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Dynamic Capital Mobility, Capital Market Risk, and Exchange Rate Misalignment

Evidence from Seven Asian Countries

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This study of recent instability in seven Asian countries — Hong Kong, Indonesia, the Republic of Korea, Malaysia, the Philippines, Singapore, and Thailand — finds that capital mobility increased in six of the countries. Capital market risk increased the most in Thailand. And except in Singapore, the countries' currency (relative to the yen) was overvalued, largely because their interest rates differed from Japan's.

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Summary findings

The Asian financial crisis of 1997, which started as an apparently limited shake-up in remote Thailand, became a crisis whose impact has affected stock markets worldwide. To explore the causes and policy implications of Asia's financial crises, Min investigates dynamic capital mobility, time-varying capital market risk, and exchange-rate misalignment in seven Asian countries (Hong Kong, Indonesia, the Republic of Korea, Malaysia, the Philippines, Singapore, and Thailand), relative to Japan.

Building on recent theoretical literature, Min empirically estimates dynamic capital mobility in the seven countries, using deviations from uncovered interest parity. He finds that capital mobility increased in six countries in the 1990s.

Using a GARCH model, Min estimates capital market risk in the Asian countries. He finds that volatility has increased the most in Thailand. Causality test results may provide evidence of contagion in Indonesia, the Republic of Korea, and Malaysia, which experienced little increase in capital risk before 1997.

Using the concept of interest parity forward rate, Min estimates exchange rate misalignment relative to the Japanese yen for the seven countries.

He finds that before the crisis, all seven countries' currencies were overvalued 30 to 40 percent against the yen. They can improve their currencies' valuation by increasing the weight of the Japanese yen in a multiple basket or by revising their exchange rate system to reflect the relative fundamentals in the two countries.

As financial markets become more integrated, problems with capital mobility, capital market risk, and exchange rate misalignment may worsen conditions in the world economy.

This paper — a product of Finance, Development Research Group — is part of a larger effort in the group to study capital market integration and international transmission of financial crises in emerging economies. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Kari Labrie, room MC3-459, telephone 202-473-1001, fax 202-522-1155, Internet address klabrie@worldbank.org. The author may be contacted at hmin@worldbank.org. December 1998. (51 pages)

Dynamic Capital Mobility, Capital Market Risk and Exchange Rate Misalignment: Evidence from Seven Asian Countries

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I. Introduction

The Asian financial crisis of 1997 started as an apparently limited shaking in remote Thailand, but then amplified into a crisis whose impact was felt in stock markets on every continent. Both international institutions and national governments joined in the policy response (Obstfeld, 1998). The sources of these large repercussions may include increased capital mobility, capital market risk and volatility of exchange rates.

This paper investigates the dynamic capital mobility, time-varying capital market risk and exchange rate misalignment of seven Asian countries with special reference to Japan, in an attempt to find the causes and policy implications of financial crisis in east Asia.

The question of international capital mobility and financial crisis has attracted much recent attention from both researchers and policymakers. A high degree of capital mobility not only affects the independence of domestic monetary and fiscal policies, it also increases the intricacy of managing a county's saving and investment problems. The issue is of particular interest to Asia-Pacific countries, many of whom embarked upon large scale financial market liberalization in the early 1980s. In Japan and Korea, as well as ASEAN countries such as Thailand and Malaysia, the removal of various capital and exchange controls coincided with a higher degree of capital mobility, overborrowing, increased capital market risk and financial crises. A study of dynamic capital mobility can serve many useful purposes. First, even in the absence of capital and exchange rate controls, there are periods when capital flows are more smooth than others. Second, from a policy perspective, it is rewarding to know whether capital markets have indeed become more closely linked across other countries. Increased capital mobility not only reflects the influence of various liberalization measures taken in each country, but also provides obvious suggestions about management of the exchange rate. The tremendous problems faced with Asian crisis countries point to the policy dilemma in financially open economies.

More specifically, this paper deals with issues of capital mobility between seven Asian countries and Japan by estimating the dynamic capital mobility of those countries using the deviation from uncovered interest parity. Second, we estimate capital market risk or volatility using a GARCH model of conditional heteroscedasticity. Finally, we investigate the misalignment of Asian countries' exchange rate vis-a-vis the Japanese yen using the concept of *interest parity forward rate* defined in chapter II.

This paper is organized as follows: Section II provides the dynamic capital mobility of seven Asian countries. Section III estimates the time-varying capital market risk of these countries using a GARCH model. Section IV investigates the misalignment of Asian countries' exchange rate vis-a-vis the Japanese yen and section V concludes.

II. Dynamic Capital Mobility in Seven Asian Countries

Recently, some estimates of dynamic capital mobility are reported in the literature for developed economies using simple interest rate differential or the deviation from uncovered interest parity. However, little effort has been made to estimate dynamic capital mobility for emerging economies with the exception of Faruqee (1991). This paper estimate the dynamic capital mobility of seven Asian countries by estimating the deviations from uncovered interest parity (UIP) and using Japanese LIBOR as a benchmark interest rate. Table 1 and 2 show that Asian countries' economic dependence on Japan is larger than on the U.S. in terms of trade volumes and long-term capital flows. For the trade volumes (addition of export and import), four countries' trade volume in with Japan is much larger than U.S for the 1990-1996.

Table 2 compares currency composition of long-term debt of four Asian countries with five Latin American countries. With the exception of Malaysia in 1991 and 1995, during the period of 1991-1995, the remaining Asian countries depended on Japan as a long-term capital supplier more than the U.S., while the U.S. played dominant role in supplying capital to Latin American countries.

1. Economic Interdependence of Pacific Asian countries with Japan

It has been extensively studied whether Pacific Asia's development has increased regional economic interdependence through trade flows (Frankel 1992; Frankel and Wei 1994) and capital flows (Kohsaka 1996). Koshaka (1996) investigated the role of Japan as a major capital supplier as well as a financial intermediary in Pacific Asia and he estimated that Japan's total long-term capital outflow reached its peak of $192 billion in 1989. Table 3 compares the contemporaneous correlation of market interest rates between seven Asian countries and the U.S. and Japan for the 1990s. Correlation coefficients for Japan are larger than those for the of U.S both in levels and first differences, except Singapore. This suggests that six Asian countries have more integrated capital market with Japan.

Table 4 shows Granger-causality tests of Asian countries' market interest rate (IFS line 60c) with Japan LIBOR and U.S. commercial paper rate (IFS line 60bc). With Japanese LIBOR, three sets of countries are bi-directionally Granger causing (Japan and Korea, Singapore and Korea, Indonesia and Malaysia) and Japan is Granger causing Korea's interest rate unidirectionally. While with U.S.CP rate, two sets of countries (Indonesia and Malaysia , Indonesia and Thailand) are mutually Granger causing for their interest rates and U.S. is Granger causing Thailand. For both cases, one salient common feature is that Indonesia and Malaysia is mutually Granger causing each other implying close financial interdependence of two countries. However, there is little evidence that interest rates of Asian countries are highly integrated differently from advanced countries.

2. Interest Parity and International Capital Mobility

Feldstein and Horioka (1980) argued that, building on a close link between domestic saving and investment, international capital might not as mobile as is often assumed. Since then , that line of research has evolved into two directions. One uses the Feldstein-Horioka criterion, investigating the link between domestic savings and investment (Cumby 1987: Krol 1996), and the other investigates the parity between domestic and foreign interest rates (Kuen and Song, 1996). To equate a zero correlation between domestic saving and investment with perfect capital mobility, a number of conditions must hold. Not only must the real interest parity be satisfied but also investment behavior need to respond in a particular way to interest changes but these two requirements can not be easily met (Frankel 1991; Obstfeld 1994).

Also, it is obvious that heavily indebted small countries will not be able to go on raising international indebtedness indefinitely at a fixed interest rate, not even in the lender's currency. The reason is that country risk will rise as pressures mount to return to a sustainable path of borrowing. (Furstenberg, 1998).

Regarding tests for interest rate parity, opinions differ on the proper measure to be used. Of the two commonly used parity concepts, covered interest parity (CIP) is often believed to be a better measure of financial openness than uncovered interest parity (UIP). Deviations from CIP indicate that there are some risk-free arbitrage opportunities that might have arisen from capital and exchange controls, differential tax treatments for capital returns in different countries, the possibility of future controls and regulations, and other country-specific transaction costs such as differences in language and business practices. These are generally considered barriers to capital movement in a generic sense (Kuen and Song, 1996).

However, while the relevance of UIP as a measure of capital mobility is limited in static analysis, it may provide more telling indications a dynamic setting. Here, changes in the extent of deviation from UIP do provide some information about changing capital mobility. As capital markets become more integrated, one possible consequence is that assets denominated in different currencies become more substitutable. This will decrease the risk-premium and reduce the uncovered interest differential. In other words, an increased tightening of uncovered interest differentials over time could be associated with an increased level of capital mobility.

Faruquee (1992) applied this argument in his study of dynamic capital mobility in four Asian economies. He investigated the differential between the LIBOR rate on yen deposits and domestic interest rates and fitted a ARCH structure to these differentials. The size of the differential bands in these countries was used to illustrate the dynamic changes of capital mobility in these countries. A smaller band is said to reflect more financial openness.

3. The Model.

I start from covered interest parity (CIP) hypothesis, which follows the assumption of arbitrage between spot and forward foreign exchange markets. If the conditions for risk-free arbitrage exist, the ratio of the forward to the spot exchange rate will equal to the interest differential between assets. CIP can be expressed in following way:

(1) $$F_{t,t+1} / S_t = I_{t,,1} / I^*_{t,,1}$$

where S_t is the price of foreign currency in units of domestic currency at time t, $F_{t,t+1}$ is the forward value of S for a contract expiring 1 period in the future, $I_{t,,1}$ is one period ahead interest rate on domestic bond, and $I^*_{t,,1}$ is the corresponding interest rate on the foreign bond. Taking the logarithm of equation (1) yields equation (2).

(2) $$f_{t,t+1} - s_t = i_{t,,1} - i^*_{t,,1}$$

where logarithms are denoted by lower-case letters.

Equation (2) is a risk-free arbitrage condition that holds independently from the investor's preferences. However, if investors are risk averse, the forward rate can differ from the expected future spot rate by a premium that compensates them for the perceived riskiness of holding domestic versus foreign assets.

(3) $$\Delta s^e_{t,t+1} = (i_{t,,1} - i^*_{t,,1}) - r_{t,,t+1}$$

When risk premium ($r_{t,,t+1}$) is zero, equation (3) defines UIP, i.e., the change in the expected exchange rate ($\Delta s^e_{t,t+1}$) equals the current interest differential. Equation (3) is generally tested jointly with the hypothesis of rational expectations in foreign exchange markets. In this case, future realization of S will equal its expected value at time t plus a white-noise error term that is uncorrelated with all information known at time t.

(4) $$s_{t+1} = s^r_{t,t+1} + \varepsilon_{t,t+1}$$

where, $s^r_{t,t+1}$ is the rational expectation of the exchange rate at time t+1 formed in time t. Plugging equation (4) into equation (3) yields equation (5).

(5) $$\Delta s_{t,t+1} = (i_{t,,1} - i^*_{t,,1}) - r_{t,,t+1} + \varepsilon_{t,t+1}$$

where the left side of equation (5) is the realized change in the exchange rate from t to t+1. The joint hypothesis of UIP and rational expectations is tested via the following regression equation:

(6) $\Delta\ s_{t,t+1} = a + b(i_{t,,1} - i^*_{t,1}) + \eta_{t,t+1}$

Under the assumption that the composite error term, $\eta_{t,t+1}$, which consists of both risk premia and expectational errors, is orthogonal to the interest differential, the estimated slope parameter in equation (6) should be unity which is generally referred to as the "unbiasedness hypothesis" in tests of UIP (Meredith and Chinn, 1998).

To operationalize the model, the uncovered interest parity (UIP) and ex ante PPP conditions are modeled in following way (Moosa 1997: Bhati and Moosa 1994, 1995). The UIP hypothesis postulates that in the presence of perfect capital mobility with no capital controls, transaction costs or risk premia, the expected rate of change of the spot exchange rate will equal to the nominal interest differential on perfectly comparable financial assets denominated in different currencies across countries. This condition is given by

(7) $(1 + I_t) = (1 + \Delta S^e_t)(1 + I^*_t)$,

where ΔS^e_t is the expected rate of change of the spot exchange rate. The alternative specification is derived by solving equation (7) for the expected spot exchange rate S^e to obtain

(8) $S^e = F^*$,

where $F^* = S[(1+I)/(1+I^*)]$ is the interest parity forward rate which is equal to the forward exchange rate, F, if and only if the CIP holds. Taking logarithms in equation (8), we obtain equation (9)

$$(9)\quad s^e_{t+1} = f^*_t,$$

where s^e_t is the logarithm of the expected spot rate and f^*_t is the logarithm of the interest parity forward rate. By allowing for the behavior of the risk premium and incorporating the rational expectations hypothesis the model can be written in a testable form as

$$(10)\quad s_{t+1} = \beta_0 + \beta_1 f^*_t + \omega_{t+1}$$

where ω_{t+1} is an error term reflecting the impact of news, and β_0 is a constant term reflecting the value of risk premium as well as other factors such as transaction cost. The UIP holds in strong form if $\beta_0 = 0$ and $\beta_1 = 1$ are not rejected. Assuming that this condition holds, equation (10) becomes

$$(11)\quad s_{t+1} = f^*_t + \omega_{t+1}$$

However, when capital is not perfectly mobile because of the capital and foreign exchange control, UIP will not hold as in the case of Pacific Asian developing countries. The deviation from UIP (DUIP) can be written as

$$(12)\quad DUIP_t = s_{t+1} - f^*_t + \xi_{t+1}$$

where, $DUIP_t$ is a deviation from UIP and this value will vary over time and it can be used as a measure of dynamic capital mobility. The larger is the deviation from UIP the higher is capital or foreign exchange control in that country, and the lower is capital mobility. The assumption of UIP adds an element of dynamics to the CIP condition by hypothesizing a relationship between the observed values of variables at time t and the value of the spot exchange rate that market participants expect at time t to prevail at time t+1. As such, UIP has been embedded in many multi-period and continuous time models of open economies.

4. Estimation of Dynamic Capital Mobility

A. Data

For the seven Asian countries, dynamic capital mobility has been estimated with reference to Japan using the London inter-bank offer rate (LIBOR) on 3 month Japanese deposits (IFS line 60ea). For six of the Asian countries, market interest rates (IFS line 60b) are used, while the treasury bill rate (IFS line 60c) is used for the Philippine due to data avaiability. To get the nominal Japanese yen exchange rate for the other seven Asian countries, their U.S. dollar exchange rates (IFS line ae) are converted using the U.S. dollar exchange rate of Japanese yen (IFS line 158..ae). In light of the large liberalization process and possible consequent structural changes in financial structure in each country during the 1980s, monthly data from 1990 January to March 1998 are used for the estimation and all data are extracted August 1998 issue of IMF's IFS CD-Rom.

B. Test of Unit Roots

Before estimation, we tested the stationarity or non-stationarity of each time series using Augmented Dickey-Fuller tests. Test results are reported in Table 5. From Table 5, we find that, for most of time series, based on ADF_τ and ADF_z statistics, we can not reject the null hypothesis that each series has a unit root. The exceptions are market interest rates and exchange rates for Hong Kong. In other words, all other time series are non-stationary. However, for the test of second unit roots, we can reject the null hypothesis that first difference of each time series has a unit root with the exception of the deviation from UIP (ADF_τ) for Indonesia and the nominal exchange rate of Indonesia (ADF_τ and ADF_z).

C. Estimation

First of all, models for seven countries are identified based on various statistics including the Akaike information criterion and the Schwarz baysian criterion for the estimation of capital mobility ($DUIP_t$).

Table 6 shows the summary statistics for the identification of an ARIMA model. Third column shows the identified ARIMA(p,i,q) process where i denotes the degrees of integration. The fourth column show the Akaike information criterion (AIC) and the Schwarz Baysian criterion (SBC) for the model selection. The fifth column shows the probability of significance of the Ljung-Box Q statistic which is uded to test a group of autocorrelations. The estimation results show that there is no autocorrelation in the systems. The last column of table 6 displays the existence of GARCH error test using the Lagrangian Multiplier test for each model and we can conclude that each country have GARCH error structure [for Hong Kong ARCH(1) error structure is identified].

Models are estimated using the Box-Jenkins procedure and the estimation results are reported in Table 7. Standard errors are reported in parentheses and we can see from the table 7 that most of the estimated coefficients are highly significant and all diagnostic statistics are reasonable.

Finally, the estimated dynamic capital mobility of seven Asian countries are presented in Figure 1. Except Korea, all six Asian countries' dynamic capital mobility increased in 1990s, although with different volatilities. The one exception, the estimates of decreasing capital mobility of Korea with Japan (increasing DUIP until 1995) by the end of 1995 can be explained by the relative importance of U.S. economy with of Korea[1]. If we compare the trade volume of Korea with Japan and the U.S., we can find that Korea has a larger trade volume with the U.S. than Japan and increased deviation from UIP during the crisis period was attributable to high interest differentials with Japan (Indonesia shows the same tendency during the crisis). The capital mobility of Hong Kong has dramatically increased during early 1990's and changed little for the next couple of years. However, with financial crisis in 1997, capital mobility decreased (deviation from UIP increased) substantially because of the increased interest rate differentials with Japan (see Figure 4).

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1 The share of Japanese yen receipts and payments in current transactions of Korea to total foreign receipts and payments decreased to 10.8% in 1995, compared to the 11.3 % in 1992. However, that of U.S has increased from 81.4% in 1992 to 82.1% in 1995. The absolute share of U.S. dollar is also significantly larger than Japanese yen for Korea during the early 1990s.

The dynamic capital mobility of Indonesia increased slowly up to the financial crisis. With the crisis, Indonesia's capital mobility (deviation from UIP increased) decreased substantially owing to the large interest differential with Japan. The dynamic capital mobility of Philippines increased through out the 1990s with some volatility.

From Figure 1, we can see that capital mobility increased steadily. Also, this was true even during the crisis period of 1997 and early 1998. Dynamic capital mobility in Malaysia increased during the 1990s at a relatively steady rate out of seven Asian countries although there was a marginal decrease after the 1997 crisis. For Singapore, capital mobility increased throughout the period which is consistent with the findings of Kuen and Song (1997). For Thailand, capital mobility also increased throughout the 1990s steadily with the most volatility.

In this section, we examined dynamic changes in the degree of international capital mobility for the seven Asian countries with Japan. Our concern was not so much with financial openness of Asian countries, but with the changes over time. For most of the countries, deviations from uncovered interest parity declined over the 1990s, implying that capital was indeed become increasingly mobile.

The most significant increase in capital mobility was identified for Thailand and the Philippines, and the financial crisis started in Thailand in 1997. The increased capital mobility in Asian emerging economies suggests that central banks' ability to conduct independent domestic monetary operations will be severely hampered. Table 8 shows multiple Granger causality tests of dynamic capital mobility in Asian countries. From Table 8, we can see that capital mobility of Asian countries are most significantly affected by Singapore.

III. Capital Market Risk in Seven Asian Countries

For capital mobility to be useful, it must contribute to welfare consequences. In this section, we connect the concept of dynamic capital mobility with capital market risk as measured by conditional heteroscedasticity. Conditional heteroscedasticity has been used as a measurement of risk in various studies [Domowitz and Hakkio, 1985: Hassapis, 1995: Malliaropulos: 1997]. Both country and currency risk are often defined relative to an international reference country or currency, with the differential country risk of the others allowed to include actuarial compensation for losses expected from political instability, payments delays, and partial expropriation or default (Furstenberg, 1988).

This section specifies and estimates a model of time-varying systematic risk in deviations from uncovered interest parity in international capital market. Following Bollerslev (1990) and Bailie and Bollerslev (1990), a particular parameterization of the multivariate GARCH process is employed to model the conditional variance of covariance matrix of unforecastable components of deviations from UIP. The empirical results indicate substantial conditional systemic risk for all Asian countries and this time-varying risk can be explained by both fluctuations in interest rate differentials and interest parity forward rates.

1. GARCH Model

Next, we turn to the model determining the conditional second moments of innovations to UIP. A considerable amount of empirical evidence suggests that deviations from UIP are characterized by ARCH effects [Cumby and Obstfeld, 1984: Domowitz and Hakkio, 1985: Diebold and Pauly, 1988]. Since we did not specify a full equilibrium model of the economy, it is impossible to relate the conditional covariance matrix to those innovations to a set of structural variables. Thus, the linear GARCH model is a good candidate for modeling the time-dependence of conditional second moments. In order to ensure positive definiteness, the parameterization of the multivariate GARCH model proposed by Bollerslev (1990) and Bailie and Bollerslev (1990) is adopted. Bringing equation (12), GARCH (1,1) can be specified in following way.

(12) $DUIP_t = s_{t+1} - f^*_t + \xi_{t+1}$

(13) $\xi_t \sim N(0, h_t)$

(14) $h_t = \phi_1 + \phi_2 \varepsilon^2_{t-1} + h_{t-1}$

where h_t is the conditional second moment.

2. Maximum Likelihood Estimation

Using Lagrangian multiflier (LM) test, we test for the existence of a GARCH or an ARCH error structure is tested. Results appear in the last column of table 6. shows the test statistics. The LM test statistic has a chi-squared distribution with degrees of freedom equal to the number of restrictions. We find that, except Hong Kong which has an ARCH(1) error structure, the six countries have GARCH error structures. Note that the order of the GARCH is based on well established selection criteria, such as the Akaike or Schwarz information criteria, which suggest that a GARCH (1,1) variance is sufficient to capture the dynamics of the conditional variance. This also means that there is no need to employ a higher order GARCH model since the simple GARCH (1,1) seems to be an adequate representation of the stochastic process that gives rise to the observed data. Maximum Likelihood estimation of the GARCH model is reported in table 9.

For the maximum likelihood estimation, the BFGS (Broyden, Fletcher, Goldfeld and Shanno) method is used. Table 9 shows that except some constants, most of the estimated coefficients are highly significant.

3. Capital Market Risk of Seven Asian Countries

Using the GARCH model estimates, the conditional heteroscedasticity of deviations from UIP of seven Asian countries are displayed in Figure 2. We can see that the estimated time-varying conditional heteroscedasticity captures capital market risk for the seven Asian countries quite well, especially during the recent financial crisis period. Table 2 shows that conditional heteroscedasticity of all seven Asian countries jumps to extremely high levels reflecting increased capital market risk and capital outflow in those countries. Hence, figure 2 shows the successful estimation of capital market risks in seven Asian countries, especially for the recent financial crisis in this area.

Capital market risk measured by conditional heteroscedasticity is highest in Indonesia. Hong Kong shows the lowest capital market risk during the period. Before the financial crisis of 1997, we can not find signs of a substantial increase in capital market risk in Hong Kong, Indonesia, Malaysia and Korea. However, both the Philippines and Thailand have displayed increasing capital market risk before the crisis .

A sudden increase in capital market risk in 1997 with little volatility during the previous period can be found in Korea, Malaysia and Indonesia. This indicates that these countries may be affected by Thailand's capital market risk and it is confirmed by multiple Granger causality test in Table 10. This test results may serve as an evidence of contagion. Table 10 shows the probability of significance of multiple Granger causality test of capital market risk among seven Asian countries.

Those tests confirm that Asian financial crisis started in Thailand since no other Asian countries Granger caused movements in the capital market risk of Thailand. While capital market risk in Thailand Granger-caused movements in Korea and Indonesia.

IV. Exchange Rates Misalignments of Asian Countries with Japanese yen

Using the concept of interest parity forward rate defined in Chapter II, we estimated nominal exchange rate misalignments of seven Asian countries against the Japanese yen.

First of all, the exchange rate systems of Asian seven countries before the crisis are explained. Second, the exchange rates behavior of the seven Asian countries' currencies against the yen and the dollar are discussed. Finally, misalignments of the nominal exchange rate with the yen are investigated.

1. Exchange Rate System of Seven Asian Countries before the Crisis

The Philippines accepted Article VIII of the IMF on September 1995, and Philippine Peso exchange rates are now determined on the basis of demand and supply in foreign exchange market (IMF, 1997). However, Banco Sentral ng Pilipinas (BSP) intervenes when necessary to limit sharp fluctuations in the exchange rate and to maintain orderly conditions in the market. Commercial banks trade in foreign exchange through the Philippine Dealing System (PDS), an electronic screen based network. The exchange rate of the Peso vis-à-vis the U.S. dollar at the beginning of the day is the weighted average of all transactions in the PSD during the preceding day.

The Hong Kong dollar is linked to the U.S. dollar, the intervention currency, at the rate of HK$ 7.80 per US$ 1. Under this linked exchange rate arrangement, the 3 note-issuing banks must deliver to the Exchange Fund an amount in US dollars that is equivalent to the local currency issued at the linked local exchange rate as backing for their Hong Kong dollar note issues. The Exchange Fund, in turn, issues to each note-issuing bank non-interest bearing certificates of indebtedness denominated in Hong Kong dollars. The exchange rate of the Hong Kong dollar is set in the exchange market at freely negotiated rates for transactions except those that are conducted for non-issuing purposes between the Exchange Fund and the note-issuing banks. No exchange control requirements are imposed on capital receipts or payments by residents or nonresidents.

Indonesia accepted Article VIII of the IMF in 1988 and its exchange rate is determined by Bank Indonesia (BI) under a system of managed float, under which the bank announces a daily "conversion rate band" (for official transactions with foreign exchange banks, government, as well as with supranational institutions), and an "intervention band" consisting of buying and selling rates that are computed on the basis of a basket of currencies. The conversion rates are set so that the buying and selling rates are within 2% of the previous day's closing spot market rate. The spread of the intervention band was increased on June 13, 1996, to Rp 118 (5%) from Rp 192 (approximately 8%) on September 10, 1996. The U.S. dollar is the intervention currency (IMF, 1997).

The exchange rate of Korean won against the U.S. dollar is determined on the basis of a weighted average of interbank rates for the won-dollar spot transactions of the previous day. During each business day, the won rate against the dollar in the interbank market is allowed to fluctuate within margins of +(-) 2.25% against the market average rate of the previous day (Bank of Korea, 1995).

The price of Malaysian ringgit is determined by supply and demand. The Bank of Negara Malaysia (BNM) intervenes only to maintain orderly market conditions and to avoid excessive fluctuations in the value of ringgit. The BNM also monitors the exchange rate against a weighted basket of currencies of Malaysia's major trading partners and the currencies of settlement. The commercial banks are free to determine and quote exchange rates, whether spot or forward, to all customers for all currencies other than those of Israel and Federal Republic of Yugoslavia (Serbia/Montenegro).

The exchange rate of Singapore dollar is determined freely in the foreign exchange market. However, the Monetary Authority of Singapore (MAS) monitors the external value of the Singapore dollar against a trade weighted basket of currencies. There are no controls on capital and money market instruments, derivatives and other instruments, and direct investment for capital transactions.

The external value of the Thailand baht is determined on the basis of an undisclosed, weighted basket of currencies of Thailand's major trading partners. For capital transactions, the sale or issue of securities is under the jurisdiction of the Securities Exchange Commission (SEC). Under the securities law, the same rules and regulations apply to both capital market securities (those with maturities over i years) and short-term money market securities (those debt securities with maturities of not more than one year). Foreign issuers must comply with the same rules and regulations as local issuers. Under those regulations, any companies wishing to issue securities to the public need to be approved by the SEC and file the disclosure documents with the SEC for public access (IMF, 1997).

2. Exchange Rates Movements in Asian Countries against Japanese yen and U.S. dollar

Asian countries' exchange rate movements against the Japanese yen and U.S. dollar are analyzed using a multivariate Granger causality test; their significance is reported in

Table 11. First of all, an optimal lag length is chosen using a likelihood-ratio test. For the Japanese yen, a lag length of 8 is chosen since lag length of 7 is a restriction on lag length 8, i.e., the significance probability of chi-squared test statistic with 49 degrees of freedom is 0.0065. For U.S. dollar, optimal lag length of 9 is using the same tset.

When Japanese yen exchange rates are concerned, there is more significant co-movement of exchange rates among seven Asian countries (24 significant Granger causalities out of 42 cases) than U.S. dollar rates (18 significant Granger causalities). Also, we can see that there are seven pairs of countries that have bi-directional causality for the Japanese yen exchange rates (Malaysia and Korea, Thailand and Korea, Hong Kong and Korea, Philippines and Hong Kong, Philippines and Singapore, Hong Kong and Malaysia, and Hong Kong and Philippines). Also, Hong Kong is Granger causing five Asian countries with the only exception of Singapore implying that the exchange rate movements of Hong Kong dollar against the Japanese yen have the most impact on the movements of other Asian countries Japanese yen exchange rates.

With U.S. dollar exchange rates, four pairs of countries have bi-directional Granger causality. However, Indonesia and Thailand show more close Granger causality among seven Asian countries when U.S. dollar rate is used likely due to a heavy weight on the U.S. dollar ion Thailand's currency basket and the fact that the dollar is the Indonesian intervention currency.

3. Misalignments of Exchange Rates for Seven Asian Countries against Japanese yen.

Nominal exchange rate misalignments are estimated using the concept of *interest parity forward rate* for seven Asian countries with the Japanese yen. Nominal Japanese yen exchange rates and interest parity forward rates for seven countries are shown in Figure 3. Except Singapore, the other six Asian countries experienced overvaluation of their currency against Japanese yen in the later sample period (i.e., Indonesia from July 1994, Hong Kong and Malaysia from July 1995, Thailand from January 1995, and Korea from July 1992). Singapore actually recorded an undervaluation in the 1990s relative to Japanese yen. In the early 1990s, Asian countries exchange rates relative to Japanese yen were undervalued. However, as timewent on, the magnitude of the undervaluation decreased eventually yielding to overvaluation. Furthermore, the magnitude of the overvaluation of the six Asian countries increased substantially and resulted in a loss of international competitiveness and a huge trade deficit with Japan.

The overvaluation of exchange rate was smallest for Hong Kong (maximum of 35% in October 1997) and highest for Thailand (maximum of 54% in August 1997). On the average, the overvaluations (based on interest parity forward rates) ranged about 30 to 40 percent during the later sample period.

One possible important reason for the Asian countries' currency overvaluations relative to the yen may be caused by the high interest rate differentials with Japan. Figure 4 shows the market interest differentials of seven Asian countries with Japan Libor and

U.S. CP rate. By the end of 1993, interest differentials with the U.S. were higher than those with Japan. However, beginning in 1994, interest differentials with Japan were much larger than with the U.S., and that disparity increased up to the crisis. In other words, Asian countries increasing interest differentials with Japan Libor might contributed for the overvaluation of six Asian countries currencies against Japanese yen and this might resulted in the increasing current account deficit.

V. Concluding Remarks

Recent instability in world financial markets has prompted much research in the areas of capital mobility, capital market risk and exchange rate misalignment. We find that capital mobility measured by deviations from uncovered interest parity have been decreasing significantly for seven Asian countries with different volatility implying incresaed capital mobility in this area.

We also examined the capital market risk of seven Asian countries using GARCH estimation. For Indonesia, Hong Kong, Korea and Malaysia, capital market risk did not show significant volatility before the financial crisis. However, the capital market risk of Thailand had been increasing rapidly since early 1995 and of the Philippines since 1992.

Finally, this paper studied the exchange rate misalignments of Asian countries against Japanese yen using the concept of *interest parity forward rates*. Estimation results showed that, except for Singapore, Asian countries' yen exchange rate were overvalued due, partly, to the large interest differential with Japan.

The policy implications of this study are straightforward for the exchange rate system. Asian countries' exchange rate determination systems are biased toward the overvaluation of domestic currencies relative to Japanese yen. These misalignments could be removed by (i) increasing weight of the Japanese yen in a multiple basket or (ii) revising their exchange rate system such that their yen exchange rates reflect the relative economic fundamentals of the two countries including, for example, productivity, terms of trade, net foreign assets, etc.

As financial market integration increases, the issues of capital mobility, capital market risk and exchange rate misalignment may cause more serious and comprehensive problem in the world economy.

References

Bank of Korea, 1995, Financial System in Korea, Seoul:Bank of Korea

Bhatti, R.H. and Moosa, I.A.," A New Approach to Testing Ex Ante Purchasing Power Parity," *Applied Economics Letters*, 1, 148-51.

Bhatti, R.H. and Moosa, I.A.,"An Alternative Approach to Testing Uncovered Interest Parity," *Applied Economics Letters*, 2, 478-81.

Bollerslev, T., 1986," Generalized Autoregressive Conditional Heteroscedasticity," *Journal of Econometrics*, 31, 307-28.

Bollerslev, T. and Engle,R.F. and Wooldrige,J.M., 1988," A Capital Asset Pricing Model with Time-varying Covariances," *Journal of Political Economy*, 96, 116-31

Cumby, R.E., 1987, Is It Risk ? Explaining Deviations from Uncovered Interest parity, *NBER Working Paper* no. 2380

Demos, A. and E. Sentana, 1998," Testing for GARCH Effects: A One-sided Approach," *Journal of Econometrics*, 86, 97-127.

Domowitz, I. and Hakkio, C.S., 1985," Conditional Variance and the Risk premium in the Foreign exchange Market," *Journal of International Economics*, 19, 47-66.

Eaton, J. and C. Ho, 1993,"Trade and Investment in North-America Pacific Region: Does NAFTA matter ?," in Asian Economic Dynamism and new Asia-Pacific Economic Order. Proceedings of Kyushu University International Symposium, Fukuoka, Kyushu University.

Edwards, Sebastian and Moshin S. Kahn, 1985, "Interest Rate Determination in Developing Countries:A Conceptual Framework," *IMF Staff Papers*, IMF 32, 377-403.

Enders, W., 1995, Applied Econometric Time Series, New york:John Wiley & Sons, Inc.

Engle, R.F.,1982,"Autoregressive Conditional Heteroscedasticity with estimates of the variance of UK Inflation," *Econometrica*, 50, 987-1007.

Engle, C.M., 1986,"On the Correlation of Exchange Rates and Interest Rates," *Journal of International Money and Finance*, 5, 125-28.

Faruqee, H. 1992,"Dynamic Capital Mobility in Pacific Basin Developing Countries: A Conceptual Framwork," *IMF Staff Papers*, 39, 706-17.

Feldstein, M. and C. Horioka, 1980,"Domestic saving and International Capital Flows," *Economic Journal*, 90, 314-26.

Frankel, J. A., 1991, Quantifying International Capital Mobility in the 1980s," in B. Douglas Bernheim and John B. Shoven, eds, National Saving and Economic Performance, Chicago:University of Chicago Press.

Frankel, J. A.,1992, " Is Japan Creating yen Bloc in East Asia and the Pacific ?", *NBER Working Paper* no. 4050. Cambrige,Mass.:National Bureau of Economic Research, April

Furstenberg, G. M., 1998,"From Worldwide Capital Mobility to International Financial Integration: A Review Essay," *Open Economies Review*, 9, 53-84.

Hamilton, J.D.,1994, Time Series Analysis, New Jersey: Princeton University Press.

Hassapis, C., 1995," Exchange Risk in the EMS: Some Evidence Based on a GARCH Model," *Bulletin of Economic Research*, 47, 295-303.

Hordick, R.J. Risk, 1989,"Uncertainty and Exchange Rates," *Journal of Monetary Economics*, 11, 573-87.

International Monetary Fund, 1997, Exchange Rate Arrangement and Exchange Restrictions, Washington D.C.

Kohsaka, A. ,1996," Interdependence through Capital Flows in Pacific Asia and the Role of Japan," in Financial Deregulation and Integration in East Asia ed. by T. Ito and A. Kreuger, Chicago, University of Chicago Press.

Krol, R. , 1996," International capital Mobility:Evidence from Panel Data," *Journal of International Money and Finance*," 15, 467-74.

Kuen, T.Y. and T.K. Song, 1996," Interest parity and Dynamic Capital Mobility: The Experience of Singapore," in Financial Deregulation and Integration in East Asia ed. by T. Ito and A. Kreuger, Chicago, University of Chicago Press.

Lemmen, Jan J.G. and S.C.W. Eiffinger, 1995," The Quantity Approach to Financial Integration: The Feldstein-Horioka Criterion Revisited," *Open Economies Review*, 6, 145-65.

Malliaropulos, D., 1997," A Multivariate GARCH Model of Risk premium in Foreign Exchange Markets," *Economic Modeling*, 14, 61-79.

Mark, N.C. ,1985," On Time-varying Risk Premium in the Foreign Exchange Market:An Econometric Analysis," *Journal of Monetary Economics*, 16, 3-18.

McCurdy T.H. and I.G. Morgan, 1991," Tests for a Systemic Risk Component in Deviations from Uncovered Interest Parity," *Review of Economic Studies*, 587-602.

Meredith, G., 1998, Long-Horizon Uncovered Interest Parity, IMF mimeo.

Moosa, I.A., 1997,"Resolving the Feldstein-Horioka Puzzle," *Economia Internazionale*, 437-58.

Moosa, I. A. and R.H. Bhatti, 1997," Are Asian Markets integrated ? Evidence for Six Countries vis-[redacted]vis Japan," International Economic Journal, 11, 51-67.

Obstfeld, M. 1994, International Capital Mobility in the 1990s," *CEPR Discussion Paper* no. 902. London: Center for Economic Policy Research.

Obstfeld,M. 1998,"The Global Capital Market: Benefactor or Menace ?", Journal of Economic Perspective, forthcoming.

Table 1. Trade Volume of Asian Countries with Japan and U.S.

Unit: Billion US dollars

			1990	1991	1992	1993	1994	1995	1996
Indonesia	Export	Japan	10.9	10.8	10.8	11.2	11.5	12.4	12.9
		U.S.	3.4	3.5	4.4	5.2	6.2	6.5	6.8
	Import	Japan	5.5	6.3	6.0	6.3	8.3	8.9	8.5
		U.S.	2.5	3.4	3.8	3.3	3.4	4.6	5.1
Korea	Export	Japan	12.6	12.4	11.6	11.6	13.5	17.1	16.0
		U.S.	19.5	18.6	18.1	18.1	20.6	24.2	21.8
	Import	Japan	18.6	21.1	19.5	20.0	25.4	32.6	31.4
		U.S.	16.9	18.9	18.3	17.9	21.6	30.4	33.3
Malaysia	Export	Japan	4.5	5.5	5.4	6.1	7.0	9.2	10.4
		U.S.	4.9	5.8	7.6	9.6	12.4	15.3	14.3
	Import	Japan	7.1	9.6	10.4	12.5	15.9	21.2	19.2
		U.S.	4.9	5.6	6.3	7.7	9.9	12.7	12.1
Philippines	Export	Japan	1.6	1.8	1.8	1.8	2.0	2.7	3.7
		U.S.	3.1	3.2	3.8	4.3	5.2	6.2	7.0
	Import	Japan	2.4	2.5	3.1	4.0	5.5	6.3	7.0
		U.S.	2.5	2.6	2.6	3.5	4.2	5.2	6.2
Thailand	Export	Japan	3.9	5.1	5.7	6.3	7.7	9.5	9.4
		U.S.	5.2	6.1	7.3	8.0	9.5	10.1	10.0
	Import	Japan	10.1	11.0	11.9	14.0	16.4	21.6	20.5
		U.S.	3.6	4.0	4.8	5.4	6.5	8.5	9.2
Total	Trade	Japan	77.2	83.3	86.0	93.7	112.9	138.5	138.8
		U.S.	66.5	71.7	77.1	83.1	99.4	123.6	125.8

Source: IMF, Direction of Trade, various issues.

Table 2. Currency Composition of Long-term Debt for Selected Countries

Unit: Percent

ASIA		1991	1992	1993	1994	1995
Indonesia	Japanese yen	35.7	36.4	37.6	38.0	35.4
	US $	19.4	19.9	19.9	20.0	20.0
Malaysia	Japanese yen	33.2	35.4	38.2	41.4	31.7
	US $	38.9	29.3	30.9	31.0	45.1
Philippines	Japanese yen	34.3	34.7	38.3	38.7	36.9
	US $	32.9	33.9	30.4	30.3	31.5
Thailand	Japanese yen	45.6	47.2	50.1	49.7	48.1
	US $	19.1	22.9	22.4	25.9	26.6
Latin America						
Brazil	Japanese yen	7.5	6.1	6.4	5.0	6.9
	US $	59.3	61.8	63.1	68.7	67.5
Chile	Japanese yen	8.5	8.2	8.4	8.8	9.5
	US $	37.9	37.7	34.9	34.9	42.3
Colombia	Japanese yen	4.7	4.3	4.0	4.3	6.1
	US $	44.2	44.6	46.6	52.4	49.9
Mexico	Japanese yen	7.2	8.2	8.8	9.1	6.7
	US $	61.8	59.2	60.6	60.4	66.8
Venezuela	Japanese yen	2.0	2.8	2.6	4.0	4.2
	US $	76.2	75.6	75.1	72.1	68.5

Source: The World Bank, Global Development Finance, 1997

Table 3. Contemporaneous Correlation Matrix of Interest Rates

Japan

(1). LEVELS,1990:1-1998:03(Japan LIBOR)

	RIND	RKOR	RMAL	RTPP	RSNG	RTHL	RHK	RLBJAP
RIND	1							
RKOR	.497	1						
RMAL	.526	.500	1					
RTPP	.369	.408	.300	1				
RSNG	.612	.743	.544	.369	1			
RTHL	.760	.495	.602	.321	.575	1		
RHK	.343	.048	.182	.205	.019	.398	1	
RLBJAP	-.187	.196	-.245	.608	.027	-.186	.153	1

(2). FIRST DIFFERENCE, 1990:01-1998:03 (Japan LIBOR)

	RIND	RKOR	RMAL	RTPP	RSNG	RTHL	RHK	RLBJAP
RIND	1							
RKOR	.119	1						
RMAL	-.419	.373	1					
RTPP	.232	.171	.246	1				
RSNG	-.154	.454	.462	.188	1			
RTHL	-.199	-.039	.146	.143	-.074	1		
RHK	.345	.149	-.137	.124	.030	-.035	1	
RLBJAP	-.085	.359	.244	-.016	.484	.137	-.063	1

U.S.

(1). LEVELS,1990:1-1998:03 (CP rate)

	RIND	RKOR	RMAL	RTPP	RSNG	RTHL	RHK	RUS
RIND	1							
RKOR	.497	1						
RMAL	.526	.500	1					
RTPP	.369	.408	.300	1				
RSNG	.612	.743	.544	.369	1			
RTHL	.760	.495	.602	.321	.575	1		
RHK	.343	.048	.182	.205	.019	.398	1	
RUS	.315	.155	.242	-.049	.057	.044	.077	1

(2). FIRST DIFFERENCE, 1990:01-1998:03

	RIND	RKOR	RMAL	RTPP	RSNG	RTHL	RHK	RUS
RIND	1							
RKOR	.119	1						
RMAL	-.419	.373	1					
RTPP	.232	.171	.246	1				
RSNG	-.154	.454	.462	.188	1			
RTHL	-.199	-.039	.146	.143	-.074	1		
RHK	.345	.149	-.137	.124	.030	-.035	1	
RUS	.015	.008	-.142	-.001.	.049	.060	.215	1

Table 4. Test for Multiple Granger-causality of Interest Rates

A. Japanese LIBOR

	RJAP	RKOR	RMAL	RSNG	RTHL	RIND	RPP
RJAP	.000	.001**	.864	.002**	.283	.382	.003**
RKOR	.021*	.000	.966	.034*	.082	.000**	.121
RMAL	.912	.661	.000	.174	.262	.000**	.295
RSNG	.760	.031*	.018*	.000	.272	.000**	.832
RTHL	.904	.223	.320	.339	.000	.078	.951
RIND	.687	.811	.000**	.614	.022*	.000	.852
RPP	.414	.256	.137	.005**	.522	.192	.000

Note:

1) Each entry (i,j) denotes the marginal significance level of the F test on the joint exclusion of all lags of explanatory variable j in the regression of variable i.
2) lag length of 4 is chosen by likelihood-ratio test. Prob [Lag (6 vs 4): Chisquared (98) = 63.4] = 0.997, Prob [Lag (4 vs 3) : Chisquared (49) = 82.4] = 0.0019.

B. U.S. CP Rate

	RUS	RKOR	RMAL	RSNG	RTHL	RIND	RPP
RUS	.000	.001**	.864	.002**	.283	.382	.003**
RKOR	.256	.000	.719	.342	.278	.000**	.568
RMAL	.812	.658	.000	.220	.239	.000**	.251
RSNG	.837	.064	.024*	.000	.263	.000**	.927
RTHL	.046*	.223	.046*	.905	.000	.020*	.887
RIND	.204	.467	.000**	.688	.010*	.000	.867
RPP	.936	.482	.096	.001**	.400	.235	.000

Note:

1) Each entry (i,j) denotes the marginal significance level of the F test on the joint exclusion of all lags of explanatory variable j in the regression of variable i.
2) lag length of 4 is chosen by likelihood-ratio test. P[Lag (8 vs 4): Chisquared(196) = 197.9] = 0.45, Prob[Lag (4 vs 3) :Chisquared (49) = 86.6] = 0.007.

Table 5. Test of Unit Roots

A. Level	Lag[1)]	ADF_{τ}	ADF_{z}	B. Difference	Lag[1)]	ADF_{τ}	ADF_{z}
Deviation from UIP							
DXK	3, 3	-2.26	-15.6*	ΔDXK	3,2	-6.85**	-352.4**
DXM	8, 3	-0.87	-1.15	ΔDXM	9,0	-12.21**	-121.0**
DXS	3, 0	-0.73	-1.77	ΔDXS	5,1	-9.67**	-193.9**
DXT	0, 0	-0.81	-2.23	ΔDXT	0,0	-11.04**	-110.9**
DXI	17, 5	1.86	-1.06	ΔDXI	7,4	2.52	16.15*
DXP	4, 0	-0.21	-0.69	ΔDXP	0,0	-7.43**	-72.12**
DXH	3, 0	-1.52	-3.41	ΔDXH	3,0	-7.57**	-55.92**
Exchange rates against Japnese yen							
XKOR	8, 3	-0.52	-1.58	ΔXKOR	7,2	-7.75**	-613.5**
XMAL	0, 0	-1.76	-6.36	ΔXMAL	5,0	-10.52**	-106.71**
XPP	4, 0	0.08	0.25	ΔXPP	0,0	-8.37**	-89.97**
XSNG	0, 0	-1.42	-4.62	ΔXSNG	0,0	-9.12**	-91.74**
XTHL	4, 1	-2.30	-10.9	ΔXTHL	1,1	-7.79**	-128.31**
XHK	7, 0	-3.16*	-14.1**	ΔXHK	0,0	-7.73**	-76.92**
XIND	17,17	1.38	1.52	ΔXIND	5,4	2.582	10.67
Market Interest Rates							
RLBJAP	0, 0	-0.74	-0.52	ΔRLBJAP	0,0	-7.01**	-67.01**
RIND	4, 0	-1.49	-9.85	ΔRIND	3,1	-8.98**	-180.2**
RKOR	2, 0	-1.76	-9.49	ΔRKOR	1,1	-7.89**	-126.7**
RMAL	12, 7	-0.63	-10.2	ΔRMAL	11,6	-1.24	-8.38
RTPP	1, 1	-2.03	-8.12	ΔRTPP	8,0	-7.91**	-76.61**
RTHL	1, 0	-2.42	-13.6	ΔRTHL	0,0	-12.29**	-120.35**
RHK	0, 0	-3.00*	-15.3*	ΔRHK	0,0	-9.41**	-66.27**
RSNG	2, 2	-1.74	-6.67	ΔRSNG	5,1	-9.48**	-189.2**

Note:
1) Smaller lags (SIB) are used for the estimation

Tabel 6. Identification of the Model for 7 Asian countries

Country	Estimation Period	ARIMA[1)]	AIC, SBC	prob[Q]	Standard Error of Estimation	Adj. R^2	GARCH Error Test [2)]
Hong Kong	1994:07 - 1998:05	(1,1,1)	-17.76, -14.06	0.429	.118	0.861	P[χ(1)] =.048
Indonesia	1990:01 - 1998:03	(3,1,3)	670.9, 686.4	0.986	3.131	.807	P[χ(2)]=. 000
Korea	1990:01 - 1998:04	(3,0,3)	302.9, 318.5	0.969	0.450	0.804	P[χ(3)]=. 045
Malaysia	1990:01 - 1998:04	(2,0,2)	-16.5, -6.2	0.345	0.090	0.986	P[χ(2)]=. 004
Philippines	1990:01 - 1998:04	(2,1,1)	14.6, 22.4	0.548	0.170	0.964	P[χ(2)]=. 043
Singapore	1990:01 - 1998:04	(1,2,1)	73.3, 84.6	0.051	0.145	0.941	P[χ(2)]=. 000
Thailand	1990:01 - 1998:04	(3,1,3)	160.3, 175.9	0.803	0.219	0.937	P[χ(2)]=. 039

Note:
1) Model is identified using SBC and AIC.
2) Lagrangian Multiflier Test of Existence of GARCH errors.

Table 7. Estimation of ARIMA Model for 7 Asian Countries

Dependent Variable: Deviations from Uncovered Interest Parity

	α_1	α_2	α_3	β_1	β_2	β_3	Adj R^2	D.W.	p[Q]	SEE
Hong Kong	.868**			-1.23**			.861	2.17	.429	.118
	(.036)			(.125)						
Indonesia	.952**	2.67**	.680**	1.29**	-0.66**	-.97**	.801	1.43	.993	1.432
	(.235)	(.370)	(.246)	(.084)	(.153)	(.105)				
Korea	.95**	.81**	-.75**	-.13	-.69**	-.51**	.804	2.02	.969	.451
	(.002)	(.000)	(.000)	(.109)	(.101)	(.124)				
Malaysia	1.68**	-.68**		-.92**	.28**		.987	1.97	.345	.090
	(.200)	(.202)		(.218)	(.102)					
Philippines	1.14**	-.32**		-.83**			.968	2.04	.356	.105
	(.204)	(.097)		(.196)						
Singapore	.205**			.049**			.942	2.45	.051	.146
	(.048)			(.051)						
Thailand	1.33**	-1.41**	.59	-1.60**	1.74**	-.84*	.938	1.91	.803	.219
	(.349)	(.254)	(.344)	(.301)	(.256)	(.333)				

Note: Single Asterisk denotes significance of the estimated coefficient at 5 percent critical level and double asterisks at 1 percent critical level.

Table 8. Granger-causality Test of Capital Mobility

	Explanatory lagged variables						
	DXK	DXM	DXS	DXT	DXI	DXP	DXH
DXK	.000	.046*	.610	.366	.050*	.011*	.510
DXM	.565	.000	.211	.382	.329	.496	.144
DXS	.782	.166	.000	..725	.175	.110	.039*
DXT	.133	.555	.188	.000	.314	.572	.637
DXI	.000	.032*	.004*	.298	.000	.283	.602
DXP	.488	.131	.016*	.415	.457	.000	.537
DXH	.004*	.050*	.001*	.127	.023*	.019*	.000

Note:
1) Each entry (i,j) denotes the marginal significance level of the F test on the joint exclusion of all lags of explanatory variable j in the regression of variable i.

Table 9. Maximum Likelihood Estimation of GARCH Model

Country	ϕ_{t-1}	ϕ_{t-2}	ϕ_{t-3}	ε_{t-1}	ε_{t-2}	ε_{t-3}	h_t	Function Value
THAILAND	1.018**	-.918**	.885**	.083	.864**	.065	$.001 + .42^{**}\varepsilon^2_{t-2} + .63^{**}h_{t-1}$	246. 58
	(.054)	(.090)	(.084)	(.099)	(.009)	(.089)	(.001) (.143) (.096)	
MALAYSIA	1.718**	-.721**	-	-.912 **	.269**	-	$.006^{**} + .19\varepsilon^2_{t-2} + .90^{**}h_{t-1}$	195.01
	(.132)	(.131)		(.221)	(.154)		(.001) (.128) (.00)	
KOREA	1.054**	556**	-.610**	-.024	- .028**	- .24**	$.089^{**} + 1.44^{**}\varepsilon^2_{t-2} + .5^{**}h_{t-1}$	63.31
	(.052)	(.052)	(.053)	(.053)	(.052)	(.052)	(.007) (.052) (.052)	
PHILIPPINES	0.245**	.771**	-	1.018**	-	-	$.004 + .36^{*}\varepsilon^2_{t-2} + .26^{**}h_{t-1}$	181.2
	(.075)	(.066)		(.022)			(.002) (.177) (.270)	
INDONESIA	.453**	-.076*	.639**	.275**	.400**	-.581**	$1.93 + .31^{**}\varepsilon^2_{t-2} + .42^{**}h_{t-1}$	−166.5
	(.035)	(.034)	(.027)	(.000)	(.003)	(.003)	(22.79) (.065) (.126)	
SINGAPORE	.429**	-	-	- 0.34**	-	-	$.007 + .92^{**}\varepsilon^2_{t-2} + .37^{**}h_{t-1}$	90.94
	(.048)			(.01)			(.373) (.03) (.021)	
HONG KONG	.904**	-	-	-.15.065	-	-	$.014^{**} + .13\varepsilon^2_{t-2}$	73.88
	(.046)			(.151)			(.003) (.158)	

NOTE:

1) GARCH(p,q) is selected using AIC and SBC.
2) * denotes significance at 5% critical level and double asterisks denote significance at 1% critical level.
3) BFGS algorihm is used.
4) Figures in parentheses are standard errors.

Table 10. Granger-causality Test of Capital Market Risk

	Explanatory lagged variables					
	KVAR	MVAR	SVAR	TVAR	IVAR	PVAR
KVAR	.0	.049*	.216	.002**	.000**	.307
MVAR	.000**	.0	.338	.294	.001**	.021*
SVAR	.665	.041*	.0	.567	.067	.419
TVAR	.276	.523	.126	.0	.814	.053
IVAR	.000**	.338	.007**	.003**	.0	.285
PVAR	.037*	.489	.109	.829	.192	.0

Note

1) Each entry (i,j) denotes the marginal significance level of the F test on the joint exclusion of all lags of explanatory variable j in the regression of variable i.

2) KVAR is the Korea's Time-Varying Conditional Variances

Table 11. Multiple Granger-causality Test of Exchange Rates

A: Test with Japanese yen

	Explanatory lagged variables						
	XKOR	XMAL	XSNG	XTHL	XIND	XPP	XHK
XKOR	.000	.036*	.947	.000**	.656	.031*	.000**
XMAL	.016*	.000	.207	.154	.005**	.006**	.002**
XSNG	.004**	.022*	.000	.597	.085	.023*	.112
XTHL	.001**	.012*	.127	.000	.363	.004**	.005**
XIND	.006**	.139	.097	.000**	.000	.074	.000**
XPP	.083	.002**	.014*	.264	.177	.000	.000**
XHK	.012*	.016*	.418	.528	.183	.006**	.000

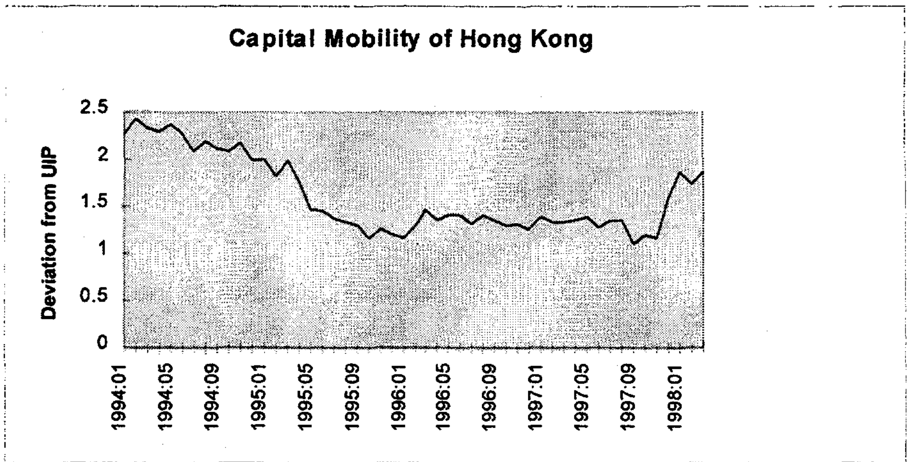
Note:
1) Each entry (i,j) denotes the marginal significance level of the F test on the joint exclusion of all lags of explanatory variable j in the regression of variable i.

B. Test with US dollar

	Explanatory lagged variables						
	XKOR	XMAL	XSNG	XTHL	XIND	XPP	XHK
XKOR	.000	.879	.610	.000**	.000**	.516	.129
XMAL	.008**	.000	.340	.000**	.054	.012*	.314
XSNG	.035*	.000**	.000	.000**	.002**	.000**	.013*
XTHL	.004**	.387	.202	.000	.001**	.740	.383
XIND	.001**	.158	.439	.000**	.000	.526	.859
XPP	.717	.104	.393	.034*	.158	.000	.655
XHK	.258	.171	.006**	.229	.038*	.191	.000

Note:
1) Each entry (i,j) denotes the marginal significance level of the F test on the joint exclusion of all lags of explanatory variable j in the regression of variable i.

Figure 1. Dynamic Capital Mobility of Seven Asian Countries



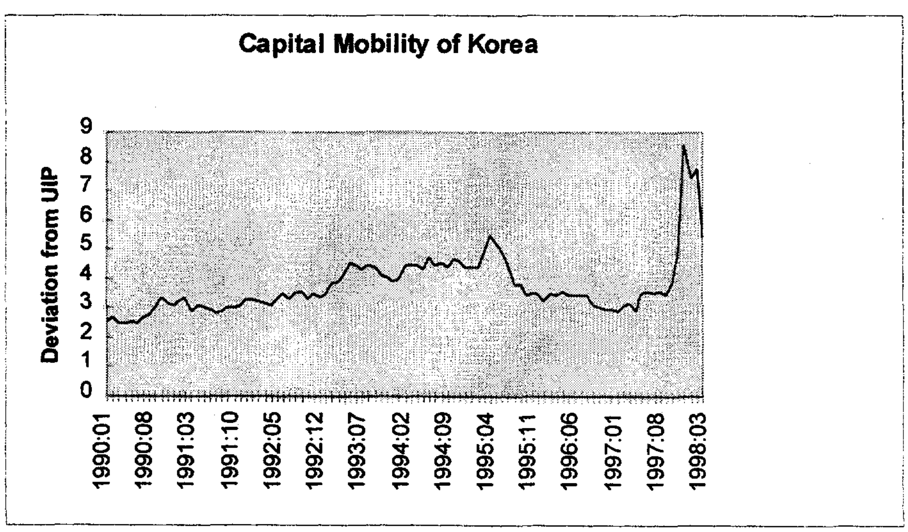
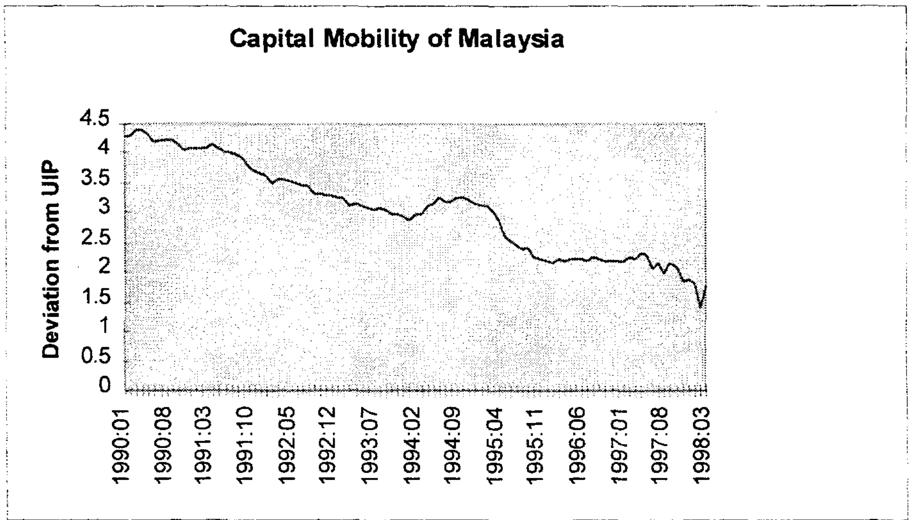
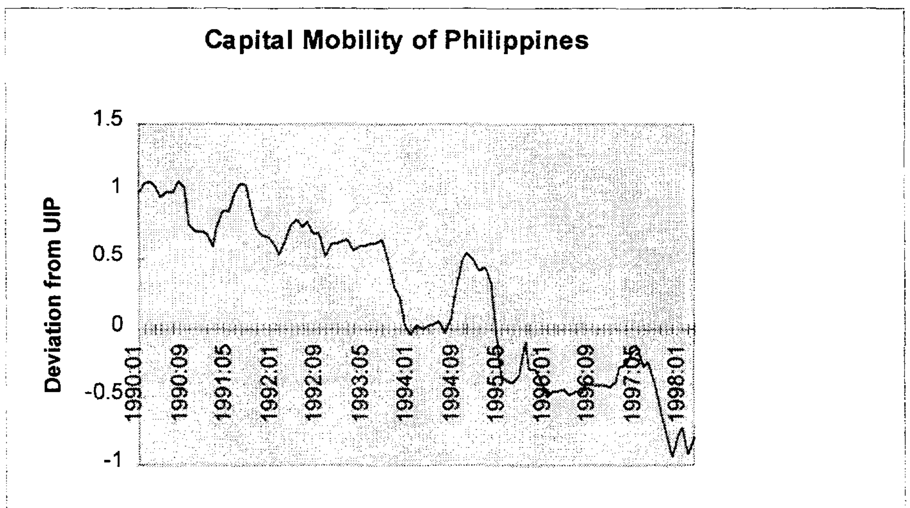


Figure 1. Dynamic Capital Mobility (Continued)





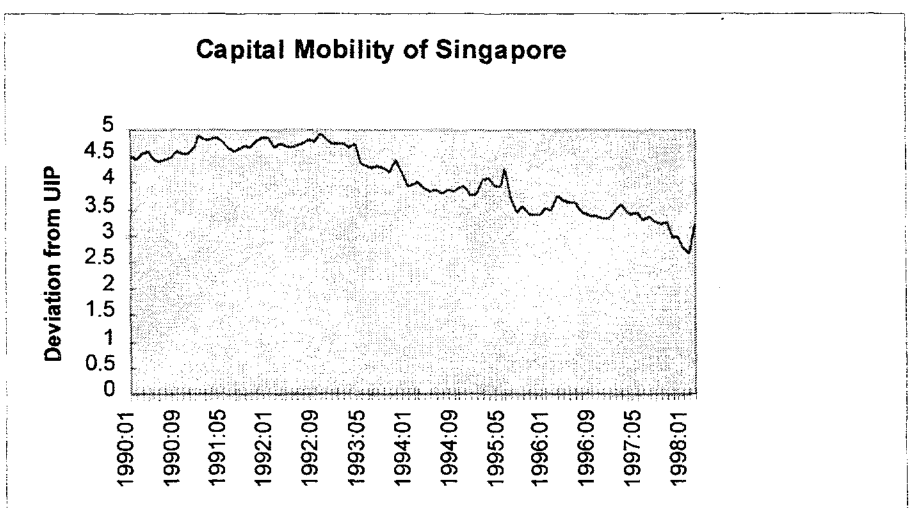


Figure 1. Dynamic Capital Mobility (continued)

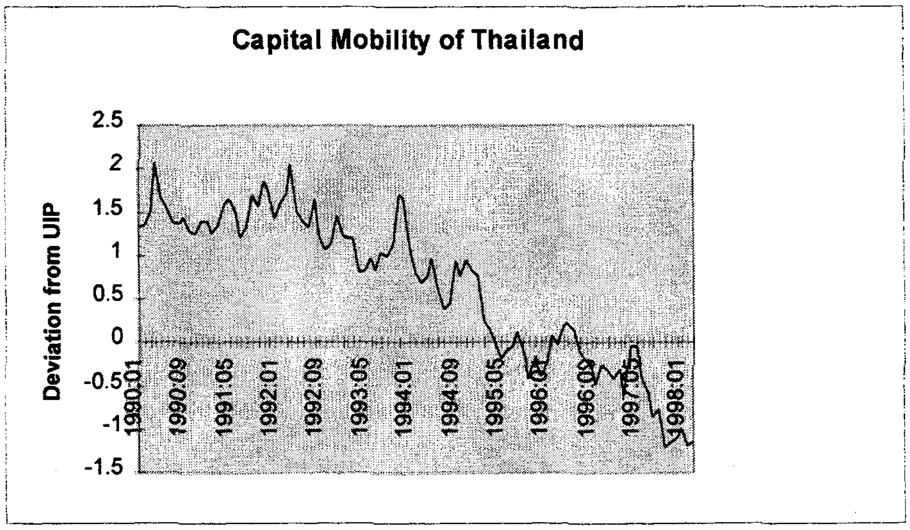
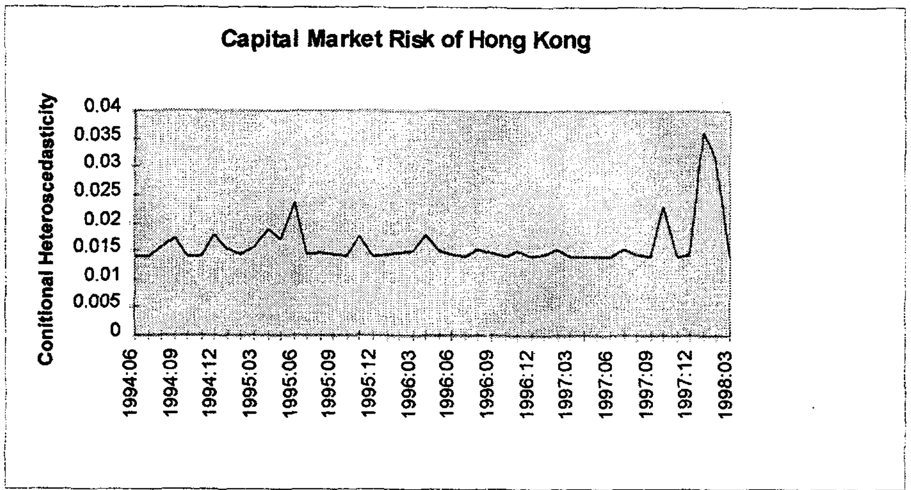


Figure 2. Capital Market Risk of Seven Asian Countries



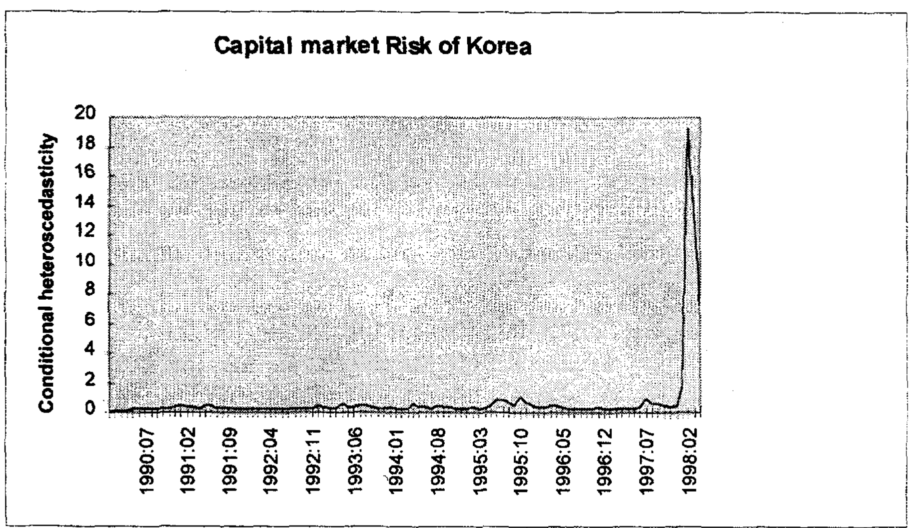
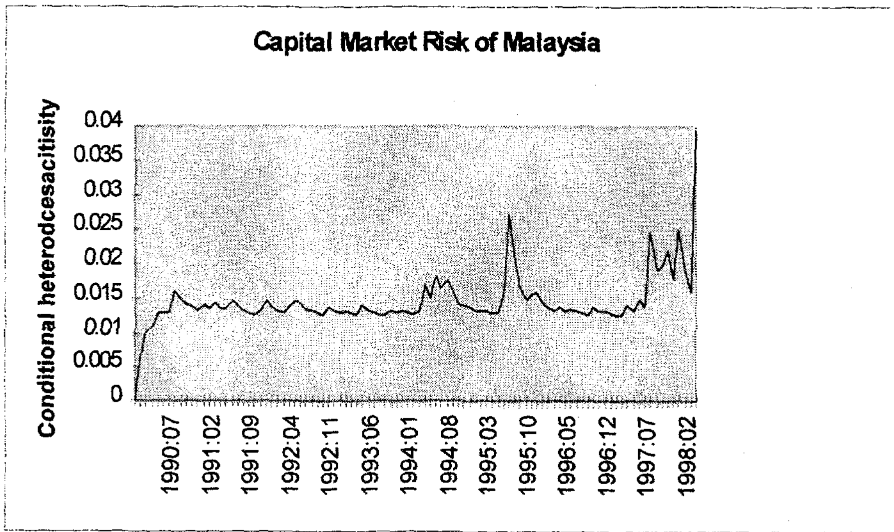
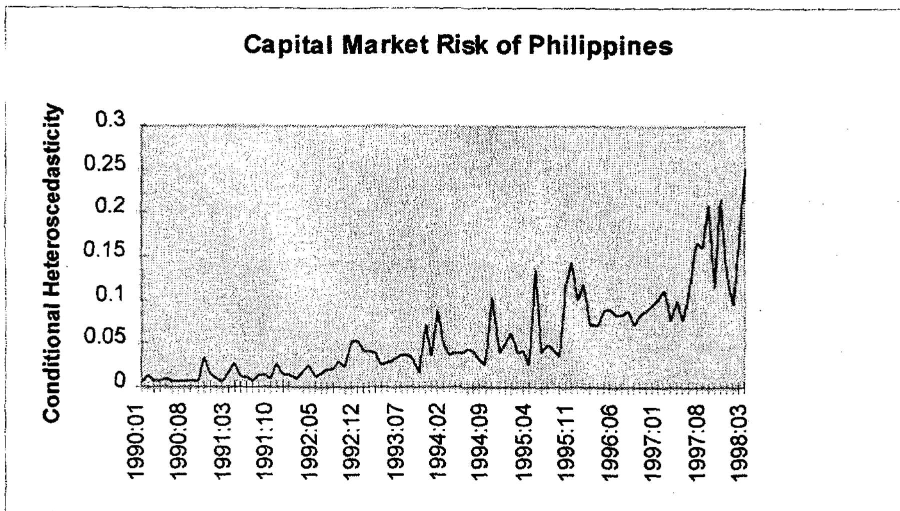


Figure 2. Capital Market Risk (continued)





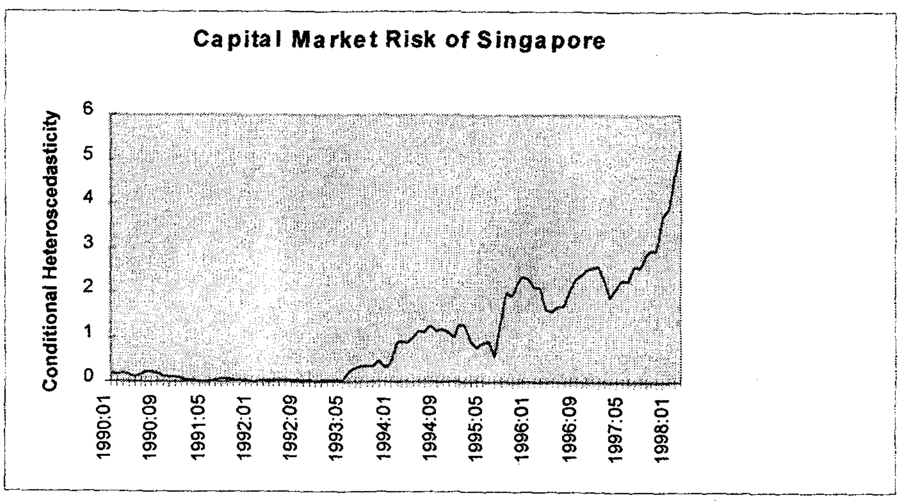


Figure 2. Capital Market Risk (continued)

Figure 3. Exchange Rate Misalignments against Japanese yen

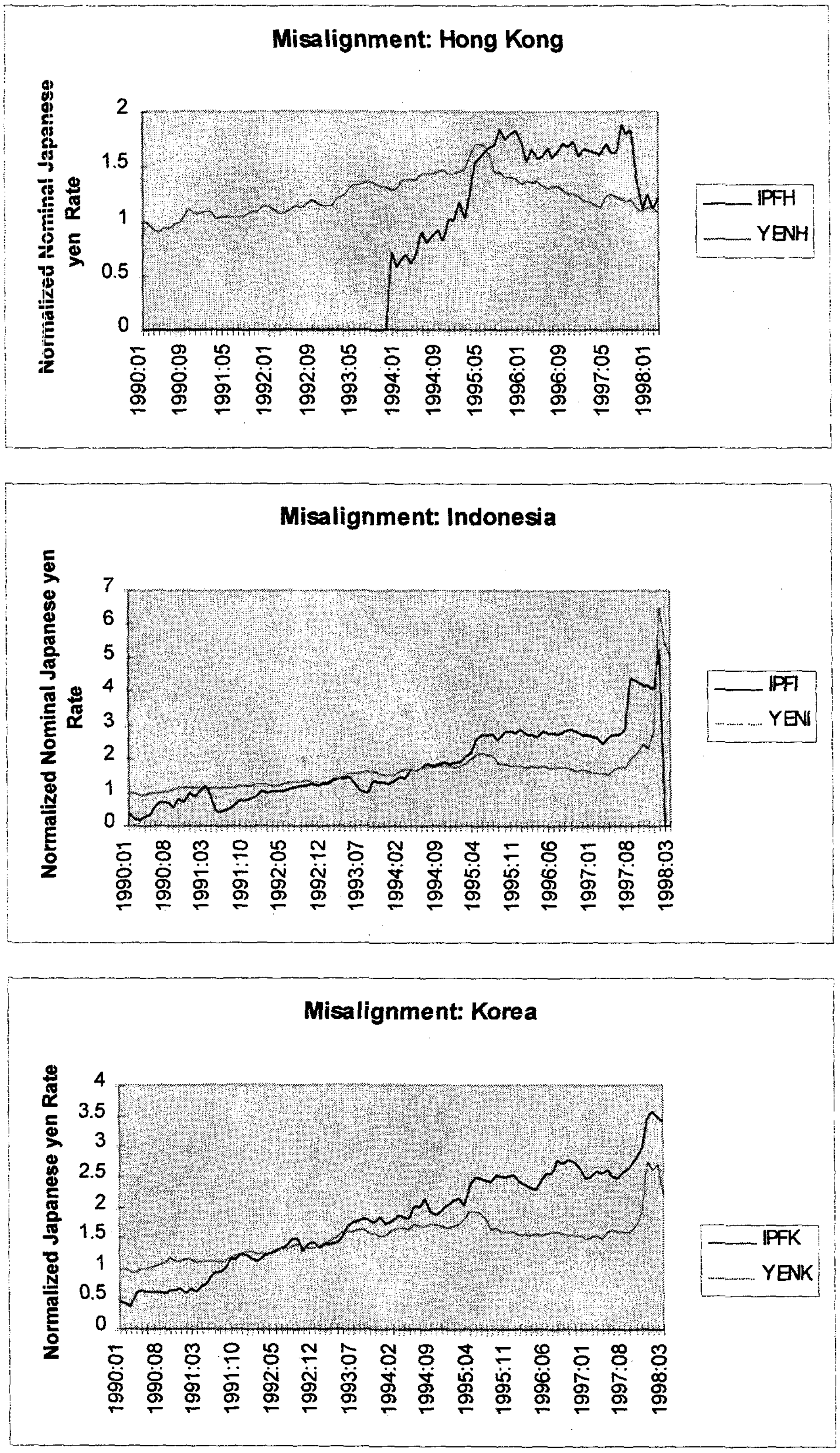
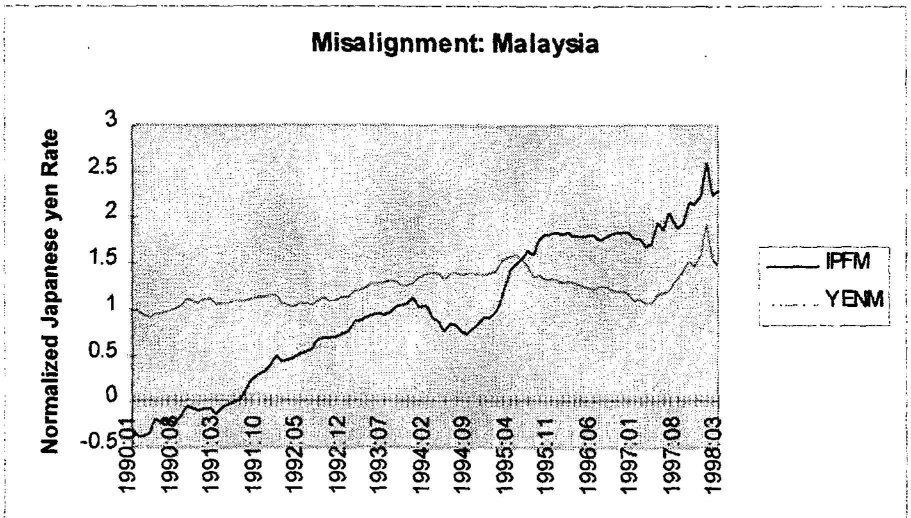
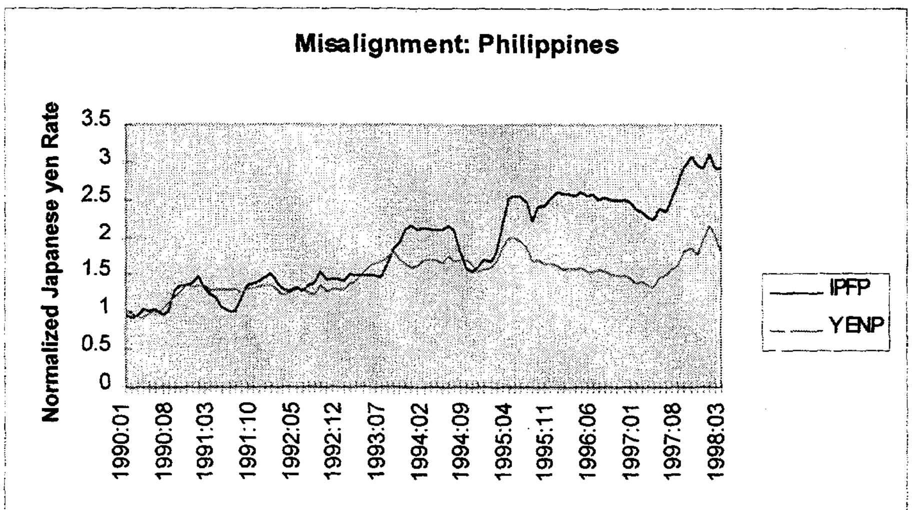


Figure 3. Exchange Rate Misalignments (continued)





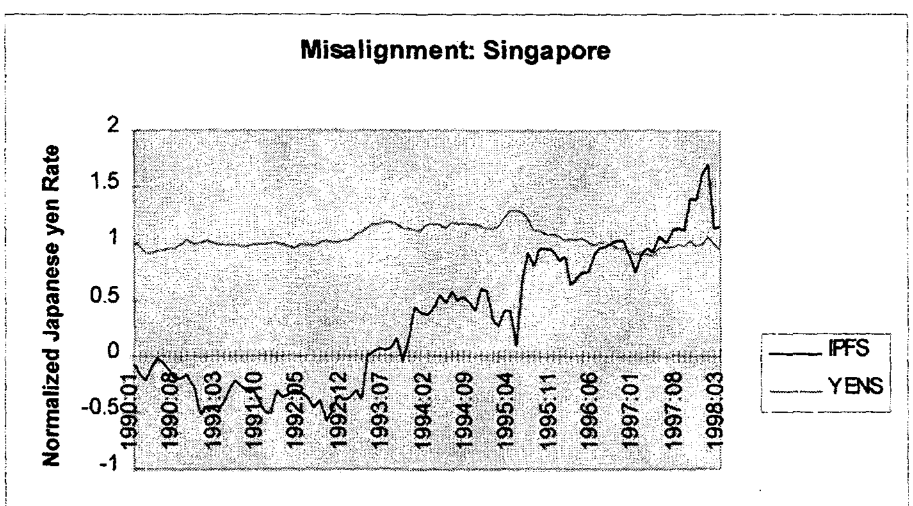


Figure 3. Exchange Rate Misalignments (continued)

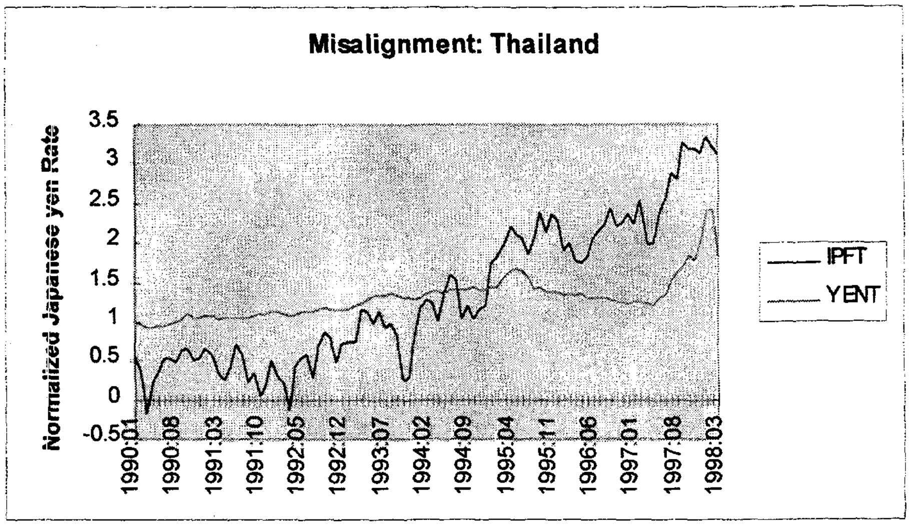
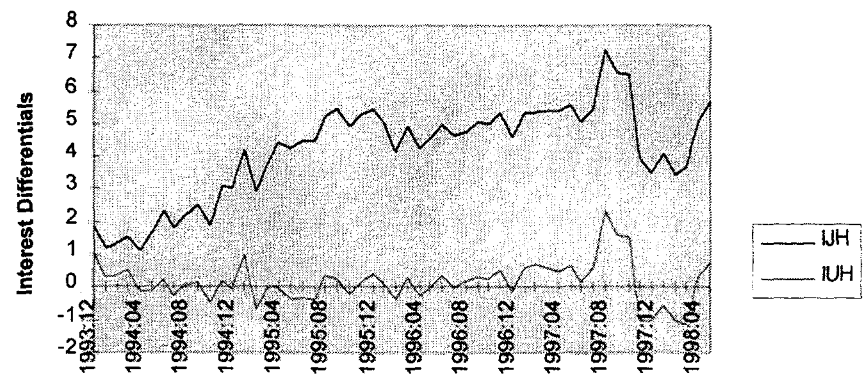
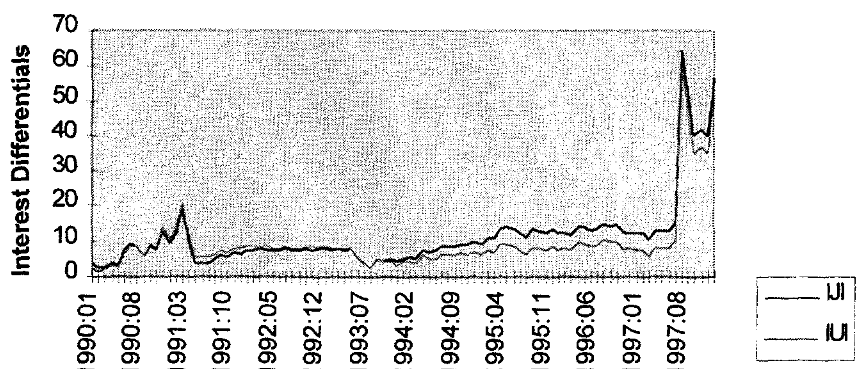


Figure 4. Interest Rate Differentials with Japan and U.S.

Hong Kong: Japan and U.S.



Indonesia: Japan and U.S.



Korea: Japan and U.S.

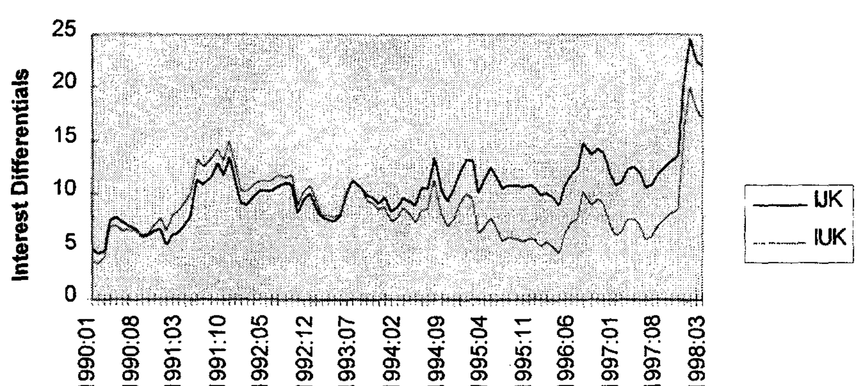
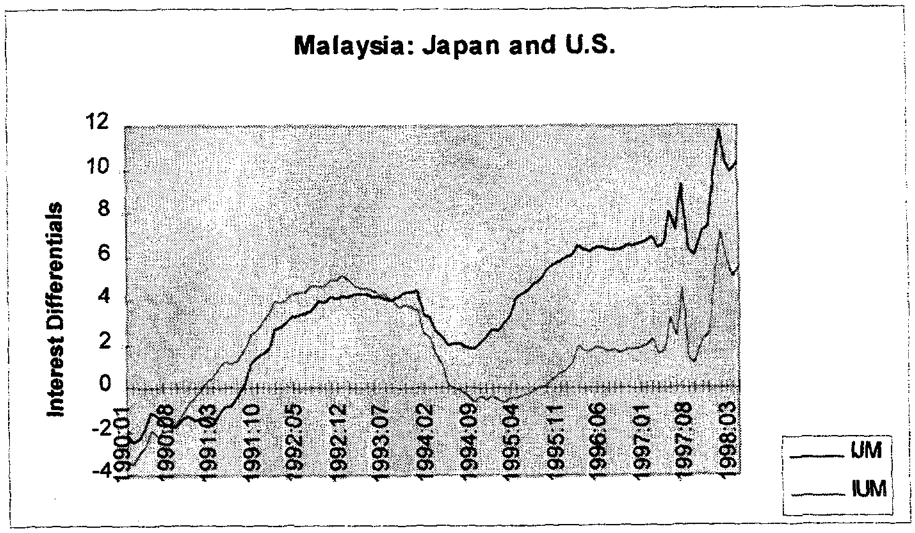
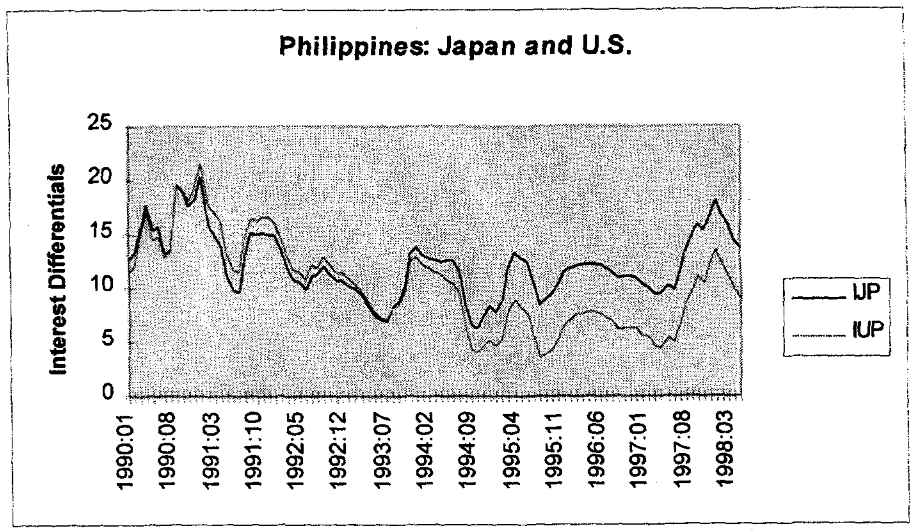


Figure 4. Interest Rate Differentials (continued)





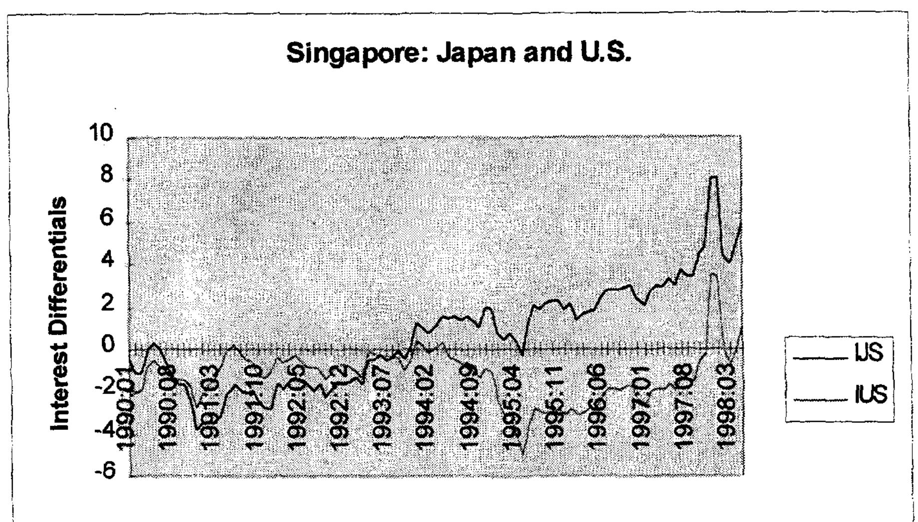
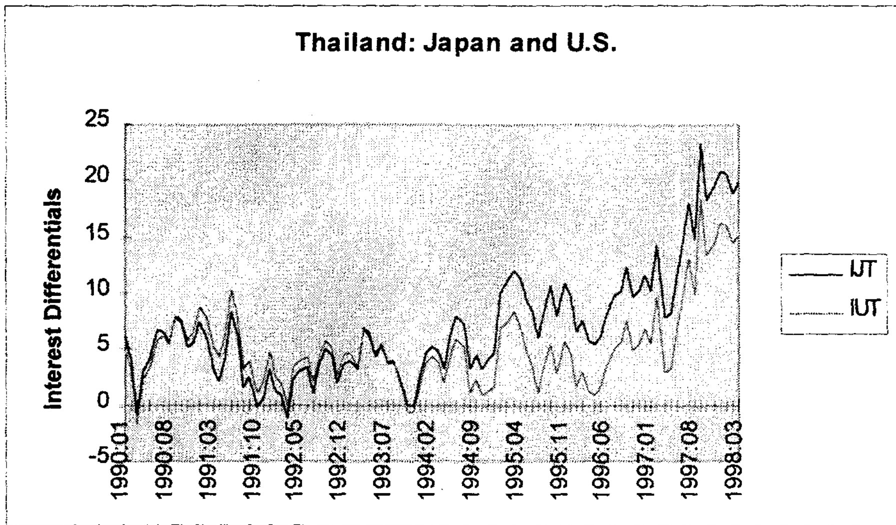


Figure 4. Interest Rate Differentials (continued)



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