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Ramkishen Rajan, Reza Siregar and Graham Bird

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Adelaide University
Adelaide 5005 Australia

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CIES DISCUSSION PAPER 0219

Capital Flows and Regional Financial Interdependencies in the Context of Crises: Evidence From East Asia

Ramkishen Rajan, Reza Siregar and Graham Bird

School of Economics, University of Adelaide, Australia
ramkishen.rajan@adelaide.edu.au

and

School of Economics, University of Adelaide, Australia
reza.siregar@adelaide.edu.au

and

Surrey Centre of International Economic Studies, University of Surrey, Guildford UK
g.bird@surrey.ac.uk

August 2002

1. Introduction

Capital volatility has been a key feature of the international financial system over recent years, yet our understanding of what determines capital flows remains limited at best. Following the surge of private capital towards and consequent economic booms in some Latin American and Asian in the early 1990s, both theoretical and empirical analysis began to distinguish between "pull" and "push" factors. Was capital *pulled* into recipient countries by their internal policies and performance, or was it *pushed* towards them as a consequence of external factors beyond their control, such as interest rates and economic activity in the rest of the world? Recent research has shown how pull and push factors may be complementary, with push factors determining the timing and magnitude of capital flows to emerging economies and pull factors determining their geographic distribution (Carlson and Hernandez, 2002, Dasgupta and Ratha, 2000 and Montiel and Reinhart, 2000).

Capital volatility and related currency crises and consequent economic busts have often been linked to short term bank lending and portfolio equity flows. Theoretical models have been developed to explain how bank flows and portfolio flows may be subject to swings in market sentiment which may be cumulative and self-endorsing (Rajan, 2002)[1].

Capital flows to and from East Asia during the 1990s provide further evidence of capital volatility. During the boom period of the early-to-mid 1990s there were large capital inflows primarily in the form of bank lending. Superficially, the inflows were consistent with both pull and push explanations. Many of the regional economies had embarked on policies of financial liberalization, which saw domestic interest rates rise (Bird and Rajan, 2001). Moreover, rapid economic growth and credibly pegged exchange rates were attractive to foreign creditors. At the same time, slow economic growth in many industrial countries at the beginning of the 1990s, combined with relatively low rates of interest, pushed capital towards

[1] In recognition of the urgent need to further study and understand the workings and dynamics of international capital markets and flows, the IMF recently established a new International Capital Markets Department.

emerging economies where economic prospects seemed brighter[2]. However, the subsequent loss of confidence in these economies resulted in a massive turnaround in capital flows. Boom was followed by bust. What do the data tell us about this?

Balance of payments data from the IMF reveal that the five Asian economies most afflicted by the regional crisis, viz. Indonesia, Malaysia, Philippines, Thailand and Korea (henceforth termed "Asia-5 economies") saw a sharp reversal in net private capital flows of over $100 billion between 1996 and 1998. This reversal was primarily due to the "other investment component" of net short term lending by foreign commercial banks, which averaged about $30 billion in *inflows* between 1995 and 1996, but turned into a net *outflow* of about $30 billion over the following two years as international banks became unwilling to roll over existing short term debts to the region (Table 1).

BIS data reveal that international bank lending to the Asia 5 economies which had remained buoyant at almost $50 billion in the first half of 1997, swung to -$40 billion over the following three quarters (BIS, 1999)[3]. This sudden reversal in bank lending is often presented as providing strong evidence in support of a bank panic model (Chang and Velasco, 1998, and Radelet and Sachs, 1998)[4]. However, a less emphasized feature of this period was the decline in portfolio flows following the initial bank panic as investors also tried to scale down their exposures in the region (also see Carlson and Hernandez, 2002). Referring again to the IMF balance of payments data, portfolio inflows totaled $36 billion in 1995 and 1996, but they slowed to $9 billion in 1997; then there was a net outflow of $9 billion in 1998.

[2] The trigger country, Thailand, Malaysia and Indonesia were among the ten largest emerging market recipients of net private capital flows during the period under consideration (Rajan and Siregar, 2001 and Lopez-Mejia, 1999 and World Bank, 1997).

[3] Bank-related outflows have continued unabated (i.e. the "other net investment" component). The sustained bank outflows from the regional occurred despite a renewed willingness of lenders to maintain, if not slightly increase, exposures to the region because of repayments of external liabilities to commercial banks. These repayments were largely concentrated in Thailand and Indonesia (IIF, 2001, 2002). It is important to note that a central difference between the outflows in 1997-98 and since then was that the former was largely unanticipated and thus highly disruptive. In the latter, the loan repayments had been anticipated and scheduled.

[4] Of course, these *ex-post* swings in bank flows are only *necessary* and not *sufficient* evidence in support of a bank panic model (Rajan, 2001).

These flows once again turned positive in 1999 and 2000. In contrast, FDI flows have remained remarkably stable throughout the period under consideration[5] (Table 1).

Having briefly outlined the dynamics of capital flows in East Asia in the 1990s, the remainder of this paper concentrates on portfolio equity flows. Its purpose is essentially empirical and is to see whether evidence drawn from the Asian economies during the 1990s allows us to acquire a clearer understanding of what factors determine portfolio capital flows. The theoretical framework adopted is that of a simple informational-frictions capital crisis model which focuses on portfolio flows and which emphasizes the importance of sudden losses of confidence that spread quickly throughout international capital markets.

The paper is structured as follows. Section 2 briefly introduces the theoretical foundations underpinning instability in short term capital flows, and shows how rumors and news, even if unsubstantiated by fundamentals, may create panic in terms of market sentiment. Section 3 goes on to provide some relatively simple but still useful tests based on empirical evidence drawn from the Asia 5 economies using variables suggested by the theoretical analysis. Section 4 concentrates on the dynamics of financial interdependencies between the regional Asian economies. Section 5 offers a summary and a few concluding remarks.

2. Capital Account Crises: Theoretical Preliminaries

2.1 Bank-based Models

It has become commonplace to interpret the new genre of flow-based currency crisis models as taking a "bank centered" view. While this is far too narrow a perspective and does not do adequate justice to the large milieu of new crisis models, it is not altogether surprising. After all, the high correlation between banking and currency crises (so-called "twin crises") since the late 1980s and 1990s is well documented, with the causation most often running from banking to currency crises (Kaminsky and Reinhart, 1999). What is more, these twin

[5] Indonesia was the only exception, FDI having collapsed due to ongoing socio-political uncertainties (ADB, 2001 and World Bank, 1999).

crises are far more pervasive in developing countries than developed ones (Glick and Hutchison, 1999).

Much ink has been spilt over the question of whether the East Asian crisis was due to *insolvency* or *illiquidity*. Whatever the reasons for the crisis and devaluation, the extent of the post devaluation collapse is exacerbated by the nominal appreciation of external liabilities which are often foreign currency based and unhedged, slashing the net worth of individuals, corporations and the domestic financial systems at large (Aghion et al., 2000, Dornbusch, 2000, Krugman, 1999, 2000 and Velasco, 2001). This so-called "balance sheet" effect leads to massive collateral damage and outright bankruptcies, which in turn aggravate domestic economic conditions and intensify capital outflows.

2.2 A Portfolio-based Model

As noted, it is a common misconception to assume that all flow-based third generation models are bank-based. A prominent example of one that is not is the portfolio equity-based model by Calvo and Mendoza (2000). We consider below a bare-bones version of the Calvo-Mendoza capital crisis model - a simple one period mean-variance model of optimal portfolio diversification/allocation.

Assume the existence of homogenous atomistic investors. Assume J countries in which investors allocate a fixed pool of funds which we normalize to one unit. Assume returns in each are distributed i.i.d. with mean of ρ and variance of σ_0^2. Focusing on a single agent, assume the investor hears a "rumor" that country k's new stochastic return is r, where $(r - \rho) = \varepsilon \neq 0$. Let returns in country k = σ_1. Let $\varnothing$ be the share of the portfolio invested in all countries other than country k. Denote the portfolio by X. Thus, the portfolio's mean and variance are respectively:

$$E(X) = \rho + (1 - \varnothing)\varepsilon, \quad (1)$$

$$\text{Var}(X) = [(\varnothing\sigma_0)^2/(J - 1) + (1 - \varnothing)\sigma_1^2]. \quad (2)$$

Assume that the representative agent is a price taker. Under the assumption of normal distribution of returns, let the agent maximize the following quadratic objective function (U) w.r.t. $\varnothing$:

$$\text{Max } EU(X) = [(1 - \varnothing)\varepsilon + \rho] - \nu/2[(\varnothing\sigma_0)^2/(J - 1) + (1 - \varnothing)^2\sigma_1^2], \quad \nu > 0. \quad (3)$$

Solving for the proportion of funds devoted to country k obtains:

$$(1 - \varnothing) = [\Upsilon + \varepsilon/\nu]/[\Upsilon + \sigma_1^2], \quad (4)$$

where: $\Upsilon = \sigma_0^2/(J - 1)$.

In the absence of news on returns in country k (i.e. country k is identical to all other countries *ex-ante*), from eq. (4), the share of portfolio allocated to the country is 1/J, as would be expected a priori. Accordingly, in the absence of news, the portfolio allocated to country k tends to become negligible as J gets arbitrarily large (i.e. abundant alternatives for portfolio diversification). On the other hand, from eq. (4), with the impact of news, the change in portfolio composition to country k becomes extremely sensitive to the expected mean return differential (ε) and variance in country k as $J \rightarrow \infty$. Specifically,

$$\partial(1 - \varnothing)/\partial\varepsilon = [\nu/[\Upsilon + \sigma_1^2]^{-1}, \quad (5)$$

and, $$\partial(1 - \varnothing)/\partial\varepsilon \rightarrow 1/(\nu\sigma_1^2) \text{ as } J \rightarrow \infty. \quad (5^l)$$

$$\partial(1 - \varnothing)/\partial\sigma^2_1 = -[\Upsilon + \varepsilon/\nu]/[\Upsilon + \sigma_1^2]^2, \quad (6)$$

and, $$\partial(1 - \varnothing)/\partial\sigma^2_1 \rightarrow -\varepsilon/(\nu\sigma_1^4) \text{ as } J \rightarrow \infty. \quad (6^l)$$

Those who take a benign view of speculation argue that it would be in agents' best interests to gather the necessary information upon which to make their investment decisions. To the extent that their actions are based on best available information, speculation cannot be

considered arbitrary - the Krugman (1979) first generation model being a case in point. The incentive for investors to gather information may be explored within this portfolio diversification model.

Let there be an unspecified fixed cost involved in learning about country k. Assume that the learning costs allow the agent to obtain information about returns in the country with certainty (i.e. $\sigma_1^2 = 0$). From eq. (4):

$$(1 - \varnothing) = [1 + \varepsilon/(\nu\Upsilon)]. \qquad (4^1)$$

Assuming no short sales, the following relationship between the range of values of ε and (1 - ∅) may be derived:

f	***then***
ε	(1 - ∅)
[0, ∞)	1
[- νϒ, 0)	(0, 1)
(-∞, - νϒ)	0

From the above conditions we see that for $\varepsilon \geq 0$, as long as the fixed information costs are not prohibitively large, there is gain to be had from information gathering ex-post. Conversely, for $\varepsilon \leq -\nu\Upsilon$, there is no ex-post gain to be reaped from information gathering. What about the intermediate case of $\varepsilon = [-\nu\Upsilon, 0)$? As $J \rightarrow \infty$, there is no ex-post gain to be had, as the i.i.d. distribution of returns ensures that a highly diversified portfolio will provide a return of ρ which exceeds r (as $\varepsilon = r - \rho$). On the other hand, for small J, ex-post utility could still increase with information gathering. Putting all this together and assuming continuity, we reach the conclusion that the marginal gain of information gathering about any single country falls as portfolios get increasingly diversified internationally.

The second generation (escape clause-based) multiple equilibria models *a la* Obstfeld (1994, 1996) require the existence of a range or zone of weakness (i.e. “gray area”) in which a currency is potentially vulnerable to a speculative attack. In contrast, the Calvo-Mendoza

model does not necessarily require the existence of any actual macroeconomic weaknesses. Rather, just a rumor of such vulnerabilities may suffice to generate large-scale reallocation of funds away from one destination to another, making small open economies susceptible to large swings in capital flows and costly boom-bust cycles. In this light, the Calvo-Mendoza model is most appropriately seen as an open economy extension of the information-based herding and cascades genre of models that have been recently developed to explain herding behavior in domestic financial markets (Bikhchandani and Sharma, 2000).

3. Empirical Analysis

As noted, the recovery in capital flows in the region has been primarily due to a rebound in portfolio flows (as opposed to bank loans). It would therefore be useful to explore the determinants of private portfolio capital flows to the Asia-5 economies. We also include Singapore in the analysis in view of the important role it plays as a regional trade and financial hub. To be sure, no attempt is made here to provide a fully specified regression analysis[6]. Rather, insofar as the recovery in portfolio capital flows has been accompanied by a rebound in regional output and currencies (ADB-ARIC, 2002), we examine the importance of the nominal exchange rate (nominal variable) and GDP (real variable) in determining portfolio flows in the Asia-5 economies[7]. What is the rationale for doing this?

A broader interpretation of the information frictional-based Calvo-Mendoza model is that small rumors or bad "news" could trigger capital outflows as investors, spoilt for choice, may not undertake detailed country evaluations when making investment decisions. Exchange rates and GDP are among the most timely and easily available data of a country's economic performance. As such, one would expect *a priori* these variables to be important determinants of portfolio flows. For instance, exchange rate volatility could diminish the extent of capital flows into a country and therefore negatively impact stock market returns as well. Carlson and

[6] Dasgupta and Ratha (2000) do undertake a regression analysis of both portfolio and FDI flows. However, absent a theoretical framework, their results, while interesting, are open to criticism of misspecification.

Hernandez (2002) find that countries with floating exchange rate regimes tend to have a smaller share of portfolio equity and FDI in total capital inflows. Two important caveats are in order.

First, while data on exchange rates are available on a daily basis, those on portfolio flows are available only on a quarterly basis from the early 1990s, and even then there are questions about the reliability of such balance-of-payments data. For instance, we are unable to decompose private portfolio capital flows into equity and debt. Accordingly, our analysis of the magnitude of portfolio flows is complemented by one involving a price corollary, i.e. stock market returns, for which higher frequency data are available. In particular, we assume that the higher the stock market returns in a country, the greater will be the portfolio flows to that country.

Second, there is clearly a circular reasoning at work, as changes in capital flows and stock returns ought in turn to affect the nominal exchange rate and overall economic performance including GDP growth (Mishra et al., 2001). In other words, there is inevitably a two-way interaction which creates an endogeneity problem. To overcome this we make use of the conventional Granger-causality tests to ascertain the direction of causation. While our interest, based on theory, is in whether private capital flows are influenced by the variables under consideration, we examine bi-directional Granger-causation for completeness. A general specification of our test in the bi-variate context (X, Y) may be expressed as:

$$\Delta Y_t = \sum_{i=1} \alpha_{1i} \Delta Y_{t-i} + \sum_{i=1} \beta_{1i} \Delta X_{t-i} + \varepsilon_{1t} \tag{7}$$

$$\Delta X_t = \sum_{i=1} \alpha_{2i} \Delta Y_{t-i} + \sum_{i=1} \beta_{2i} \Delta X_{t-i} + \varepsilon_{2t} \tag{8}$$

where ε_t is a white noise error term and Δ is the first difference operator. All variables are in the log-forms. The Granger-causality test examines the statistical significance of the ΔX_t in

[7] The descriptions of relevant variables for the empirical section are summarized in Table 2.

explaining ΔY_t (Eq. 7) and vice-versa in (Eq. 8). For the sake of brevity, we will only report the significant test results.

We are cognizant of the limitations the Granger-causality test. There exist more "structural approaches" to examine interdependence of different variables than the conventional Granger-causality test, such as cointegration tests between variables based on a more fully specified theoretical model (Dickinson, 2000)[8]. Nonetheless, Granger-causality remains a useful and widely used statistical test, particularly in instances of limited degrees of freedom (see Kwan et al. 1995, for instance). Another popular test is the correlation test. However, the power of this test has been questioned for various reasons (Dungey and Zhumabekova, 2001).

3.1 Exchange Rates and Stock Exchange Indices

We begin our empirical investigation by first examining the nexus between exchange rate volatility and stock market performance. Unlike the other variables (portfolio flows and output), data for both these variables are available on a daily basis from January 1, 1996 to July 1, 2001, offering far greater degrees of freedom. We use lags of five and ten days[9].

Since the volatility rates are also strongly determined by the type of exchange regime adopted, it is important in the first instance to understand the kind of arrangements that were in place at different periods in East Asia, particularly pre and post-1997 crisis. Building on the work of Frankel and Wei (1993), McKinnon (2000) concluded that the Asia-5 economies reverted to their pre-crisis US dollar soft pegged exchange rate policies. Using daily and weekly nominal exchange rate observations he finds that there was a temporary adoption of more flexible regimes during the height of the crisis (July 1997 to December 1998). However, starting from January 1999, the test results suggest a similar degree of tightness of the

[8] We have evaluated the unit-root properties of the variables using the ADF unit-root test and the KPSS unit-root test. All variables are integrated of order 1 at the level or I(1) at a 5 percent critical value except the GARCH(1,1) volatility exchange rate series which is I(0). Detailed results are available upon request.

[9] Our results have shown that the significant results can be found only either at 5 or 10 lags.

regional currencies to the US dollar as existed pre-crisis. Lim (2002) extends the study to cover observations until November 2001 and confirms McKinnon's results[10].

To test the implication of nominal exchange rate volatility of the Asia-5 economies for their respective stock returns (as well as those of each other), we first estimate the volatility rates using the following GARCH (1,1) specification:

$$\ln NER_t = a_0 + a_1 \ln NER_{t-1} + e_t, \text{ where } e_t \sim N(0, h_t) \quad (9)$$

$$h_t = \alpha + \beta e_{t-1}^2 + \gamma h_{t-1} + u_t. \quad (10)$$

The variable (NER) represents the daily nominal exchange rate of the various East Asian currencies against the US dollar. The conditional variance equation (Eq. 10) described above is a function of three terms: (i) the mean, α; (ii) news about volatility from the previous period, measured as the lag of the squared residual from the mean equation, e_{t-1}^2 (the ARCH term); and (iii) last period's forecast error variance, h_{t-1} (the GARCH term). We *do not* include the Malaysian ringgit for the crisis and the post-crisis tests as Malaysia adopted a fixed exchange rate in September 1998 as part of a larger macroeconomic package which included the imposition of capital controls (Athukorala, 2001 and Kaplan and Rodrik, 2001).

We divide the daily observations into three sets. The *pre-crisis*, the *crisis* and the *post-crisis* periods. These periods respectively cover the daily observations from January 1, 1996 to December 31, 1996; January 1, 1998 to December 31, 1998; and from January 1, 2000 to July 1, 2001. By breaking the observation samples into three separate periods according to the economic condition of the country, we avoid potential structural breaks in the

[10] Hernandez and Montiel (2001), who analyse the evidence regarding post-crisis exchange rate policies pursued in the Asia-5 economies, conclude as follows.

> contrary to the views of some observers…there has indeed been a change in *de facto* exchange rate regimes in all five of these countries between the pre- and post-crisis periods. While none of them have adopted "soft pegs" with unfettered capital movements, neither have they moved to the extreme corner solutions of "hard" pegs or clean floats. In other words, all of them have continued to manage their exchange rates in an active manner..and have thus occupied the supposed "hollow middle" of exchange rate policy (p.16).

observation sets. Dungey and Zhumabekova (2001) have argued persuasively that the transition from a non-crisis to crisis period usually involves an alteration in the volatility of the error term, i.e. the assumption of homocedasticity is violated. This problem is even worse when we have "unbalanced sample sets" where for instance we have more non-crisis period observations than the crisis data within one testing sample set.

Table 3 reports the coefficient estimates for β and γ[11]. Partly reflecting the temporary abandonment of the soft US dollar regime, we find that, on average, the volatility rates during the crisis have been significantly higher than those in the pre-crisis and the post-crisis periods. During the peak of the crisis period (January - December 1998), the Indonesian rupiah experienced the most dramatic increase in the rate of volatility, some 350 times higher than during the pre-crisis period (Table 3b). The volatility of the Philippine peso also escalated sharply (230 times the pre-crisis period), as did that of the Thai baht (50 times the pre-crisis period). Even the Singapore dollar and the Korean won, which have been among the relatively more stable regional currencies, experienced 20 and 30 times higher rates of volatility during the crisis period. However, as the economies recovered and reverted to the *de facto* soft US dollar pegged regimes, the volatility rates have been relatively more moderate in 2000-01. Although the post-crisis volatility (January 2000 - July 2001) of the nominal exchange rates has been discernibly higher than during the pre-crisis period, the increase in the volatility rates between these two periods was significantly smaller than those reported between the crisis and pre-crisis periods. The Indonesian rupiah and the Philippine peso continue to experience the most severe volatility during the post-crisis period.

As expected, the test results for the periods of "moderate volatility" (viz. the pre and post-crisis) offer limited evidence that exchange rate volatility has played any significant role in explaining the returns of the listed stocks of the East Asian capital markets (Table 4 and 6). As noted above, stable currencies resulted from the tight exchange rate arrangement adopted during the pre-crisis. This probably explains the limited "causality" between the exchange

[11] For the brevity of the paper, we do not report the volatility figures for each of the nominal exchange rates. However, the results can be made available upon request.

rate and stock returns. As for the post-crisis period, the combination of moderate volatility and the relatively weak market confidence in most of the capital markets in East Asia may rationalize the rather poor Granger-causality test results (Table 6).

In marked contrast, there is strong evidence of the impact of currency volatility on stock market returns during the peak of the crisis as reported in Table 5. With the exception of Singapore stock market index, the performance of all other stock exchange indices was highly influenced by the movements of the regional currencies. The volatility of the Indonesian rupiah and the Korean won are found to be important contributory factors in explaining the returns on the Jakarta stock exchange as well as other capital markets included in the test. The volatile peso was another influential currency, affecting every market except Singapore. Variations in the Thai baht also contributed to the poor performance of the Thailand stock exchange as well as those in the Indonesian and Korean stock markets.

The relatively strong results for the crisis period not only reflect the breakdown of the rigid exchange rate regimes during the crisis period but may also highlight the vulnerabilities of a country due to its *de facto* high degree of market integration with other countries. It is plausible that during the crisis period, the economic performance of one country (as reflected in a commonly available economic indicator like currency value) has a relatively stronger impact on other markets in the region. This may occur for a number of reasons. A weakness in or attack on one currency could lead to a wholesale reassessment of the region's "fundamentals" and the probability of a similar fate befalling regional economies with broadly similar macroeconomic stances (whether *actual* or *perceived*). This information updating is popularly termed the "wake-up call" effect (Ahluwalia, 2000). This phenomenon could also refer to the sudden realization of how little market participants truly understand about the regional economies, leading to a region-wide downgrading/sell-off. Mullainthan (1998) has developed a model in which investors recall past events imperfectly. Accordingly, a new crisis all of a sudden reminds them of previous crises and induces them to reassess the probabilities of an adverse outcome. In related literature, Drazen (1998) has developed a contagion model which is based on economies being in an implicit or explicit

currency/monetary union. Thus, devaluation by one economy acts as a wake up call to investors in the sense that it leads them to question the commitment of other regional economies to maintain "club membership" by not devaluing. Dooley (2000) suggests that the "bunching together" of crises may be due to revisions in the effective size of official lines of credit available to the regional governments to defend the currency (either from international agencies or ad hoc bilateral, multilateral agreements).

3.2 Exchange Rates and Portfolio Flows

As noted, we would ideally have liked to determine the impact of exchange rate volatility on portfolio flows during the three sub-periods. To our knowledge, daily data or weekly data are not available for portfolio flows, hence precluding such a task. Due to a limited number of observations, the empirical tests for this sub-section cannot be divided into pre-and post-crisis period, except in the cases of the Philippines and the Korea (Table 2). For the full period set, we include a crisis dummy in the Granger-causality equation (Eqs. 7 and 8) so as to capture the possible structural changes associated with the break caused by the 1997 crisis[12]. In addition, we estimate two sets of exchange rate variables, viz. the GARCH(1,1) volatility and ΔNEX (quarterly/monthly change in the nominal exchange rate). We do this so as to extract, in a more conclusive manner, the nexus between exchange rate volatility and capital flows[13]. Malaysia is excluded from the analysis given data limitations and the country's adoption of capital controls.

Test results suggest that the volatility of the nominal exchange rate does not Granger-cause fluctuations in portfolio flows for the emerging markets of the Southeast Asia except Indonesia (Table 7). In fact, for Indonesia and Singapore, the causality between portfolio investment and exchange rate runs both ways during the full period of pre- and post-crisis.

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[12] The crisis dummy equals zero up to quarter 1, 1986 to quarter 1, 1997 and one otherwise.

[13] The GARCH(1,1) results are the same as posted in Table 3. For the monthly/quarterly numbers, we just take the daily average for the month or quarter. ΔNEX equals to ($NEX_t - NEX_{t-1}$).

For the post-crisis period, the direction of causality was from Korean won to portfolio investment.

3.3 GDP and Portfolio Investment

A number of studies, such as Ferson and Harvey (1993), Levine and Zervos (1995) and Dickinson (2000) have examined the roles of macroeconomic fundamentals in explaining the performance of stock markets. Wolf (1999) groups the macro-fundamentals into three categories: (a) performance indicators (GDP, exports, investment); (b) the structure indicator of the economy (share of exports in GDP); and (c) risk indicators (ratio of debt to GDP, current account deficit). Given the substantial swings in the GDP growth rate of the crisis-affected economies in East Asia, our empirical test focuses on examining the role of macroeconomic performance (GDP growth) on portfolio investment in the domestic economy.

A few results from Table 8 warrant highlighting. For the more developed economies in East Asia, viz. Korea and Singapore, the change in GDP growth rates Granger-cause portfolio flows in these countries. As for the rest of the Southeast Asian economies, portfolio investment flows Granger-cause GDP growth in Indonesia and Thailand with the t-statistics showing statistical significance at the 5 percent level. For Indonesia, the country's GDP growth rate has also significantly influenced the flow of portfolio capital to the country. This last finding may help explain the drastic fall in the values of portfolio investment as Indonesia experienced a sharp contraction in real economic activity in 1998.

4. Interdependencies Between the Regional Capital Markets

The potential importance of the extent of interdependence of regional equity market has been highlighted in the preceding section. A rumour of vulnerabilities in one of the regional markets may suffice to generate large scale of reallocation of funds away from one region to another. In this section we examine the daily returns of portfolio assets in the Asia-5

economies which are tested against each other to unearth any evidence of causality between them, as well as to estimate the variance decomposition of each forecast error.

4.1 Causality Test

Table 9 to 11 report the Granger-causality tests during the pre-1997 crisis period (January 1, 1995 to December 31, 1996), the height of the crisis period (January 1, 1998 to December 31, 1998) and the post-crisis period (January 1, 2000 to July 1, 2001)[14]. In addition, we also examine the roles of the Hong Kong Hang Seng Index and the US Dow Jones index in influencing the performance of the East Asian markets. We impose up to 10 lags (2 weeks (5 working days per week) and report only the statistically significant results[15]

The test results indicate that relatively limited degrees of integration among the Southeast Asian economies (Indonesia, Malaysia, Philippines, Singapore and Thailand) had already been established during the pre-1997 crisis (Table 9). The returns of each of the Southeast Asian markets influenced the returns of at least two other neighbouring capital markets. The returns of the Indonesian stock exchange are influenced significantly by the performances of the rest of the Southeast Asian stock markets, except Malaysia. Furthermore, the fluctuations in the composite price index of the US Dow Jones and the Hong Kong Hang Seng strongly influenced the Southeast Asian markets during the pre-1997 crisis. These findings are broadly consistent with that of Calvo et. al (1996) who stress the roles of global leaders in the world capital markets. In contrast, we fail to find any evidence of Granger-Causality between the Southeast Asian markets and Korean capital markets.

At the peak of the 1997 East Asian crisis, the results indicate a closer link among the stock market returns of the crisis-affected economies (Table 10). In particular, the performance of Korea Stock Exchange Composite Price Index (KOSPI) was influenced by the returns of the Southeast Asian capital markets (except the Philippines), while reciprocally,

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[14] The capital market return is calculated as the difference of the log of stock exchange index $[\ln(sxi_t) - \ln(sxi_{t-1})]$.

[15] In general, we find that the most significant t-statistics are found at lags = 2, 4 or 6. In fact, no

the returns of listed stocks in the capital market of Korea significantly Granger-caused the returns of two markets in Southeast Asia (Philippines and Thailand) and Hong Kong. More importantly, test results also reveal that the two worst crisis-afflicted stock exchanges, Indonesia and Thailand, had the most widespread spillover effects at the peak of the 1997 crisis. These findings seem to lend more support to the Calvo-Mendoza model. News about one of the East Asian markets had significant repercussions on other neighboring markets during the height of the 1997 crisis. In addition, the Dow Jones remains the most important market for the East Asian capital markets, reflected by the highest set of F-statistics.

The results for the post-crisis period suggest a pointed fall in the degree of regional stock market integration (Table 11). For instance, the returns on the assets listed on the Jakarta (Indonesia) and the Philippines Stock Exchanges had no significant influence on any other regional markets. This may suggest a decoupling of the regional economies and markets during the post-crisis period.

4.2 Variance Decomposition

To appreciate further the degrees of stock market integration among the crisis affected economies, we test the forecast error decomposition of the daily stock exchange returns of the five heavily crisis-affected economies (Indonesia, Thailand, Philippines, Korea and Singapore) during the three different periods as listed above (Table 12-14).

In general, we find the error variance for each of the stock returns is largely explained by its own innovation. In fact, at most only about 30 percent of the variations in each regional stock return can be explained by the returns of other markets during each of the three periods. With the exception of the US dollar for Singapore in all three periods and for Korea during the last period (2000-01), the fluctuations of other stock market returns contributed less than 10 percent of variations in each of the Asia-5 stock returns.

Consistent with the causality results, we find that, on average, the fluctuations in the returns of the regional markets and the US markets impacted one another more during the

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significant results are found at 10 or more lags.

height of the crisis (Table 13) than during the pre-crisis, except for Indonesia and Singapore. Furthermore, the impact of stock returns in Indonesia on the rest of the crisis-affected economies has increased by as much as 2 percent. As for the rest of the markets, we find no consistent trend with regard to their impact on regional capital markets.

Lastly, higher percentage shares of error variances in the five markets are explained by their own innovations during the post crisis period than the pre-crisis period and the height of the crisis period, except for the case of Korea. The results for the post-crisis period confirms our previous conclusion that there has been a pointed fall in the degree of market integration in these economies as reported by the causality test results.

5. Concluding Remarks

Capital volatility causes problems for macroeconomic management. But similarly, macroeconomic policy and performance may influence international capital flows. The nature of the interaction between macroeconomic variables and capital flows is indeed highly complex. This paper sets out to examine one part of it by investigating the empirical relationship between portfolio equity flows, on the one hand, and exchange rate volatility and GDP performance across five Asian economies, on the other. We also examine regional interdependences between the capital markets in the Asia-5 economies.

The paper builds on a theoretical model that suggests that investors may be influenced by aspects of economic policy and performance that are relatively easy to monitor. This is used to justify our choice of the nominal exchange rate and GDP. Because of data constraints we assume that portfolio equity flows will be influenced by stock market returns. The theory also strongly underlines herding behavior in regional financial markets; a rumor in one market may be enough to generate speculative attacks in most regional markets.

Although there are some differences across countries, we find evidence that instability in the nominal exchange rate and GDP performance are associated with stock market returns and portfolio equity flows. Simple Granger causality tests suggest that these measures of economic policy and performance may exert a causal impact on portfolio equity

investment, although in some cases the causal relationship may be two way. One inference is that exchange rate instability and not just expectations of a fall in the value of a currency may negatively impact capital inflows. Moreover, we find that instability in the value of a currency may not only affect the domestic stock market but also the stock markets of regional countries.

Our evidence suggests that, to the extent that governments can influence exchange rates and economic growth, they can also influence portfolio equity flows. The adoption of a more relaxed exchange rate policy at the peak of the 1997 financial crisis clearly resulted in much more severe exchange rate volatilities in all the regional currencies that we tested. In turn, the rise in the degrees of uncertainty in the regional currency markets not only had more significant but also much wider impacts on regional capital markets. Concern that freely floating exchange rates will be unstable and will discourage portfolio equity investment may be another reason why governments in Asia have exhibited a "fear of floating" (Kim, 2000 makes a broadly similar point).

While economic growth rates in East and Southeast Asia was rapid, the regional interdependences among the stock exchange markets were found to be only moderate, with domestic economic and other factors may having more weight in influencing the performance of local stock exchanges. In contrast, the returns in other regional markets became a significant determinant of the returns in local stock markets during the peak of the 1997 financial crisis. Clearly supporting the theoretical model in section 2 of the paper, the empirical results show that the small open economies in the Southeast Asian region have been more susceptible to swings in the stock exchange returns of large markets such as the United States.

Although modest in ambition the paper adds something to our knowledge of capital flows. At a time when capital volatility and the choice of exchange rate regime remain central issues in the context of designing the new international financial architecture (Bird and Rajan, 2002), research that shows linkages between them is of contemporary relevance. Equally important is the observation that the regional interdependences among neighboring markets

heighten during a financial crisis. One caveat should be noted here however. As acknowledged already in the empirical section, with the lack of high frequency data for some of our variables preventing us to group the series and the test into the pre- and post-crisis sets, the power of our quarterly testing may be limited. This, in some cases, may lead to insignificant results that we have discussed in section 3.

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Table 1
Net Capital Flows to East Asia, 1995-2001
(billions of US dollars)

	1995	1996	1997	1998	1999	Proj. 2000	Proj. 2001
Asia-5 Economies[a]:							
Private Capital Flows	53.9	67.4	-15.6	-28.2	2.9	-22.4	10.6
Direct investment	8.8	9.8	9.8	10.3	13.1	9.1	9.0
Portfolio Investment	18.8	25.5	8.4	-8.2	12.8	13.20	3.3
Other Investment Flows	26.3	32.0	-33.8	-30.4	-23.0	-44.6	-1.7
Official Flows	0.7	-6.1	15.7	19.5	-6.7	5.0	-2.1
Reserves[a]	-18.5	-5.6	39.5	-47.0	-38.8	-19.2	-30.6
Other Asian Emerging Economies:							
Private Capital Flows	38.3	52.6	22.3	-12.5	-0.6	4.6	13.0
Direct Investment	39.3	44.4	45.3	49.6	41.1	38.4	38.9
Portfolio Investment	2.6	3.9	-0.1	-7.2	-8.9	-8.0	-0.2
Other Investment Flows	-3.5	4.3	-23.0	-54.8	-32.8	-25.8	-25.8
Official Flows	-3.8	-7.6	-8.3	-1.1	-0.1	-8.1	-4.2
Reserves[b]	-26.2	-43.1	-46.8	-16.9	-20.9	-16.4	-30.8

Notes: a) Asia-5 economies denote Indonesia, Malaysia, Philippines, South Korea and Thailand; b) Minus sign denotes a rise and vice versa
Source: IMF (2001)

Table 2: Descriptions of Variables

Variable	Description	Source
1). Stock Exchange Index	Daily observations for all countries are available from January 1, 1996 – December 31, 2001.	DATASTREAM data base.
2). Portfolio Investment	a). For Philippines and Korea, monthly observations are available from January 1990 – December 2001. b). For Indonesia: quarter 1, 1986 – quarter 4, 2001. For Singapore: quarter 1, 1990 – quarter 4, 2001. For Thailand: quarter 1, 1990 – quarter 4, 2001.	CEIC Data Base, and DATASTREAM data base.
3). Real GDP	Quarterly data for all countries from quarter 1, 1986 to quarter 4, 2001.	The Econometrics Study Unit (ESU), Department of Economics, National University of Singapore
4). Nominal Exchange Rate against the US$	All nominal exchange rates are available in both daily and monthly series. For daily: January 1, 1996 – December 31, 2001. For monthly: January 1986 – December 2001.	Pacific Exchange Rate Data Base for the daily data. International Financial Statistics, CD-Roam for the monthly data.

Table 3: Exchange Rate Volatility Coefficients

$$h_t = \alpha + \beta e_{t-1}^2 + \gamma h_{t-1} + u_t .$$

January 1996 - December 1996	**(ARCH) β**	**(GARCH) γ**
Indonesian rupiah	0.1714 (0.0585)**	
Malaysian ringgit	0.1714 (0.0653)**	
Philippines peso	0.1714 (0.0758)**	
Thailand bath	0.1711 (0.0674)**	
Singapore dollar	0.1668 (0.0629)**	
Korea won	0.1499 (0.0691)**	0.6000 (0.0000)*
January 1998 - December 1998		
Indonesian rupiah	0.0612 (0.0139)*	0.8884 (0.0150)*
Philippines peso	0.1939 (0.0711)*	0.6762 (0.0814)*
Thailand bath	0.2355 (0.0614)*	0.6637 (0.0759)*
Singapore dollar	0.1894 (0.0572)*	0.6657 (0.0868)*
Korea won	0.2001 (0.0579)*	0.7279 (0.0437)*
January 2000 - July 2001		
Indonesian rupiah	0.1269 (0.0240)*	0.7683 (0.0210)*
Philippines peso	0.2479 (0.0209)*	0.6664 (0.0264)*
Thailand bath	0.1655 (0.0538)*	0.6124 (0.1126)*
Singapore dollar	0.0925 (0.0564)**	0.5978 (0.2913)*
Korea won	0.1871 (0.0378)*	0.7283 (0.0459)*

* 5% significant; ** 10% significant; ( ) are the standard errors. With the exception of Thai bath and Malaysian ringgit in 1996---where the series are ARCH(1), the rest of the nominal exchange rate volatilities are GARCH(1,1).

Table 3b: Mean of Conditional Variance

	Jan 1996- Dec 1996	**Jan 1998 - Dec 1998**	**Jan 2000 - July 2001**
Rupiah	0.000008	0.002836	0.000222
Peso	0.0000005	0.000136	0.000086
Baht	0.000005	0.000242	0.000016
Singapore Dollar	0.000004	0.000086	0.000012
Korea Won	0.000009	0.000252	0.000022

Table 4: Exchange Rate Volatility on the Stock Exchange Returns
(Period: January 1, 1996 – December 31, 1996)

Null Hypothesis	**# of Obs (lags)**	**F-statistics (Prob)**
Volatility of Ringgit does not Granger Cause Return of Malaysia Stock	241 (5)	1.9989 (0.0796)
Volatility of Ringgit does not Granger Cause Return of Philippines Stock	241 (5)	2.1034 (0.0659)
Volatility of Ringgit does not Granger Cause Return of Singapore Stock	241 (10)	1.7434 (0.0728)
Volatility of Peso does not Granger Cause Return of Indonesia Stock	241 (5)	1.6706 (0.0892)

Table 5: Exchange Rate Volatility on the Stock Exchange Returns
(Period: January 1, 1998 – December 31, 1998)

Null Hypothesis	**# of Obs (lags)**	**F-statistics (Prob)**
Volatility of Rupiah does not Granger Cause Return of Indonesia Stock	238 (10)	1.6979 (0.0826)
Volatility of Won does not Granger Cause Return of Indonesia Stock	238 (10)	2.7612 (0.0032)
Volatility of Bath does not Granger Cause Return of Indonesia Stock	238 (10)	4.1115 (0.0000)
Volatility of Peso does not Granger Cause Return of Indonesia Stock	238 (10)	1.7218 (0.0773)
Volatility of Rupiah does not Granger Cause Return of Korea Stock	238 (5)	1.9177 (0.0092)
Volatility of Peso does not Granger Cause Return of Korea Stock	238 (5)	2.7387 (0.0199)
Volatility of Bath does not Granger Cause Return of Korea Stock	238 (10)	1.6369 (0.0976)
Volatility of Sing Dollar does not Granger Cause Return of Korea Stock	238 (5)	1.9849 (0.0817)
Volatility of Won does not Granger Cause Return of Korea Stock	238 (5)	1.9380 (0.0888)
Volatility of Rupiah does not Granger Cause Return of Philippines Stock	238 (5)	3.8726 (0.0022)
Volatility of Peso does not Granger Cause Return of Philippines Stock	238 (5)	3.1175 (0.0096)
Volatility of Sing Dollar does not Granger Cause Return of Philippines Stock	238 (5)	2.1227 (0.0636)
Volatility of Won does not Granger Cause Return of Philippines Stock	238 (5)	2.4449 (0.0349)
Volatility of Rupiah does not Granger Cause Return of Thailand Stock	238 (5)	4.5824 (0.0005)
Volatility of Won does not Granger Cause Return of Thailand Stock	238 (5)	3.0768 (0.0104)
Volatility of Peso does not Granger Cause Return of Thailand Stock	238 (10)	1.7023 (0.0816)
Volatility of Bath does not Granger Cause Return of Thailand Stock	238 (10)	2.0774 (0.0274)
Volatility of Sing Dollar does not Granger Cause Return of Thailand Stock	238 (10)	1.6342 (0.0984)
Volatility of Rupiah does not Granger Cause Return of Singapore Stock	238 (5)	5.5977 (0.0000)
Volatility of won does not Granger Cause Return of Singapore Stock	238 (5)	7.2268 (0.0000)

Note: The Malaysian case is excluded due to capital control policy and fixed exchange rate policy adopted in September 1998.

Table 6: Exchange Rate Volatility on the Stock Exchange Returns
(Period: January 1, 2000 – July 1, 2001)

Null Hypothesis	**# of Obs (lags)**	**F-statistics (Prob)**
Volatility of Sing Dollar does not Granger Cause Return of Indonesia Stock	375 (5)	2.4989 (0.0305)
Volatility of Peso does not Granger Cause Return of Philippines Stock	375 (5)	2.9612 (0.0124)
Volatility of Sing dollar does not Granger Cause Return of Thailand Stock	375 (5)	2.0464 (0.0716)
Volatility of Baht does not Granger Cause Return of Thailand Stock	375 (5)	1.9727 (0.0819)
Volatility of Peso dollar does not Granger Cause Return of Thailand Stock	375 (5)	2.6506 (0.0227)
Volatility of Peso does not Granger Cause Return of Korea Stock	375 (5)	2.1642 (0.0575)

Note: The Malaysian case is excluded due to capital control policy and fixed exchange rate policy adopted in September 1998.

Table 7: Exchange Rate and Portfolio Investment (PI)

Null Hypothesis	# of obs (lags)	F-Stat (Prob)
Korea:		
ΔPI does not Granger Cause ΔNEX of won for January 1990 – January 1997	78 (6)	2.752 (0.0682)
ΔNEX of won does not Granger Cause ΔPI for January 1998-January 2001	48 (6)	2.5292 (0.0386)
Volatility of won does not Granger Cause ΔPI for January 1998-January 2001	48 (6)	2.8539 (0.0228)
Indonesia:		
ΔNEX of rupiah does not Granger Cause ΔPI for quarter 1, 1986 - quarter 4, 2001	60 (2)	3.5871 (0.0368) [a]
ΔPI does not Granger Cause ΔNEX of rupiah for quarter 1, 1986 - quarter 4, 2001	60 (2)	48.532 (0.0000) [a]
ΔPI does not Granger Cause Volatility of rupiah for quarter 1,1986-quarter 4,2001	60 (2)	8.2748 (0.0007) [a]
Singapore:		
ΔPI does not Granger Cause ΔNEX of dollar for quarter 1, 1990 - quarter 4, 2001	48 (2)	2.7210 (0.0521) [a]
ΔNEX of dollar does not Granger Cause ΔPI for quarter 1, 1990 – quarter 4, 2001	48 (2)	4.4886 (0.0163) [a]

Note: The Malaysian case is excluded due to capital control policy and fixed exchange rate policy adopted in September 1998. [a]/ crisis dummy is found to be significant.

Table 8: GDP and Portfolio Investment (PI)

Null Hypothesis	# of obs (lags)	F-Stat (Prob)
Indonesia: ΔPI does not Granger Cause ΔGDP for quarter 1,1986 - quarter 4, 2001 ΔGDP does not Granger Cause ΔPI for quarter 1, 1990 – quarter 4, 2001	 64 (2) 64 (2)	 3.7198 (0.0305) [a] 4.1483 (0.0198) [a]
Singapore: ΔGDP does not Granger Cause ΔPI for quarter 1, 1990 – quarter 4, 2001	48 (1)	2.7745 (0.1002) [a]
Thailand: ΔPI does not Granger Cause ΔGDP for quarter 1, 1990 - quarter 4, 2001	48 (1)	4.3676 (0.0427) [a]
Korea: ΔGDP does not Granger Cause ΔPI for quarter 1, 1986 – quarter 4, 2001	64 (2)	7.4580 (0.0006) [a]

[a]/ crisis dummy is found to be significant.

Table 9: Granger-Causality on the Stock Exchange Returns

Period: January 1, 1996 - December 31, 1996

Null Hypothesis	# of Obs (lags)	F-stats (Prob)
Hong Kong does not Granger Cause Indonesia	242 (2)	9.9080 (0.0001)
Hong Kong does not Granger Cause Malaysia	242 (2)	2.5121 (0.0832)
Hong Kong does not Granger Cause Thailand	242 (2)	2.2404 (0.1000)
Indonesia does not Granger Cause Malaysia	242 (2)	2.3579 (0.0968)
Indonesia does not Granger Cause Hong Kong	242 (2)	5.0705 (0.0069)
Malaysia does not Granger Cause Hong Kong	242 (2)	3.4824 (0.0323)
Malaysia does not Granger Cause Singapore	242 (4)	2.1104 (0.0803)
Philippines does not Granger Cause Indonesia	242 (2)	2.3529 (0.0973)
Philippines does not Granger Cause Thailand	242 (2)	6.9427 (0.0018)
Thailand does not Granger Cause Indonesia	242 (2)	4.9711 (0.0077)
Thailand does not Granger Cause Philippines	242 (2)	3.7774 (0.0243)
Singapore does not Granger Cause Indonesia	242 (2)	5.6611 (0.0039)
Singapore does not Granger Cause Malaysia	242 (2)	3.4478 (0.0334)
USA does not Granger Cause Hong Kong	242 (2)	54.515 (0.0000)
USA does not Granger Cause Indonesia	242 (2)	11.081 (0.0000)
USA does not Granger Cause Malaysia	242 (2)	14.956 (0.0000)
USA does not Granger Cause Philippines	242 (2)	7.2885 (0.0000)
USA does not Granger Cause Singapore	242 (2)	20.033 (0.0000)

Table 10: Granger Causality on the Stock Exchange Returns
Period: January 1, 1998 – December 31, 1998

Null Hypothesis	**# of Obs (lags)**	**F-stats (Prob)**
Hong Kong does not Granger Cause Korea	249 (2)	2.9842 (0.0525)
Hong Kong does not Granger Cause Philippines	249 (2)	3.3062 (0.0383)
Indonesia does not Granger Cause Hong Kong	249 (2)	11.388 (0.0000)
Indonesia does not Granger Cause Korea	249 (2)	3.6757 (0.0268)
Indonesia does not Granger Cause Singapore	249 (2)	4.7085 (0.0099)
Indonesia does not Granger Cause Philippines	249 (2)	5.8752 (0.0032)
Indonesia does not Granger Cause Thailand	249 (2)	4.1054 (0.0176)
Indonesia does not Granger Cause USA	249 (2)	5.0108 (0.0074)
Korea does not Granger Cause Philippines	249 (2)	7.7611 (0.0005)
Korea does not Granger Cause Thailand	249 (2)	4.6059 (0.0109)
Korea does not Granger Cause Hong Kong	249 (2)	3.7780 (0.0242)
Philippines does not Granger Cause Hong Kong	249 (2)	10.557 (0.0000)
Philippines does not Granger Cause USA	249 (2)	4.1743 (0.0165)
Philippines does not Granger Cause Singapore	249 (2)	6.1567 (0.0025)
Thailand does not Granger Cause Hong Kong	249 (2)	8.4097 (0.0003)
Thailand does not Granger Cause Korea	249 (2)	2.6809 (0.0705)
Thailand does not Granger Cause Philippines	249 (2)	3.4172 (0.0344)
Thailand does not Granger Cause Singapore	249 (2)	2.8589 (0.0593)
Thailand does not Granger Cause USA	249 (2)	3.1102 (0.0464)
Singapore does not Granger Cause Korea	249 (2)	4.1467 (0.0169)
Singapore does not Granger Cause Philippines	249 (2)	2.3565 (0.0969)
USA does not Granger Cause Hong Kong	249 (2)	9.6092 (0.0000)
USA does not Granger Cause Indonesia	249 (2)	3.1401 (0.0451)
USA does not Granger Cause Korea	249 (2)	3.6214 (0.0282)
USA does not Granger Cause Philippines	249 (2)	10.070 (0.0000)
USA does not Granger Cause Thailand	249 (2)	10.026 (0.0000)
USA does not Granger Cause Singapore	249 (2)	3.2541 (0.0403)

Note: The Malaysian case is excluded due to capital control policy and fixed exchange rate policy adopted in September 1998.

Table 11: Granger-Causality Test on the Stock Exchange Returns

(Period: January 1, 2000 – July 1, 2001)

Null Hypothesis	**# of Obs (lags)**	**F-statistics (Prob)**
Hong Kong does not Granger Cause Singapore	388 (2)	3.4139 (0.0339)
Korea does Granger Cause Philippines	388 (2)	7.0784 (0.0009)
Korea does Granger Cause Thailand	388 (2)	4.3598 (0.0135)
Singapore does Granger Cause Philippines	388 (2)	3.2728 (0.0390)
Singapore does Granger Cause Indonesia	388 (2)	2.6593 (0.0714)
Thailand does Granger Cause Philippines	388 (2)	4.3080 (0.0132)
Thailand does Granger Cause Indonesia	388 (2)	2.7565 (0.0648)
USA does Granger Cause Hong Kong	388 (2)	53.262 (0.0000)
USA does Granger Cause Korea	388 (2)	24.342 (0.0000)
USA does Granger Cause Philippines	388 (2)	6.0886 (0.0025)
USA does Granger Cause Singapore	388 (2)	31.812 (0.0000)
USA does Granger Cause Thailand	388 (2)	7.9173 (0.0004)

Note: The Malaysian case is excluded due to capital control policy and fixed exchange rate policy adopted in September 1998.

Table 12: Variance Decomposition
(Daily Observations from January 1, 199 to December 31, 1996)

Indonesia:

Period	Indonesia	USA	Singapore	Hong Kong	Thailand	Philippines	Korea
1	100	0	0	0	0	0	0
5	75.08	7.21	3.67	8.05	2.66	3.03	0.31
10	69.54	6.92	5.32	7.58	3.10	6.91	0.63

Thailand:

Period	Thailand	USA	Singapore	Hong Kong	Indonesia	Philippines	Korea
1	100	0	0	0	0	0	0
5	88.41	0.69	1.54	0.62	1.95	6.45	0.34
10	77.69	1.51	1.63	1.98	3.86	9.94	3.37

Philippines:

Period	Philippines	USA	Singapore	Hong Kong	Indonesia	Thailand	Korea
1	100	0	0	0	0	0	0
5	85.06	3.68	3.28	0.48	0.77	4.28	2.45
10	75.36	4.22	3.06	4.51	2.89	6.71	3.28

Korea:

Period	Korea	USA	Singapore	Hong Kong	Indonesia	Thailand	Philippines
1	100	0	0	0	0	0	0
5	89.99	1.67	1.94	0.13	3.83	1.03	1.41
10	82.49	3.49	2.67	0.99	4.11	3.56	2.89

Singapore:

Period	Singapore	USA	Hong Kong	Indonesia	Thailand	Philippines	Korea
1	100	0	0	0	0	0	0
5	75.61	17.07	0.39	0.73	1.97	0.52	3.71
10	67.32	16.46	2.64	3.35	2.54	2.87	4.83

Table 13: Variance Decomposition

(Daily Observations from January 1, 1998 to December 31, 1998)

Indonesia:

Period	Indonesia	USA	Singapore	Hong Kong	Thailand	Philippines	Korea
1	100	0	0	0	0	0	0
5	86.08	2.94	1.31	4.83	0.61	1.06	3.17
10	77.61	3.69	2.48	5.35	6.31	1.59	2.96

Thailand:

Period	Thailand	USA	Singapore	Hong Kong	Indonesia	Philippines	Korea
1	100	0	0	0	0	0	0
5	81.17	6.09	0.71	0.82	3.02	3.73	4.47
10	72.87	8.22	1.51	2.03	5.93	4.02	5.43

Philippines:

Period	Philippines	USA	Singapore	Hong Kong	Indonesia	Thailand	Korea
1	100	0	0	0	0	0	0
5	78.06	8.97	2.82	2.89	2.46	1.56	3.24
10	68.96	8.81	3.66	3.69	3.12	4.65	7.10

Korea:

Period	Korea	USA	Singapore	Hong Kong	Indonesia	Thailand	Philippines
1	100	0	0	0	0	0	0
5	83.87	3.78	6.18	1.54	3.33	0.76	0.54
10	75.26	5.45	7.68	3.57	4.85	2.18	1.03

Singapore:

Period	Singapore	USA	Hong Kong	Indonesia	Thailand	Philippines	Korea
1	100	0	0	0	0	0	0
5	79.78	8.64	0.67	2.81	1.93	3.85	2.32
10	73.13	10.07	2.09	3.94	4.12	3.72	2.92

Table 14: Variance Decomposition

(Daily Observations from January 1, 2000 to July 1, 2001)

Indonesia:

Period	Indonesia	USA	Singapore	Hong Kong	Thailand	Philippines	Korea
1	100	0	0	0	0	0	0
5	92.80	1.54	2.61	0.59	1.11	0.95	0.39
10	85.99	2.21	3.16	0.94	3.93	1.51	1.48

Thailand:

Period	Thailand	USA	Singapore	Hong Kong	Indonesia	Philippines	Korea
1	100	0	0	0	0	0	0
5	89.51	4.34	1.23	0.87	0.74	0.90	2.41
10	81.59	4.81	3.98	3.49	2.07	1.82	2.24

Philippines:

Period	Philippines	USA	Singapore	Hong Kong	Indonesia	Thailand	Korea
1	100	0	0	0	0	0	0
5	89.56	3.63	0.29	1.11	1.42	1.84	2.13
10	81.89	3.71	1.35	1.60	1.54	7.09	2.83

Korea:

Period	Korea	USA	Singapore	Hong Kong	Indonesia	Thailand	Philippines
1	100	0	0	0	0	0	0
5	82.97	11.06	1.12	0.31	0.52	3.61	0.41
10	77.27	10.29	2.48	0.76	1.31	5.42	2.47

Singapore:

Period	Singapore	USA	Hong Kong	Indonesia	Thailand	Philippines	Korea
1	100	0	0	0	0	0	0
5	79.87	16.00	1.21	0.47	2.02	0.27	0.12
10	74.27	15.86	1.69	1.28	4.56	1.39	0.93

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