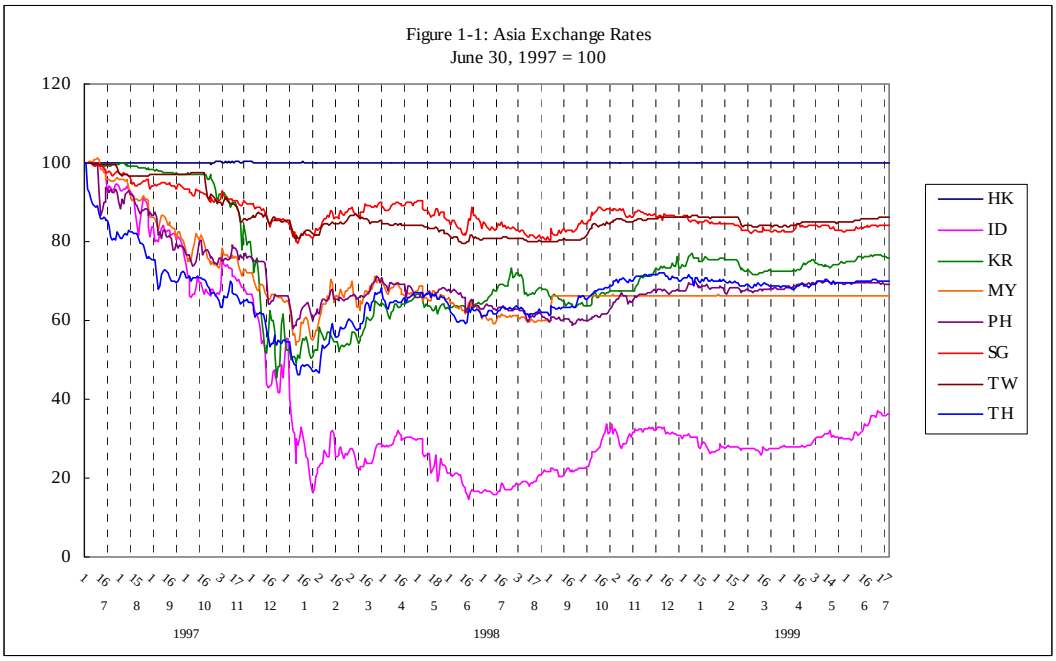
Figure 1-1: Asia Exchange Rates
June 30, 1997 = 100
120
100
80
60
40
20
0
1997
1998
1999
HK
ID
KR
MY
PH
SG
TW
TH

Figure 1-2: Asia Stock Price Index
July 1, 1997 = 100

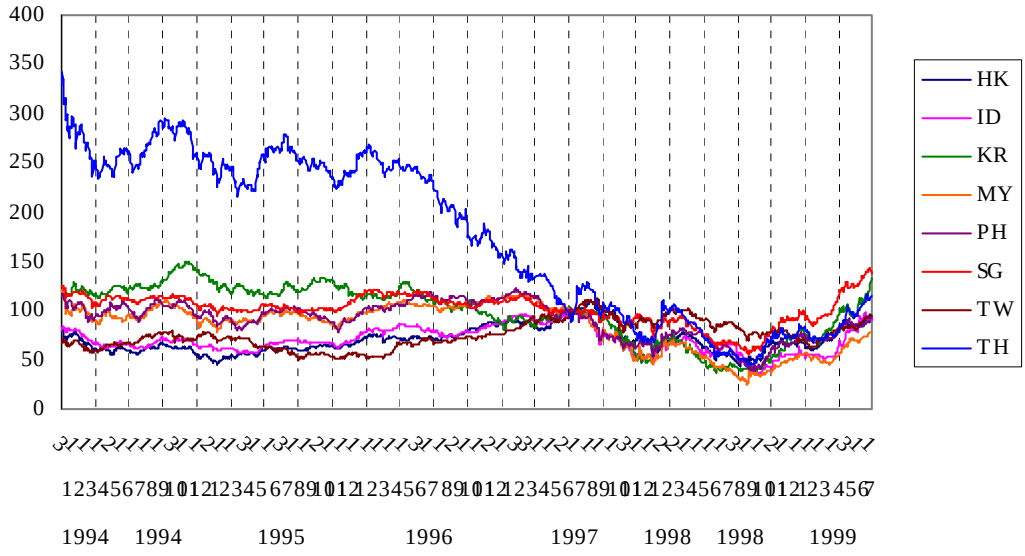

Table 1-1
Daily Origin of Exchange Rate, July 1997-March 1999

			Origin	devaluation rate(%)				Origin	devaluation rate(%)				Origin	devaluation rate(%)
1997	7	2	TH	-3.40	1997	12	11	KR	-8.02	1998	3	6	ID	-4.24
1997	7	3	TH	-2.22	1997	12	12	ID	-10.97	1998	3	9	ID	-2.40
1997	7	4	TH	-2.06	1997	12	15	ID	-6.72	1998	4	16	ID	-2.23
1997	7	14	PH	-5.30	1997	12	16	TH	-3.66	1998	4	21	PH	-2.49
1997	7	21	ID	-2.83	1997	12	22	KR	-10.12	1998	5	6	ID	-6.12
1997	7	23	TH	-2.06	1997	12	23	KR	-10.12	1998	5	7	ID	-4.99
1997	8	15	ID	-2.99	1997	12	24	ID	-4.32	1998	5	13	ID	-10.37
1997	8	18	ID	-3.23	1997	12	25	ID	-2.34	1998	5	14	ID	-3.24
1997	8	27	ID	-2.93	1997	12	31	KR	-3.96	1998	5	19	ID	-12.50
1997	8	28	ID	-3.19	1998	1	2	ID	-14.38	1998	5	28	ID	-5.17
1997	9	2	ID	-2.39	1998	1	5	ID	-13.08	1998	6	10	ID	-5.08
1997	9	3	TH	-2.81	1998	1	6	ID	-11.93	1998	6	11	ID	-4.66
1997	9	4	TH	-3.74	1998	1	7	ID	-7.57	1998	6	12	ID	-4.02
1997	9	18	PH	-2.06	1998	1	8	ID	-18.31	1998	6	15	ID	-4.48
1997	9	29	ID	-2.38	1998	1	12	TH	-2.39	1998	6	16	ID	-4.32
1997	9	30	ID	-2.33	1998	1	16	ID	-4.01	1998	6	17	ID	-6.82
1997	10	1	ID	-3.19	1998	1	19	ID	-7.87	1998	6	29	MY	-2.01
1997	10	3	ID	-4.32	1998	1	20	ID	-4.72	1998	8	6	KR	-3.21
1997	10	6	ID	-2.56	1998	1	21	ID	-11.10	1998	8	11	ID	-2.27
1997	10	20	TW	-2.45	1998	1	22	ID	-12.87	1998	9	8	ID	-3.44
1997	11	20	KR	-5.52	1998	1	23	ID	-12.77	1998	9	9	ID	-2.22
1997	11	25	KR	-2.24	1998	1	26	ID	-3.85	1998	10	27	ID	-2.08
1997	11	28	KR	-2.92	1998	2	12	MY	-3.04	1998	11	2	ID	-2.74
1997	12	1	KR	-2.21	1998	2	13	ID	-9.30	1998	11	3	ID	-4.26
1997	12	2	KR	-2.82	1998	2	16	ID	-3.99	1998	11	4	ID	-3.98
1997	12	3	TH	-3.66	1998	2	17	KR	-2.17	1998	12	15	ID	-2.29
1997	12	8	KR	-5.39	1998	2	23	ID	-2.62	1998	1	13	ID	-3.84
1997	12	9	KR	-6.88	1998	3	4	ID	-3.31	1999	1	14	ID	-2.08
1997	12	10	KR	-6.73	1998	3	5	ID	-6.84	1999	3	11	ID	-2.17

Source: Ito and Hashimoto (2002)

Table 1-2 Origin of Stock Price (1994-1999)

year	month	date	Origin	% decline of stock price	year	month	date	Origin	% decline of stock price
1994	1	11	ml	-3.382	1997	4	29	ph	-2.622
1994	1	12	ml	-5.068	1997	4	30	ph	-2.489
1994	1	13	ml	-4.250	1997	5	15	th	-2.540
1994	1	14	tw	-2.391	1997	5	16	th	-2.464
1994	1	18	th	-2.152	1997	5	19	ph	-2.083
1994	1	20	th	-2.176	1997	6	9	th	-2.023
1994	1	25	ml	-2.639	1997	6	19	th	-2.313
1994	2	7	th	-3.864	1997	6	20	th	-3.085
1994	2	14	tw	-2.215	1997	7	9	ph	-2.562
1994	2	16	hk	-2.223	1997	7	10	ph	-2.744
1994	2	25	hk	-2.338	1997	8	5	ml	-2.551
1994	2	28	tw	-2.470	1997	8	7	id	-2.163
1994	3	1	ph	-2.750	1997	8	15	id	-2.756
1994	3	2	ph	-2.424	1997	8	18	id	-2.738
1994	3	4	ph	-2.392	1997	8	19	hk	-2.185
1994	3	9	ph	-2.609	1997	8	20	th	-2.088
1994	3	18	hk	-2.742	1997	8	22	id	-2.182
1994	3	21	hk	-3.979	1997	8	25	id	-3.810
1994	3	22	id	-2.025	1997	8	26	th	-3.987
1994	4	21	hk	-2.104	1997	8	27	th	-2.331
1994	5	4	hk	-2.459	1997	8	28	ph	-5.402
1994	10	6	tw	-2.850	1997	8	29	hk	-4.746
1994	10	11	tw	-4.272	1997	9	1	hk	-4.310
1994	11	1	tw	-3.175	1997	9	2	tw	-2.457
1994	11	22	hk	-2.386	1997	9	3	ml	-3.418
1994	11	23	th	-3.433	1997	9	4	ml	-2.915
1994	12	9	hk	-2.348	1997	9	12	id	-2.114
1995	1	3	hk	-2.213	1997	9	18	ml	-2.165
1995	1	12	th	-2.116	1997	9	22	ml	-2.321
1995	1	13	ph	-3.186	1997	9	23	kr	-2.004
1995	1	23	th	-2.886	1997	10	3	id	-2.259
1995	2	27	ph	-2.078	1997	10	8	kr	-2.037
1995	4	17	tw	-2.311	1997	10	15	hk	-2.468
1995	7	19	tw	-2.527	1997	10	16	kr	-2.556
1995	7	20	tw	-2.620	1997	10	17	tw	-2.108
1995	8	9	tw	-2.260	1997	10	20	tw	-4.357
1995	8	11	tw	-2.739	1997	10	21	hk	-3.435
1995	11	20	ph	-2.039	1997	10	22	hk	-4.658
1995	12	14	kr	-2.117	1997	10	23	hk	-7.569
1995	12	18	kr	-2.323	1997	10	24	ml	-2.593
1996	1	5	tw	-3.430	1997	10	27	kr	-4.463
1996	1	29	tw	-2.700	1997	10	28	hk	-8.475
1996	3	11	hk	-3.737	1997	10	29	th	-3.535
1996	3	13	hk	-2.174	1997	10	30	kr	-3.169
1996	5	20	tw	-2.391	1997	10	31	kr	-3.107
1996	7	29	id	-2.305	1997	11	7	kr	-2.308
1996	10	4	th	-2.053	1997	11	11	id	-2.291
1996	10	8	th	-4.189	1997	11	12	hk	-2.433
1996	10	28	ph	-2.633	1997	11	17	kr	-2.234
1997	1	7	kr	-2.242	1997	11	18	ml	-3.900
1997	2	4	th	-3.427	1997	11	19	ml	-3.440
1997	2	14	th	-2.147	1997	11	20	ml	-7.229
1997	3	4	th	-2.279	1997	11	21	id	-2.266
1997	3	7	th	-4.563	1997	11	24	kr	-4.854
1997	3	24	tw	-2.406	1997	11	25	kr	-3.588
1997	4	8	ph	-2.244	1997	11	26	ml	-2.882

Note: Authors' calculation

Table 1-2 (cont'd) Origin of Stock Price (1994-1999)

year	month	date	Origin	% decline of stock price	year	month	date	Origin	% decline of stock price
1997	11	28	kr	-3.629	1998	6	12	kr	-4.309
1997	12	1	kr	-3.825	1998	6	15	kr	-4.552
1997	12	2	kr	-3.914	1998	6	16	kr	-3.775
1997	12	9	kr	-2.996	1998	7	10	ml	-2.967
1997	12	10	hk	-2.143	1998	7	13	ml	-2.377
1997	12	11	hk	-3.864	1998	7	22	ml	-2.065
1997	12	12	kr	-5.242	1998	7	23	kr	-2.386
1997	12	15	id	-6.215	1998	7	29	ml	-2.839
1997	12	16	ml	-2.677	1998	8	3	hk	-2.303
1997	12	23	kr	-4.231	1998	8	4	ph	-2.131
1997	12	24	kr	-4.260	1998	8	5	id	-3.063
1997	12	25	kr	-2.291	1998	8	6	id	-2.422
1998	1	5	ml	-2.864	1998	8	7	hk	-2.804
1998	1	6	ml	-3.444	1998	8	10	ml	-2.473
1998	1	7	hk	-3.818	1998	8	11	ml	-3.917
1998	1	8	ph	-3.960	1998	8	12	ph	-3.850
1998	1	9	ph	-6.210	1998	8	13	ml	-2.721
1998	1	12	hk	-6.163	1998	8	17	ml	-2.448
1998	1	22	ph	-3.084	1998	8	18	kr	-2.081
1998	2	5	th	-2.195	1998	8	21	ml	-2.426
1998	2	11	id	-3.406	1998	8	24	id	-3.312
1998	2	12	id	-6.178	1998	8	25	id	-2.018
1998	2	13	id	-2.595	1998	8	27	ml	-2.005
1998	2	16	kr	-3.767	1998	8	28	ph	-3.749
1998	2	17	kr	-2.488	1998	8	31	hk	-3.704
1998	3	5	kr	-2.656	1998	9	1	hk	-3.353
1998	3	6	kr	-2.545	1998	9	10	ph	-3.173
1998	3	9	kr	-2.859	1998	9	11	ph	-2.242
1998	3	30	kr	-2.207	1998	9	15	id	-4.884
1998	4	1	kr	-2.001	1998	9	17	id	-2.278
1998	4	2	kr	-2.488	1998	9	18	id	-3.559
1998	4	3	kr	-3.502	1998	9	21	id	-4.754
1998	4	16	ml	-2.068	1998	9	22	ph	-2.221
1998	4	23	kr	-2.432	1998	10	2	tw	-2.645
1998	4	29	id	-2.350	1998	10	5	hk	-2.071
1998	5	1	id	-2.123	1998	10	27	kr	-2.304
1998	5	4	kr	-3.199	1998	11	9	ph	-2.299
1998	5	5	id	-2.002	1998	11	10	ph	-3.259
1998	5	6	id	-3.264	1998	11	11	th	-3.624
1998	5	11	kr	-2.100	1998	11	13	th	-2.695
1998	5	12	kr	-2.518	1998	11	25	id	-2.961
1998	5	13	id	-3.240	1998	12	3	th	-2.821
1998	5	14	th	-2.181	1998	12	4	th	-2.183
1998	5	18	id	-2.379	1998	12	17	kr	-2.656
1998	5	20	th	-2.587	1999	1	5	tw	-2.130
1998	5	25	kr	-3.730	1999	1	26	th	-2.368
1998	5	26	kr	-4.838	1999	2	8	ml	-3.783
1998	5	27	hk	-2.803	1999	2	9	kr	-2.451
1998	5	28	hk	-2.065	1999	2	10	th	-2.069
1998	5	29	th	-2.010	1999	2	19	kr	-2.022
1998	6	1	tw	-2.659	1999	5	7	hk	-2.009
1998	6	2	th	-2.996	1999	5	13	kr	-2.730
1998	6	8	sg	-2.042	1999	5	17	kr	-2.324
1998	6	10	hk	-3.175	1999	5	26	th	-2.586
1998	6	11	ph	-2.516					

Note: Authors' calculation

Table 2
Threshold (Stock Price)

	1997-1999			1997-1998			1998-1999		
	coefficient	s.e.		coefficient	s.e.		coefficient	s.e.	
Hong Kong	0.010	6.24E-04	***	0.012	1.13E-03	***	0.008	7.41E-04	***
Indonesia	0.010	6.80E-04	***	0.010	9.51E-04	***	0.009	9.46E-04	***
Korea	0.011	6.79E-04	***	0.012	9.65E-04	***	0.010	9.36E-04	***
Malaysia	0.009	9.61E-04	***	0.010	1.11E-03	***	0.007	1.77E-03	***
Philippines	0.008	5.15E-04	***	0.008	7.54E-04	***	0.008	7.52E-04	***
Singapore	0.007	4.43E-04	***	0.006	5.89E-04	***	0.007	6.84E-04	***
Taiwan	0.006	3.71E-04	***	0.006	5.02E-04	***	0.006	5.71E-04	***
Thailand	0.009	7.70E-04	***	0.010	1.15E-03	***	0.009	9.08E-04	***

Threshold (Exchange rate)

	1997-1999			1997-1998			1998-1999		
	coefficient	s.e.		coefficient	s.e.		coefficient	s.e.	
Hong Kong	0.009	6.69E-04	***	0.008	1.33E-03	***	0.008	7.31E-04	***
Indonesia	0.010	6.73E-04	***	0.010	9.82E-04	***	0.009	9.66E-04	***
Korea	0.011	6.77E-04	***	0.012	9.82E-04	***	0.010	9.29E-04	***
Malaysia	0.009	9.24E-04	***	0.009	1.17E-03	***	0.007	1.70E-03	***
Philippines	0.008	5.06E-04	***	0.008	7.48E-04	***	0.008	7.59E-04	***
Singapore	0.007	4.43E-04	***	0.006	5.87E-04	***	0.007	6.73E-04	***
Taiwan	0.006	3.70E-04	***	0.006	4.95E-04	***	0.006	5.72E-04	***
Thailand	0.009	7.64E-04	***	0.010	1.09E-03	***	0.009	9.11E-04	***

***: significant at 1%

Table 3-1
Tobit estimation: dependent vatiable: exchange rate
1997-1999

	Indonesia		Korea		Malaysia		Philippines		Thailand	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
C	-0.044	4.22E-03 ***	-0.031	4.18E-03 ***	-0.022	3.02E-03 ***	-0.032	4.94E-03 ***	-0.015	1.86E-03 ***
DRRSP(-1)	-0.026	1.21E-01	0.022	8.53E-02	-0.026	6.54E-02	0.132	1.22E-01	-0.024	3.99E-02
DRRFX(-1)	0.275	6.71E-02 ***	0.534	9.99E-02 ***	0.596	1.27E-01 ***	0.670	1.53E-01 ***	0.674	8.79E-02 ***
SPORIGIN(HK)	0.011	8.76E-03 *	0.005	6.19E-03	0.004	4.08E-03	0.007	6.23E-03	0.005	2.30E-03 ***
SPORIGIN(ID)	0.009	8.45E-03	-0.012	8.77E-03 *	0.003	3.91E-03	0.005	5.94E-03	0.005	2.48E-03 **
SPORIGIN(KR)	0.009	6.25E-03 *	0.002	4.87E-03	0.003	3.24E-03	0.007	4.95E-03 *	0.004	2.09E-03 **
SPORIGIN(MY)	0.011	8.62E-03	0.009	5.50E-03 **	0.012	3.44E-03 ***	0.013	5.06E-03 ***	0.007	2.23E-03 ***
SPORIGIN(PH)	0.007	1.20E-02	0.008	7.13E-03	0.007	4.73E-03 *	0.000	8.48E-03	0.000	3.71E-03
SPORIGIN(SG)	-0.140	4.05E+02	-0.082	4.61E+03	-0.062	1.61E+04	-0.091	2.20E+04	-0.043	5.16E+02
SPORIGIN(TW)	0.007	1.70E-02	-0.095	1.10E+04	0.014	5.93E-03 ***	-0.102	1.04E+04	0.008	4.49E-03 **
SPORIGIN(TH)	0.008	1.04E-02	0.005	7.87E-03	0.000	6.54E-03	-0.086	2.81E+02	-0.004	4.54E-03
FXORIGIN(ID)	0.073	5.63E-03 ***	0.010	3.97E-03 ***	0.012	2.49E-03 ***	0.011	3.94E-03 ***	0.003	1.75E-03 *
FXORIGIN(KR)	0.034	9.19E-03 ***	0.050	5.71E-03 ***	0.004	5.03E-03	-0.092	1.62E+03	0.004	2.85E-03 *
FXORIGIN(MY)	0.030	2.40E-02	0.028	1.35E-02 **	0.037	8.08E-03 ***	0.028	1.37E-02 **	0.013	7.24E-03 **
FXORIGIN(PH)	-0.155	4.05E+02	-0.082	8.15E+02	0.009	7.87E-03	0.038	1.00E-02 ***	-0.010	6.95E-03 *
FXORIGIN(TW)	-0.145	5.30E+02	0.022	1.10E+04	0.008	1.19E-02	-0.001	0.00E+00	0.005	8.43E-03
FXORIGIN(TH)	0.018	1.36E-02 *	-0.099	1.46E+04	0.003	5.71E-03	0.008	8.03E-03	0.018	2.86E-03 ***
SIGMA	0.028	1.96E-03 ***	0.015	1.77E-03 ***	0.010	1.22E-03 ***	0.016	2.15E-03 ***	0.007	7.59E-04 ***

Note: ***, ** and * indicate the significance at the 1,5 and 10%, respectevely.

Table 3-2
Tobit estimation: dependent vatiable: exchange rate
1997-1998

	Indonesia		Korea		Malaysia		Philippines		Thailand	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
C	-0.042	5.23E-03 ***	-0.027	4.27E-03 ***	-0.018	2.70E-03 ***	-0.027	4.66E-03 ***	-0.013	1.76E-03 ***
DRRSP(-1)	-0.140	1.49E-01	-0.029	9.12E-02	-0.095	8.00E-02	0.075	1.36E-01	-0.019	4.36E-02
DRRFX(-1)	0.251	7.49E-02 ***	0.536	1.01E-01 ***	0.515	1.22E-01 ***	0.625	1.51E-01 ***	0.592	8.37E-02 ***
SPORIGIN(HK)	0.012	1.01E-02	0.004	6.62E-03	0.004	4.07E-03	0.005	6.61E-03	0.005	2.37E-03 **
SPORIGIN(ID)	0.006	1.04E-02	-0.013	8.88E-03 *	0.002	4.01E-03	0.003	6.35E-03	0.005	2.61E-03 **
SPORIGIN(KR)	0.003	7.52E-03	0.000	5.35E-03	0.002	3.28E-03	0.004	5.21E-03	0.003	2.12E-03 *
SPORIGIN(MY)	0.011	9.75E-03	0.007	5.83E-03	0.012	3.60E-03 ***	0.010	5.33E-03 **	0.007	2.24E-03 ***
SPORIGIN(PH)	0.010	1.45E-02	0.008	8.06E-03	0.008	5.04E-03 *	-0.094	1.19E+02	0.000	3.80E-03
SPORIGIN(SG)	-0.152	5.38E+02	-0.078	8.72E+02	-0.053	8.95E+02	-0.078	5.60E+02	-0.043	6.89E+02
SPORIGIN(TW)	0.009	2.01E-02	-0.084	6.36E+02	0.014	6.45E-03 **	-0.090	3.89E+02	0.009	4.97E-03 **
SPORIGIN(TH)	0.013	1.28E-02	0.005	8.61E-03	0.000	6.86E-03	-0.089	2.72E+02	-0.004	4.62E-03
FXORIGIN(ID)	0.076	6.73E-03 ***	0.009	4.28E-03 **	0.011	2.47E-03 ***	0.011	4.22E-03 ***	0.002	1.77E-03
FXORIGIN(KR)	0.034	9.99E-03 ***	0.049	5.84E-03 ***	0.000	4.87E-03	-0.086	2.73E+02	0.003	2.78E-03
FXORIGIN(MY)	0.028	2.58E-02	0.026	1.35E-02 **	0.033	7.74E-03 ***	0.023	1.38E-02 **	0.011	6.92E-03 *
FXORIGIN(PH)	-0.165	3.77E+02	-0.080	3.41E+02	0.007	7.51E-03	0.035	1.00E-02 ***	-0.010	6.73E-03 *
FXORIGIN(TW)	-0.160	5.49E+02	0.010	7.69E+02	0.006	1.19E-02	0.003	7.35E+03	0.002	8.52E-03
FXORIGIN(TH)	0.017	1.44E-02	-0.088	6.23E+02	0.001	5.38E-03	0.007	7.89E-03	0.017	2.79E-03 ***
SIGMA	0.030	2.30E-03 ***	0.015	1.83E-03 ***	0.010	1.17E-03 ***	0.016	2.21E-03 ***	0.007	7.39E-04 ***

Note: ***, ** and * indicate the significance at the 1,5 and 10%, respectevely.

Table 3-3
Tobit estimation: dependent vatiable: exchange rate
1998-1999

	Indonesia		
	Coefficients	s.e.	
C	-0.017	3.81E-03	***
DRRSP(-1)	0.186	1.33E-01	*
DRRFX(-1)	0.164	1.02E-01	*
SPORIGIN(HK)	-0.059	2.77E+02	
SPORIGIN(ID)	0.000	7.24E-03	
SPORIGIN(KR)	0.011	5.63E-03	**
SPORIGIN(MY)	-0.075	0.00E+00	
SPORIGIN(PH)	-0.075	1.66E+04	
SPORIGIN(SG)	-0.080	0.00E+00	
SPORIGIN(TW)	-0.053	1.66E+02	
SPORIGIN(TH)	-0.057	5.12E+01	
FXORIGIN(ID)	0.033	4.98E-03	***
FXORIGIN(KR)			
FXORIGIN(MY)			
FXORIGIN(PH)			
FXORIGIN(TW)			
FXORIGIN(TH)			
SIGMA	0.011	1.91E-03	5.621

Note: ***, ** and * indicate the significance at the 1,5 and 10%, respectevely.

Table 3-4
Tobit estimation: dependent vatiable: stock price
1997-1999

	Hong Kong		Indonesia		Korea		Malaysia	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
C	-0.015	1.56E-03 ***	-0.016	1.65E-03 ***	-0.010	1.16E-03 ***	-0.014	1.39E-03 ***
DRRSP(-1)	0.390	5.83E-02 ***	0.443	6.36E-02 ***	0.277	4.11E-02 ***	0.131	4.38E-02 ***
DRRFX(-1)	-9.523	2.93E+00 ***	0.000	3.11E-02	0.037	5.32E-02	0.238	9.78E-02 ***
SPORIGIN(HK)	0.035	2.90E-03 ***	0.015	3.10E-03 ***	0.007	2.79E-03 ***	0.020	2.76E-03 ***
SPORIGIN(ID)	0.011	2.70E-03 ***	0.027	2.78E-03 ***	0.004	2.38E-03 **	0.011	2.59E-03 ***
SPORIGIN(KR)	0.006	2.51E-03 **	0.006	2.78E-03 **	0.026	1.98E-03 ***	0.008	2.33E-03 ***
SPORIGIN(MY)	0.009	3.07E-03 ***	0.008	3.29E-03 ***	0.008	2.63E-03 ***	0.030	2.73E-03 ***
SPORIGIN(PH)	0.010	3.75E-03 ***	0.015	4.05E-03 ***	0.006	3.41E-03 **	0.014	3.55E-03 ***
SPORIGIN(SG)	0.012	8.91E-03 *	-0.078	1.11E+05	-0.070	0.00E+00	0.010	9.23E-03
SPORIGIN(TW)	0.004	6.32E-03	0.009	6.43E-03 *	-0.061	1.23E+02	0.009	5.75E-03 *
SPORIGIN(TH)	-0.009	5.42E-03 **	-0.005	5.20E-03	0.003	3.19E-03	0.004	3.92E-03
FXORIGIN(ID)	0.003	2.13E-03 *	0.004	2.43E-03 **	0.001	1.88E-03	0.006	2.03E-03 ***
FXORIGIN(KR)	-0.002	4.31E-03	0.002	4.53E-03	0.001	3.33E-03	0.007	3.62E-03 **
FXORIGIN(MY)	-0.065	1.42E+02	0.018	9.42E-03 **	0.002	8.34E-03	0.013	8.69E-03 *
FXORIGIN(PH)	-0.066	1.50E+02	0.008	8.51E-03	0.000	8.06E-03	-0.009	1.02E-02
FXORIGIN(TW)	0.025	1.29E-02 **	-0.070	2.68E+02	0.080	1.23E+02	0.012	1.25E-02
FXORIGIN(TH)	0.005	5.04E-03	-0.025	9.52E-03 ***	-0.071	1.69E+03	-0.001	5.16E-03
SIGMA	0.011	8.01E-04 ***	0.012	8.39E-04 ***	0.010	6.52E-04 ***	0.011	7.18E-04 ***

	Philippines		Singapore		Taiwan		Thailand	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
C	-0.013	1.32E-03 ***	-0.016	1.74E-03 ***	-0.012	1.58E-03 ***	-0.012	1.30E-03 ***
DRRSP(-1)	0.389	5.24E-02 ***	0.542	7.55E-02 ***	0.491	8.71E-02 ***	0.375	5.52E-02 ***
DRRFX(-1)	0.109	7.75E-02 *	0.307	1.97E-01 *	-0.475	2.38E-01 **	0.083	9.22E-02
SPORIGIN(HK)	0.014	2.34E-03 ***	0.018	2.63E-03 ***	0.009	2.36E-03 ***	0.015	2.75E-03 ***
SPORIGIN(ID)	0.008	2.26E-03 ***	0.006	2.79E-03 **	-0.002	3.11E-03	0.003	2.77E-03
SPORIGIN(KR)	0.002	2.19E-03	0.003	2.45E-03	0.001	2.36E-03	0.006	2.27E-03 ***
SPORIGIN(MY)	0.006	2.47E-03 ***	0.007	2.80E-03 ***	-0.008	5.03E-03 *	0.003	2.85E-03
SPORIGIN(PH)	0.028	2.83E-03 ***	0.011	3.38E-03 ***	0.005	3.22E-03 *	-0.003	4.27E-03
SPORIGIN(SG)	0.015	7.01E-03 **	0.023	6.94E-03 ***	-0.047	4.34E+02	-0.075	0.00E+00
SPORIGIN(TW)	0.005	5.03E-03	0.007	4.97E-03 *	0.020	3.90E-03 ***	0.005	6.10E-03
SPORIGIN(TH)	0.004	2.79E-03 *	0.002	3.28E-03	0.004	2.91E-03	0.024	2.94E-03 ***
FXORIGIN(ID)	0.006	1.66E-03 ***	0.005	1.94E-03 ***	0.001	1.95E-03	0.005	1.97E-03 ***
FXORIGIN(KR)	0.001	3.64E-03	-0.010	6.07E-03 *	0.000	4.05E-03	-0.002	4.19E-03
FXORIGIN(MY)	-0.056	1.46E+04	-0.052	5.15E+02	0.010	7.06E-03 *	-0.063	1.92E+02
FXORIGIN(PH)	0.006	7.16E-03	-0.053	8.43E+01	-0.049	1.25E+02	0.005	7.76E-03
FXORIGIN(TW)	-0.050	2.01E+02	-0.052	1.75E+02	0.025	9.84E-03 ***	0.010	1.24E-02
FXORIGIN(TH)	-0.009	5.49E-03 *	0.002	5.06E-03	0.010	3.99E-03 ***	0.000	5.41E-03
SIGMA	0.009	6.54E-04 ***	0.009	7.99E-04 ***	0.008	8.29E-04 ***	0.011	7.23E-04 ***

Note: ***, ** and * indicate the significance at the 1,5 and 10%, respectevely.

Table 3-5
Tobit estimation: dependent vatiable: stock price
1997-1998

	Hong Kong			Indonesia			Korea			Malaysia		
	Coefficients	s.e.		Coefficients	s.e.		Coefficients	s.e.		Coefficients	s.e.	
C	-0.016	2.15E-03	***	-0.016	2.17E-03	***	-0.010	1.39E-03	***	-0.011	1.45E-03	***
DRRSP(-1)	0.366	7.38E-02	***	0.483	7.98E-02	***	0.211	4.55E-02	***	0.263	6.14E-02	***
DRRFX(-1)	-10.110	3.26E+00	***	-0.013	3.48E-02		0.031	5.06E-02		0.141	8.69E-02	*
SPORIGIN(HK)	0.038	3.75E-03	***	0.016	3.70E-03	***	0.010	2.88E-03	***	0.015	2.57E-03	***
SPORIGIN(ID)	0.012	3.51E-03	***	0.025	3.45E-03	***	0.004	2.69E-03	*	0.009	2.47E-03	***
SPORIGIN(KR)	0.007	3.09E-03	***	0.006	3.22E-03	**	0.028	2.14E-03	***	0.007	2.13E-03	***
SPORIGIN(MY)	0.010	3.67E-03	***	0.007	3.88E-03	**	0.009	2.68E-03	***	0.025	2.55E-03	***
SPORIGIN(PH)	0.013	5.14E-03	***	0.019	5.15E-03	***	0.001	4.58E-03		0.011	3.54E-03	***
SPORIGIN(SG)	-0.066	4.89E+02		-0.064	1.17E+03		-0.063	7.33E+04		0.011	8.99E-03	
SPORIGIN(TW)	0.010	7.92E-03		0.003	9.36E-03		-0.055	1.18E+02		0.008	5.92E-03	*
SPORIGIN(TH)	-0.013	8.02E-03	*	-0.003	5.92E-03		0.003	4.00E-03		0.004	3.79E-03	
FXORIGIN(ID)	0.002	2.57E-03		0.004	2.80E-03	*	0.000	1.93E-03		0.004	1.82E-03	**
FXORIGIN(KR)	-0.003	4.70E-03		0.002	4.66E-03		0.001	3.15E-03		0.007	3.02E-03	***
FXORIGIN(MY)	-0.071	1.71E+02		0.018	9.63E-03	**	0.003	7.74E-03		0.012	6.91E-03	**
FXORIGIN(PH)	-0.073	1.91E+02		0.009	8.71E-03		-0.001	7.40E-03		-0.008	8.31E-03	
FXORIGIN(TW)	0.021	1.44E-02	*	-0.065	2.56E+02		0.074	1.18E+02		0.011	1.07E-02	
FXORIGIN(TH)	0.004	5.49E-03		-0.027	1.01E-02	***	-0.067	1.09E+03		-0.001	4.20E-03	
SIGMA	0.012	1.01E-03	***	0.012	1.01E-03	***	0.009	7.01E-04	***	0.009	6.42E-04	***

	Philippines			Singapore			Taiwan			Thailand		
	Coefficients	s.e.		Coefficients	s.e.		Coefficients	s.e.		Coefficients	s.e.	
C	-0.012	1.55E-03	***	-0.020	2.72E-03	***	-0.012	2.15E-03	***	-0.011	1.67E-03	***
DRRSP(-1)	0.470	6.54E-02	***	0.518	1.01E-01	***	0.467	1.21E-01	***	0.312	6.83E-02	***
DRRFX(-1)	0.112	7.74E-02	*	0.527	2.65E-01	**	-0.598	2.97E-01	**	0.085	1.04E-01	
SPORIGIN(HK)	0.014	2.55E-03	***	0.018	3.49E-03	***	0.010	2.99E-03	***	0.014	3.46E-03	***
SPORIGIN(ID)	0.005	2.62E-03	**	0.008	3.59E-03	**	-0.049	4.73E+01		0.003	3.46E-03	
SPORIGIN(KR)	0.001	2.34E-03		0.006	3.13E-03	**	0.000	2.78E-03		0.007	2.77E-03	***
SPORIGIN(MY)	0.005	2.59E-03	**	0.009	3.52E-03	***	-0.006	5.41E-03		0.003	3.44E-03	
SPORIGIN(PH)	0.027	3.38E-03	***	0.015	4.44E-03	***	0.004	4.47E-03		-0.001	5.12E-03	
SPORIGIN(SG)	-0.042	1.98E+02		0.022	1.03E-02	**	-0.051	9.47E+03		-0.067	6.14E+02	
SPORIGIN(TW)	-0.001	6.74E-03		0.009	6.75E-03	*	0.018	5.22E-03	***	0.008	7.60E-03	
SPORIGIN(TH)	0.002	3.39E-03		0.004	4.98E-03		0.006	3.72E-03	**	0.023	4.27E-03	***
FXORIGIN(ID)	0.005	1.82E-03	***	0.006	2.34E-03	***	0.002	2.30E-03		0.004	2.39E-03	**
FXORIGIN(KR)	0.002	3.49E-03		-0.008	6.32E-03		0.001	4.28E-03		-0.004	4.67E-03	
FXORIGIN(MY)	-0.050	6.13E+03		-0.053	5.01E+02		0.014	8.61E-03	*	-0.070	2.05E+02	
FXORIGIN(PH)	0.006	6.82E-03		-0.056	1.25E+02		-0.050	1.70E+02		0.003	8.57E-03	
FXORIGIN(TW)	-0.041	1.80E+02		-0.053	1.83E+02		0.029	1.07E-02	***	0.006	1.40E-02	
FXORIGIN(TH)	-0.011	5.59E-03	**	0.003	5.60E-03		0.010	4.19E-03	**	-0.001	5.88E-03	
SIGMA	0.008	7.19E-04	***	0.010	1.04E-03	***	0.008	1.10E-03	***	0.012	9.20E-04	***

Note: ***, ** and * indicate the significance at the 1,5 and 10%, respectevely.

Table 3-6
Tobit estimation: dependent vatiable: stock price
1998-1999

	Hong Kong		Indonesia		Korea		Malaysia	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
C	-0.010	1.89E-03 ***	-0.014	2.52E-03 ***	-0.011	2.12E-03 ***	-0.022	3.74E-03 ***
DRRSP(-1)	0.351	8.44E-02 ***	0.343	1.02E-01 ***	0.402	8.82E-02 ***	0.031	8.47E-02
DRRFX(-1)	7.442	1.33E+01	0.001	8.82E-02	0.209	3.28E-01	-0.105	5.44E-01
SPORIGIN(HK)	0.025	3.71E-03 ***	0.011	5.74E-03 **	-0.063	2.73E+02	0.034	7.94E-03 ***
SPORIGIN(ID)	0.009	3.44E-03 ***	0.030	4.55E-03 ***	0.006	4.50E-03 *	0.011	7.50E-03 *
SPORIGIN(KR)	0.001	4.43E-03	0.001	6.58E-03	0.020	4.44E-03 ***	0.001	9.61E-03
SPORIGIN(MY)	0.003	6.22E-03	0.012	6.31E-03 **	-0.060	2.60E+02	0.039	8.65E-03 ***
SPORIGIN(PH)	0.005	4.09E-03	0.009	6.20E-03 *	0.013	5.51E-03 ***	0.016	8.62E-03 **
SPORIGIN(SG)	0.015	7.60E-03 **	-0.058	1.02E+04	-0.054	1.85E+02	-0.090	3.74E+03
SPORIGIN(TW)	-0.051	1.02E+04	0.014	8.44E-03 **	-0.080	0.00E+00	0.015	1.29E-02
SPORIGIN(TH)	-0.004	5.13E-03	-0.058	4.37E+01	0.001	5.18E-03	-0.089	9.38E+02
FXORIGIN(ID)	0.006	3.71E-03 *	0.006	5.00E-03	0.004	5.21E-03	0.008	7.93E-03
FXORIGIN(KR)								
FXORIGIN(MY)								
FXORIGIN(PH)								
FXORIGIN(TW)								
FXORIGIN(TH)								
SIGMA	0.007	1.06E-03 ***	0.011	1.40E-03 ***	0.010	1.34E-03 ***	0.016	2.16E-03 ***

	Philippines		Singapore		Taiwan		Thailand	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
C	-0.014	2.63E-03 ***	-0.011	2.09E-03 ***	-0.011	2.19E-03 ***	-0.009	1.70E-03 ***
DRRSP(-1)	0.326	9.64E-02 ***	0.539	1.09E-01 ***	0.544	1.30E-01 ***	0.385	8.40E-02 ***
DRRFX(-1)	0.093	3.10E-01	0.200	3.22E-01	0.980	7.54E-01 *	0.178	2.35E-01
SPORIGIN(HK)	0.013	5.00E-03 ***	0.018	3.89E-03 ***	0.009	3.89E-03 ***	0.012	3.61E-03 ***
SPORIGIN(ID)	0.014	4.68E-03 ***	0.005	4.73E-03	0.004	3.98E-03	0.001	4.07E-03
SPORIGIN(KR)	0.003	5.77E-03	-0.002	4.61E-03	0.002	4.84E-03	-0.001	4.00E-03
SPORIGIN(MY)	0.007	6.66E-03	0.005	5.11E-03	-0.059	0.00E+00	0.001	4.66E-03
SPORIGIN(PH)	0.028	4.93E-03 ***	0.004	5.18E-03	0.006	4.55E-03	-0.038	7.38E+01
SPORIGIN(SG)	0.025	9.97E-03 ***	0.023	8.05E-03 ***	-0.041	1.92E+02	-0.095	0.00E+00
SPORIGIN(TW)	0.013	7.82E-03 *	0.007	6.44E-03	0.023	5.70E-03 ***	-0.044	0.00E+00
SPORIGIN(TH)	0.007	4.64E-03 *	-0.001	3.87E-03	-0.002	4.77E-03	0.021	2.84E-03 ***
FXORIGIN(ID)	0.014	4.25E-03 ***	0.002	4.95E-03	0.002	4.49E-03	0.006	3.07E-03 **
FXORIGIN(KR)								
FXORIGIN(MY)								
FXORIGIN(PH)								
FXORIGIN(TW)								
FXORIGIN(TH)								
SIGMA	0.009	1.30E-03 ***	0.008	1.11E-03 ***	0.007	1.14E-03 ***	0.007	8.99E-04 ***

Note: ***, ** and * indicate the significance at the 1,5 and 10%, respectevely.

Table 4-1: Contagion effects (July 1997-June 1998)

	To	stock price								exchange rate				
From		Hong Kong	Indonesia	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	Indonesia	Korea	Malaysia	Philippines	Thailand
Stock price	Hong Kong	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)	+(***)	+	+	+	+	+(**)
origin	Indonesia	+(***)	+(***)	+(*)	+(***)	+(**)	+(**)	+	+	+	-(*)	+	+	+(**)
	Korea	+(***)	+(**)	+(***)	+(***)	+	+(**)	+	+(***)	+	+	+	+	+(*)
	Malaysia	+(***)	+(**)	+(***)	+(***)	+(**)	+(***)	+	+	+	+	+(***)	+(**)	+(***)
	Philippines	+(***)	+(***)	+	+(***)	+(***)	+(***)	+	+	+	+	+(*)	-	+
	Singapore	+	+	+	+	+	+(**)	+	+	-	-	-	-	-
	Taiwan	+	+	+	+(*)	+	+(*)	+(***)	+	+	-	+(**)	-	+(**)
	Thailand	-(*)	+	+	+	+	+	+(**)	+(***)	+	+	+	-	-
exchange	Indonesia	+	+(*)	+	+(**)	+(***)	+(***)	+	+(**)	+(***)	+(**)	+(***)	+(***)	+
rate	Korea	-	+	+	+(***)	+	-	+	-	+(***)	+(***)	+	-	+
origin	Malaysia	-	+(**)	+	+(**)	-	-	+(*)	-	+	+	+(***)	+(**)	+(*)
	Philippines	-	+	-	-	+	-	-	+	-	-	+	+(***)	-(*)
	Taiwan	+(*)	-	+	+	-	-	+(***)	+	-	+	+	+	-
	Thailand	+	-(***)	-	-	-(**)	+	+(**)	-	+	-	+	+	+(***)

Note: ***, **, and * indiecate the significance at the 1,5 and 10%, respectively. Shaded areas are those with significant and correct signs.

Table 4-2: Contagion effects (July 1998-July 1999)

	To	stock price								exchange rate				
From		Hong Kong	Indonesia	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	Indonesia	Korea	Malaysia	Philippines	Thailand
stock price	Hong Kong	+(***)	+(**)	-	+(***)	+(***)	+(***)	+(***)	+(***)	-				
origin	Indonesia	+(***)	+(***)	+(*)	+(*)	+(***)	+	+	+	+(**)				
	Korea	+	+	+(***)	+	+	-	+	-	+				
	Malaysia	+	+(**)	-	+(***)	+	+	-	+	-				
	Philippines	+	+(*)	+(***)	+(**)	+(***)	+	+	-	-				
	Singapore	+(**)	-	-	-	+(***)	+(***)	-	-	-				
	Taiwan	-	+(**)	-	+	+(*)	+	+(***)	-	-				
	Thailand	-	-	+	-	+(*)	-	-	+(***)	-				
exchange	Indonesia	+(*)	+	+	+	+(***)	+	+	+ (**)	+(***)				
rate	Korea	na	na	na	na	na	na	na	na	na				
origin	Malaysia	na	na	na	na	na	na	na	na	na				
	Philippines	na	na	na	na	na	na	na	na	na				
	Taiwan	na	na	na	na	na	na	na	na	na				
	Thailand	na	na	na	na	na	na	na	na	na				

Note: ***, **, and * indiecate the significance at the 1,5 and 10%, respectively. Shaded areas are those with significant and correct signs.

Table 5-1: Estimation results of Friction model

Dependent vatiable: Stock Prices
1997-1998

	Hong Kong		Indonesia		Korea		Malaysia	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
DRRSP(-1)	-0.8039	3.79E-02 ***	-0.5360	4.33E-02 ***	-0.5150	6.63E-02 ***	-0.6903	4.24E-02 ***
DRRFX(-1)	4.0141	1.95E+00 **	0.0342	2.34E-02 *	-0.0162	6.07E-02	-0.1759	1.13E-01 *
SPORIGIN(HK)	0.0138	5.19E-03 ***	-0.0093	7.38E-03	0.0042	6.22E-03	-0.0202	8.04E-03 ***
SPORIGIN(ID)	-0.0007	1.12E-02	0.0072	5.11E-03 *	0.0069	5.81E-03	-0.0062	7.97E-03
SPORIGIN(KR)	-0.0018	6.13E-03	-0.0045	5.19E-03	0.0064	4.92E-03 *	-0.0113	5.50E-03 **
SPORIGIN(MY)	-0.0044	8.13E-03	0.0009	7.48E-03	-0.0028	8.61E-03	0.0018	4.88E-03
SPORIGIN(PH)	-0.0146	1.56E-02	-0.0138	6.35E-03 **	0.0058	1.90E-02	-0.0040	2.09E-02
SPORIGIN(SG)	-0.1748	5.99E-03 ***	0.0200	8.96E-02	0.0473	2.77E-02 **	0.1755	8.33E-03 ***
SPORIGIN(TW)	0.0014	2.19E-02	-0.0122	3.71E-02	0.0009	7.97E-02	-0.0035	2.26E-02
SPORIGIN(TH)	0.0282	5.65E-03 ***	0.0114	7.62E-03 *	-0.0010	1.32E-02	0.0028	1.18E-02
FXORIGIN(ID)	-0.0079	5.23E-03	-0.0023	3.86E-03	-0.0019	3.97E-03	-0.0049	5.52E-03
FXORIGIN(KR)	-0.0049	9.21E-03	0.0011	7.82E-03	-0.0189	8.08E-03 **	-0.0053	4.67E-03
FXORIGIN(MY)	-0.0114	3.39E-02	-0.0211	1.06E-02 **	-0.0126	5.40E-02	-0.0186	3.13E-02
FXORIGIN(PH)	0.0026	2.33E-02	-0.0183	2.25E-02	-0.0113	4.52E-02	0.0058	2.49E-02
FXORIGIN(TW)	-0.0320	1.36E+00	0.0125	1.75E-01	-0.0032	9.48E-02	-0.0124	1.12E-01
FXORIGIN(TH)	-0.0036	7.75E-03	0.0196	8.97E-03 **	0.0202	8.81E-03 **	-0.0122	1.10E-02
INVSIG	40.2639	1.10E+00 ***	44.4502	1.61E+00 ***	40.4093	1.50E+00 ***	41.5087	1.08E+00 ***
NOB	293		293		293		293	

	Philippines		Singapore		Taiwan		Thailand	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
DRRSP(-1)	-0.7997	4.65E-02 ***	-0.8267	4.02E-02 ***	-0.5633	4.71E-02 ***	-0.7655	3.62E-02 ***
DRRFX(-1)	0.0085	9.48E-02	-0.3089	1.23E-01 ***	-0.0380	1.40E-01	-0.2117	8.22E-02 ***
SPORIGIN(HK)	-0.0216	5.63E-03 ***	-0.0189	4.04E-03 ***	-0.0085	2.63E-03 ***	-0.0216	6.42E-03 ***
SPORIGIN(ID)	-0.0062	5.34E-03	-0.0087	5.05E-03 **	-0.0027	3.75E-03	-0.0065	9.76E-03
SPORIGIN(KR)	-0.0022	5.98E-03	-0.0061	4.03E-03 *	0.0000	2.19E-03	-0.0078	7.38E-03
SPORIGIN(MY)	-0.0045	8.19E-03	-0.0087	5.53E-03 *	-0.0049	3.85E-03	-0.0054	1.22E-02
SPORIGIN(PH)	0.0075	4.95E-03 *	-0.0178	8.88E-03 **	-0.0052	7.67E-03	0.0251	6.36E-03 ***
SPORIGIN(SG)	0.0253	1.08E-02 **	-0.0147	3.70E-02	-0.0112	2.39E-02	-0.0072	2.84E-02
SPORIGIN(TW)	0.0054	2.89E-02	-0.0135	1.37E-02	0.0437	4.93E-03 ***	-0.0111	1.59E-02
SPORIGIN(TH)	0.0059	7.32E-03	-0.0014	5.00E-03	-0.0067	4.32E-03 *	-0.0041	8.16E-03
FXORIGIN(ID)	-0.0127	3.56E-03 ***	-0.0053	3.25E-03 *	-0.0010	2.46E-03	-0.0020	4.27E-03
FXORIGIN(KR)	-0.0009	7.94E-03	0.0038	5.78E-03	0.0019	2.56E-03	0.0101	1.57E-02
FXORIGIN(MY)	-0.0076	1.29E-02	-0.0008	4.20E-02	0.0048	8.88E-03	0.0001	5.70E-02
FXORIGIN(PH)	-0.0159	2.44E-02	0.0057	2.75E-02	0.0062	5.39E-03	-0.0101	2.06E-02
FXORIGIN(TW)	-0.0378	4.92E-02	-0.0130	2.55E-02	-0.0292	5.43E-03 ***	0.0049	3.01E-01
FXORIGIN(TH)	0.0086	7.92E-03	-0.0113	7.00E-03 *	-0.0090	3.87E-03 **	0.0191	8.23E-03 **
INVSIG	47.2690	1.33E+00 ***	67.7984	2.37E+00 ***	86.6146	3.28E+00 ***	41.4131	1.31E+00 ***
NOB	293		293		293		293	

Note: ***, **, and * indiecate the significance at the 1,5 and 10%, respectively.

Table 5-2 Estimation results of Friction model

Dependent vatiable: Stock Prices
1998-1999

	Hong Kong		Indonesia		Korea		Malaysia	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
DRRSP(-1)	-0.4962	4.58E-02 ***	-0.8220	6.74E-02 ***	-0.5513	4.91E-02 ***	-1.1882	2.92E-02 ***
DRRFX(-1)	-17.6545	7.08E+00 ***	-0.0267	8.09E-02	-0.4250	1.82E-01 ***	-1.7749	9.06E-01 **
SPORIGIN(HK)	0.0084	7.77E-03	-0.0115	1.28E-02	0.0024	1.58E-02	-0.0413	1.06E-02 ***
SPORIGIN(ID)	-0.0045	4.82E-03	-0.0094	9.67E-03	-0.0065	8.95E-03	-0.0044	2.28E-02
SPORIGIN(KR)	0.0024	1.20E-02	-0.0100	1.92E-02	-0.0050	9.39E-03	-0.0189	2.59E-02
SPORIGIN(MY)	-0.0144	1.64E-02	-0.0181	4.73E-02	-0.0070	2.32E-02	-0.0177	2.82E-02
SPORIGIN(PH)	-0.0037	6.62E-03	-0.0109	1.21E-02	-0.0133	7.07E-03 **	-0.0131	3.12E-02
SPORIGIN(SG)	-0.0096	1.01E-01	0.0281	1.28E+00	0.0632	7.26E-03 ***	-0.0100	3.71E-02
SPORIGIN(TW)	-0.0031	1.79E-01	-0.0027	1.28E-02	-0.0019	2.54E-02	0.0013	5.73E-02
SPORIGIN(TH)	0.0012	8.55E-03	-0.0024	1.17E-02	-0.0051	9.22E-03	0.0038	4.27E-02
FXORIGIN(ID)	-0.0051	6.50E-03	-0.0004	9.49E-03	-0.0063	1.10E-02	-0.0244	8.78E-03 ***
FXORIGIN(KR)								
FXORIGIN(MY)								
FXORIGIN(PH)								
FXORIGIN(TW)								
FXORIGIN(TH)								
INVSIG	63.3960	2.46E+00 ***	37.9599	1.35E+00 ***	50.6858	2.63E+00 ***	28.0227	7.34E-01 ***
NOB	234		234		234		234	

	Philippines		Singapore		Taiwan		Thailand	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
DRRSP(-1)	-0.8766	5.86E-02 ***	-0.9397	5.66E-02 ***	-0.9860	6.85E-02 ***	-0.6007	5.11E-02 ***
DRRFX(-1)	-0.3971	2.18E-01 **	-0.3536	2.34E-01 *	-0.0239	3.99E-01	-0.3479	1.74E-01 **
SPORIGIN(HK)	-0.0165	1.68E-02	-0.0363	1.48E-02 ***	-0.0204	1.40E-02 *	-0.0078	1.25E-02
SPORIGIN(ID)	-0.0127	4.64E-03 ***	-0.0068	4.50E-03 *	-0.0080	6.02E-03 *	-0.0065	9.66E-03
SPORIGIN(KR)	-0.0061	1.26E-02	0.0037	7.31E-03	-0.0093	1.39E-02	-0.0063	8.33E-03
SPORIGIN(MY)	-0.0190	2.92E-02	-0.0129	1.22E-02	0.0100	5.16E-03 **	0.0052	7.94E-03
SPORIGIN(PH)	0.0227	9.33E-03 ***	-0.0134	9.28E-03 *	-0.0104	1.26E-02	-0.0067	1.07E-02
SPORIGIN(SG)	-0.0541	1.88E+01	-0.0925	1.06E-02 ***	0.0094	9.43E-01	0.0155	4.98E-02
SPORIGIN(TW)	-0.0123	1.92E-02	-0.0038	1.31E-02	0.0138	3.38E-02	0.0060	1.79E-02
SPORIGIN(TH)	-0.0022	6.65E-03	0.0020	5.43E-03	0.0042	7.59E-03	0.0042	6.04E-03
FXORIGIN(ID)	-0.0165	5.34E-03 ***	-0.0004	5.91E-03	-0.0051	6.57E-03	-0.0090	4.67E-03 **
FXORIGIN(KR)								
FXORIGIN(MY)								
FXORIGIN(PH)								
FXORIGIN(TW)								
FXORIGIN(TH)								
INVSIG	49.3097	1.73E+00 ***	55.5838	2.13E+00 ***	58.6626	2.30E+00 ***	54.3050	2.19E+00 ***
NOB	234		234		234		234	

Note: ***, **, and * indiecate the significance at the 1,5 and 10%, respectively.

Table 5-3 Estimation results of Friction model

Dependent vatiable: Exchange Rates
1997-1998

	Indonesia		Korea		Malaysia		Philippines	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
DRRSP(-1)	-0.3509	7.18E-01	0.0516	6.22E-02	-0.0275	3.48E-02	-0.0525	2.82E-02 **
DRRFX(-1)	-0.9849	3.91E-01 ***	-0.8382	6.48E-02 ***	-0.7182	5.34E-02 ***	-0.5292	4.23E-02 ***
SPORIGIN(HK)	-0.0056	1.31E-01	0.0093	1.04E-02	0.0044	5.36E-03	0.0002	2.94E-03
SPORIGIN(ID)	-0.0027	8.30E-02	-0.0029	7.39E-03	0.0050	2.98E-03 **	0.0012	3.39E-03
SPORIGIN(KR)	0.0230	1.09E-01	0.0155	7.52E-03 **	0.0014	3.08E-03	0.0020	2.62E-03
SPORIGIN(MY)	0.0249	2.06E-01	0.0067	7.85E-03	0.0081	4.04E-03 **	0.0034	2.59E-03 *
SPORIGIN(PH)	-0.0131	1.14E-01	0.0191	1.83E-02	0.0055	5.19E-03	-0.0054	7.46E-03
SPORIGIN(SG)	0.0447	3.10E+03	-0.1334	7.57E-03 ***	0.0245	2.06E-02	-0.0026	1.36E-01
SPORIGIN(TW)	0.0612	3.46E-01	0.0023	5.40E-02	0.0025	8.28E-03	-0.0034	1.42E-02
SPORIGIN(TH)	0.0092	1.68E-01	0.0034	1.72E-02	-0.0058	6.77E-03	-0.0013	1.02E-02
FXORIGIN(ID)	0.0354	7.30E-02	-0.0038	5.73E-03	0.0047	2.48E-03 **	0.0031	2.36E-03 *
FXORIGIN(KR)	0.0194	1.74E-01	0.0007	8.59E-03	0.0027	5.38E-03	-0.0007	5.40E-03
FXORIGIN(MY)	0.0312	2.10E+00	0.0037	4.41E-02	-0.0266	8.43E-03 ***	0.0175	8.23E-03 **
FXORIGIN(PH)	-0.0049	1.08E+00	0.0097	4.04E-02	0.0035	9.37E-03	-0.0342	5.08E-03 ***
FXORIGIN(TW)	-0.0175	2.28E+01	0.0135	2.87E-01	0.0049	1.58E+00	-0.0012	1.94E-01
FXORIGIN(TH)	0.0241	2.44E-01	-0.0189	1.17E-02	-0.0034	8.65E-03	0.0048	3.10E-03 *
INVSIG	6.0135	3.80E-01 ***	34.2272	6.82E-01 ***	73.3717	2.57E+00 ***	79.6691	2.91E+00 ***
NOB	293		293		293		293	

	Singapore		Taiwan		Thailand	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
DRRSP(-1)	-0.0372	2.15E-02 **	-0.0384	1.67E-02 **	0.0001	3.00E-02
DRRFX(-1)	-0.9059	4.19E-02 ***	-0.5710	4.02E-02 ***	-0.5467	4.96E-02 ***
SPORIGIN(HK)	0.0018	1.72E-03	0.0000	1.08E-03	0.0071	6.33E-03
SPORIGIN(ID)	-0.0005	1.85E-03	-0.0004	1.25E-03	0.0060	3.59E-03 **
SPORIGIN(KR)	0.0008	1.67E-03	0.0013	1.18E-03	0.0016	3.43E-03
SPORIGIN(MY)	0.0043	2.52E-03 *	0.0022	9.63E-04 **	0.0113	3.02E-03 ***
SPORIGIN(PH)	0.0058	2.13E-03 ***	-0.0007	1.87E-03	0.0051	9.40E-03
SPORIGIN(SG)	0.0074	1.39E-01	0.0091	7.55E-02	0.0115	6.92E-02
SPORIGIN(TW)	0.0015	7.11E-03	0.0123	9.98E-04 ***	0.0096	1.25E-02
SPORIGIN(TH)	-0.0005	2.60E-03	0.0012	2.54E-03	0.0057	7.50E-03
FXORIGIN(ID)	0.0021	1.15E-03 **	0.0010	7.27E-04 *	0.0026	2.63E-03
FXORIGIN(KR)	0.0017	3.67E-03	-0.0011	1.14E-03	0.0052	4.64E-03
FXORIGIN(MY)	0.0177	1.08E-02 *	0.0031	8.69E-03	0.0260	6.46E-03 ***
FXORIGIN(PH)	0.0020	7.80E-03	-0.0009	4.19E-03	0.0087	1.07E-02
FXORIGIN(TW)	-0.0030	1.20E-02	-0.0081	5.43E-02	-0.0053	7.60E-02
FXORIGIN(TH)	0.0014	3.14E-03	0.0018	1.55E-03	0.0029	4.77E-03
INVSIG	146.6770	5.41E+00 ***	237.4480	8.67E+00 ***	75.2579	2.48E+00 ***
NOB	293		293		293	

Note: ***, **, and * indiecate the significance at the 1,5 and 10%, respectively.

Table 5-4 Estimation results of Friction model

Dependent vatiable: Exchange Rates
1998-1999

	Indonesia		Korea		Malaysia		Philippines	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
DRRSP(-1)	-0.0567	5.01E-02	0.0042	1.42E-02	0.0438	7.34E-03 ***	-0.0265	1.56E-02 **
DRRFX(-1)	-0.6646	5.40E-02 ***	-0.5901	5.45E-02 ***	-0.5027	2.38E-02 ***	-0.6925	5.13E-02 ***
SPORIGIN(HK)	-0.0021	1.51E-02	0.0040	3.93E-03	-0.0150	1.13E-03 ***	-0.0027	1.71E-03 *
SPORIGIN(ID)	-0.0048	1.12E-02	0.0000	2.93E-03	0.0014	2.38E-03	0.0036	1.94E-03 **
SPORIGIN(KR)	0.0276	5.15E-03 ***	0.0016	2.15E-03	-0.0005	3.02E-03	0.0009	1.81E-03
SPORIGIN(MY)	0.0027	2.26E-02	0.0013	5.21E-03	0.0060	6.29E-03	0.0066	1.89E-03 ***
SPORIGIN(PH)	-0.0014	8.82E-03	0.0007	5.18E-03	-0.0011	2.66E-03	0.0073	1.06E-03 ***
SPORIGIN(SG)	0.0045	3.89E-02	-0.0023	1.43E-02	0.0037	9.20E-02	0.0016	4.64E-01
SPORIGIN(TW)	0.0070	4.84E-02	-0.0056	7.89E-03	-0.0061	1.18E-02	-0.0051	6.41E-03
SPORIGIN(TH)	-0.0115	7.41E-03 *	-0.0007	2.83E-03	0.0001	3.69E-03	-0.0057	1.32E-03 ***
FXORIGIN(ID)	-0.0026	5.61E-03	0.0020	2.77E-03	-0.0002	2.29E-03	-0.0009	1.07E-03
FXORIGIN(KR)								
FXORIGIN(MY)								
FXORIGIN(PH)								
FXORIGIN(TW)								
FXORIGIN(TH)								
INVSIG	55.8617	2.53E+00 ***	174.7060	5.25E+00 ***	165.1250	5.15E+00 ***	230.1500	1.00E+01 ***
NOB	234		234		234		234	

	Singapore		Taiwan		Thailand	
	Coefficients	s.e.	Coefficients	s.e.	Coefficients	s.e.
DRRSP(-1)	-0.0047	1.45E-02	-0.0194	8.18E-03 **	0.0273	1.48E-02 **
DRRFX(-1)	-0.8974	3.74E-02 ***	-0.5032	3.53E-02 ***	-0.9237	3.10E-02 ***
SPORIGIN(HK)	-0.0103	8.73E-04 ***	-0.0012	8.90E-04 *	-0.0092	1.34E-03 ***
SPORIGIN(ID)	0.0002	2.68E-03	0.0011	1.42E-03	0.0004	3.20E-03
SPORIGIN(KR)	0.0014	4.03E-03	0.0008	8.44E-04	0.0050	2.69E-03 **
SPORIGIN(MY)	0.0009	2.24E-03	0.0017	1.53E-03	0.0020	3.62E-03
SPORIGIN(PH)	-0.0010	1.64E-03	0.0010	1.56E-03	0.0010	3.72E-03
SPORIGIN(SG)	0.0113	3.71E-02	0.0036	3.29E-01	0.0029	5.52E-02
SPORIGIN(TW)	0.0020	9.27E-03	-0.0028	1.11E-03 ***	-0.0004	4.17E-03
SPORIGIN(TH)	-0.0003	4.98E-03	0.0000	1.31E-03	0.0005	2.91E-03
FXORIGIN(ID)	0.0002	1.64E-03	-0.0007	1.58E-03	0.0019	1.87E-03
FXORIGIN(KR)						
FXORIGIN(MY)						
FXORIGIN(PH)						
FXORIGIN(TW)						
FXORIGIN(TH)						
INVSIG	232.3390	7.80E+00 ***	438.0510	1.61E+01 ***	188.5880	6.60E+00 ***
NOB	234		234		234	

Note: ***, **, and * indiecate the significance at the 1,5 and 10%, respectively.