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Shin-ichi Fukuda
University of Tokyo
Sanae Ohno
Musashi University

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Post-crisis Exchange Rate Regimes in ASEAN: A New Empirical Test Based on Intra-daily Data[*]

Shin-ichi Fukuda (University of Tokyo) and Sanae Ohno (Musashi University)[**]

Abstract

The purpose of this paper is to investigate what affected the post-crisis exchange rates of three ASEAN countries: Singapore, Thailand, and Malaysia. Our critical departure from previous studies is the use of intra-daily exchange rates. The use of the intra-daily data is useful in removing possible estimation biases which the choice of numéraire may cause. It can also contrast exchange rate movements during the time zone when the government intervention is active with those when the intervention is not active. We examine how and when the ASEAN currencies changed their correlations with the U.S. dollar and the Japanese yen. We find significant structural breaks in the correlations during the time zone when East Asian market is open. In the post-crisis period, the first structural break happened when Malaysia adopted the fixed exchange rate and the second break happened when some East Asian countries introduced inflation targeting. The structural breaks suggest strong monetary and real linkages among the ASEAN countries.

JEL classification numbers: F31, F33, F36

Key Words: exchange rate regime, intra-daily data, currency basket, ASEAN

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[**] Correspondence: Shin-ichi FUKUDA, Faculty of Economics, University of Tokyo, Hongo Bunkyo-ku Tokyo 113 JAPAN, E-mail: sfukuda@e.u-tokyo.ac.jp, FAX: 81-3-5841-5521.

1. Introduction

The analysis of implications of alternative exchange rate regime has been one of the most important questions in international economics. In particular, an appropriate exchange rate regime for Asian countries has been a popular topic since the Asian currency crisis of 1997-98. Most of the empirical discussion on exchange rate regimes has used the *de jure* regime as compiled by the IMF, which is based on the regime the country declares to be running. However, many countries that adopt the *de jure* flexible rate intervene in foreign exchange markets so frequently. Their observable performances thus have very little difference from those of countries that have explicit fixed exchange rates.[1] Conversely, frequent devaluations of pegs in inflation-prone countries are the result of the implementation of monetary and fiscal policies that are inconsistent with the fixed exchange rate. Moreover, countries that appear to behave according to the declared regime during tranquil times may be tempted to change their course of action once the regime is under stress. Thus, a very different picture of exchange rate regime choices may appear once the international context becomes more volatile.

In the pre-crisis period, it was widely documented that currencies of most East Asian economies maintained *de facto* pegs to the US dollar (see, for example, Frankel and Wei, 1994, Goldberg and Klein, 1997, and Ogawa, 2001).[2] One of the lessons from the Asian currency crisis of 1997-98 was, however, that the *de facto* dollar peg is an inappropriate exchange rate regime for a typical Asian emerging economy, which has a diversified set of trading partners, the US, Japan, EU, and neighboring Asian countries. The real "effective" exchange rate of the typical Asian country frequently fluctuated as the third currencies—the yen and the European currencies—fluctuated vis-à-vis the U.S. dollar. In particular, as the Japanese yen depreciated against the U.S. dollar from April 1995 to the summer of 1997, appreciation of the real effective exchange rates reduced the export competitiveness and increased current account deficits in the East Asian economies (see, for

[1] Calvo and Reinhart (2002) found that many emerging market countries that say they allow their exchange rate to float mostly do not.
[2] Takagi (1999) is an exceptional study that found some significant correlations between the East Asian currencies and the Japanese yen during this period.

example, Corsetti, Pesenti, and Roubini, 1999, and Ito, Ogawa, and Sasaki, 1998).

In the post-crisis period, Hong Kong kept its currency board arrangement and the Chinese yuan virtually maintained its peg to the U.S. dollar. However, most of the other East Asian economies have adopted managed float after the crisis. Hernández and Montiel (2001) have suggested that they are now allowed to float more at low frequencies than before 1997-98. Some other observers, in contrast, have argued that the so-called floating exchange regimes of the countries are not really floating when we look at high-frequency day-to-day observations (Kawai and Akiyama, 2000, McKinnon, 2001, McKinnon and Schnabl, 2004, and Fukuda, 2006). In particular, using a regression framework developed by Frankel and Wei (1994), McKinnon asserts that the East Asian countries have fallen back to the soft dollar peg.

The purpose of this paper is to extend the previous regression framework and to investigate what affected the post-crisis exchange rates of three ASEAN countries: Singapore, Thailand, and Malaysia.[3] Our critical departure from previous studies is the use of intra-daily exchange rates. Intra-daily exchange rates have widely been used in recent literature. A limited number of studies, however, used them to explore exchange rate regimes. The use of the intra-daily data is useful in removing possible estimation biases which the choice of numéraire may cause. It can also contrast exchange rate movements during the time zone when the government intervention is active with those when the intervention is not active.

Based on the intra-daily exchange rates, we examine how and when the ASEAN currencies changed their correlations with the U.S. dollar and the Japanese yen. During the time zone when the US market is open and when the East Asian market is closed, structural breaks were less clear throughout the post-crisis period. We, however, find significant structural breaks in the correlations during the time zone when the East Asian market is open. In the post-crisis period, the ASEAN currencies temporarily increased correlations with the Japanese yen. The increased correlations were particularly conspicuous before September 1st 1998. However, after Malaysia adopted the

[3] Indonesia is another ASEAN country that has a strong regional linkage. However, we did not analyze the Indonesia rupiah because of its prolonged turbulences after the crisis.

fixed exchange rate, both the Singapore dollar and the Thai baht increased correlations with the U.S. dollar even during the time zone when the intervention is active.

Except for Malaysia that started pegging to the U.S. dollar on September 1st 1998, the ASEAN countries had no institutional switch of exchange rate regimes in the post-crisis period. It is thus far from clear why the ASEAN currencies increased their links to the U.S. dollar in the late 1990s. A noteworthy implication from our empirical results is that a regime switch in an ASEAN country had an enormously large impact on the exchange rates of other ASEAN countries that had no regime switch. This probably reflects the fact that economic linkages among the ASEAN countries are tight in monetary and real transactions. A regime switch in a country had a strong impact on its neighboring economies and that the affected economies had another impacts on their neighboring economies. Our empirical studies support this view and suggest that the exchange rate linkage was very important to see why the post-crisis ASEAN countries had a tendency reverting back to *de facto* pegs against the U.S. dollar.

In recent literature, several studies proposed a new *de facto* classification of exchange rate regimes that reflects actual rather than announced policies, and constructed a *de facto* classification from IMF-reporting countries. Levy-Yeyati and Sturzenegger (2005) defined exchange rate regimes according to the behavior of three classification variables: changes in the nominal exchange rate, the volatility of these variables, and the volatility of international reserves. Reinhart and Rogoff (2003) constructed a *de facto* classification based on market-determined parallel exchange rates and inflation rates. Their approaches are useful in identifying the *de facto* exchange rate regime in long-run. However, the approach may not be useful in evaluating the post-crisis exchange rate regimes in East Asia where the regimes could have changed frequently during short-periods. More importantly, the approach is not suitable for countries such as Singapore that adopt intermediate exchange regimes, particularly undisclosed basket pegs.

Since East Asian countries have diversified trade structure, the currency needs to track the weighted average of the trading partners' currencies in order to stabilize the real effective exchange

rate. Several economists have proposed the desirability of intermediate exchange rate regimes in East Asia that might stabilize their effective exchange rates (see, for example, Bénassy-Quéré, 1999, Williamson, 1999, 2000, Rajan, 2002). In the post-crisis period, foreign reserves have increased in all Asian countries, proving that they have intervening, managing the pressure on the currency to appreciate. It seems that increasing foreign reserves is an intended policy of many Asian central banks. The regime of Asian currencies is thus more or less managed float. However, it is far from clear whether they are more motivated by exchange rate stability, that is, "fear of float" a la Calvo and Reinhart (2002), or deliberate building up of the foreign exchange reserves, that is, the war chest for a battle against hedge funds. It is thus very important to explore how and when the East Asian currencies changed their correlations with the U.S. dollar and the other major currencies.

The paper proceeds as follows. Section 2 explains the method of estimations and the data. Section 3 theoretically explores how the choice of numéraire may affect the estimated coefficients. Section 4 investigates the timings of structural changes to determine alternative sub-sample periods. Sections 5 provides our estimation results and examines what impacts the regime switches in some ASEAN countries had on the post-crisis exchange regimes in the ASEAN countries. Section 6 examines how volatility of exchange rates changed in the post-crisis period. After providing alternative interpretations in section 7, section 8 summarizes our main results and refers to their implications.

2. The Estimation Method and Data

In order to investigate the determinants of exchange rates in the ASEAN countries, we use an extended version of the method of Frankel-Wei to estimate the weights of major currencies (that is, the U.S. dollar, the Japanese yen, and the Sterling pound) before and after the crisis.[4] The Frankel-Wei method is a pioneering method to measure the weights of a basket that the currency of a developing country is explicitly or implicitly based. In this approach, an independent currency is

[4] One may use the Deutschmark or Euro for the Sterling pound. The choice of the European currencies will not affect the essential results in the following analysis.

chosen as an arbitrary numéraire for measuring the exchange variation. The goal is to estimate the weight a currency assigns to another currency on a given frequency. Suppose that X^j_t is the exchange rate of an ASEAN country j, where j = Singapore, Malaysia, and Thailand. Suppose also that USD_t is the US dollar, JPY_t is the Japanese yen, and SP_t is the Sterling pound. The estimated model, where the local currency's value is regressed against the major world currencies, is then written as

$$(1) \quad \Delta X^j_t = \text{constant term} + \alpha_1 \cdot \Delta USD_t + \alpha_2 \cdot \Delta JPY_t + \alpha_3 \cdot \Delta SP_t,$$

where ΔE_t is the growth rate of the exchange rate E_t. A heteroskedasticity and autocorrelation consistent covariance matrix is calculated by the method of Newey and West (1987). As in the previous studies, the following analysis will use the Swiss franc as a numéraire. The Swiss franc has a desirable property as a numéraire because it is widely transacted in international markets but has little linkage with the ASEAN currencies.

Unlike previous studies, the data of each currency's exchange rate is intra-daily data. The data set was downloaded from Datastream. Datastream provides several series of daily data in different foreign exchange markets, which allow us to obtain exchange rates in different times. We downloaded daily data series from four alternative sources: noon in New York market from NY FED, 6PM in New York market from GTIS, 10AM in Tokyo market from MUFG, and 5:30PM in Singapore market. Combining these series, we constructed our series of intra-daily data. As is summarized in Table 1, we classify time zones of each business day into the time zone when the US market is open but when both the East Asian and the European markets are closed [New York time 12:00-18:00; Tokyo time 2:00-8:00; London Time 17:00-23:00], the time zone when the East Asian market is open but when both the US and the European markets are closed [New York time 20:00-4:30; Tokyo time 10:00-18:30; London Time 1:00-9:30][5], and others. We then estimate

[5] In case of Malaysia, the second time zone is New York time 19:00-4:30 (Tokyo time 9:00-18:30; London Time 0:00-9:30) for some period because the data from MUFG was available only after

equation (1) for the first two time zones.

The government usually intervenes in the foreign exchange market when the local market is open. This is particularly true for developing countries where most foreign exchange transactions of local currencies are limited to the local market. The classification of the intra-daily data thus provides useful information that allows us to contrast exchange rate movements during the time zone when the government intervention is active with those during the time zone when the intervention is not active.

3. The Choice of Numéraire and the Estimation Biases

In our estimation, the currency value of each ASEAN country vis-à-vis the Swiss franc (CHF) is regressed on the yen-CHF, the US dollar-CHF, and the pound-CHF. This coefficient gives the weights of a basket that the currency is explicitly or implicitly based. The estimated coefficients are, however, subject to change depending on the choice of numéraire. Based on a traditional monetary approach, this section explores how the choice of numéraire may affect the estimated coefficients in the Frankel-Wei method.

Define the change in the log of country i's nominal exchange rate in terms of country j's currency by e_{ij}. Denote the change in the log of country i's money supply by Δm_i and the change in the log of country i's non-monetary shock by $\Delta \varepsilon_i$ which is assumed to be independently identically distributed over time. Then, the standard log-linear monetary approach implies that

$$(2) \qquad \Delta e_{ij} = \Delta m_i - \Delta m_j + \Delta \varepsilon_i - \Delta \varepsilon_j,$$

We suppose that country S's currency is the numéraire currency and that country A's and country J's currencies are the major currencies on which currency i may put some basket weights.[6] Then,

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August 11, 1997. When the data from MUFG is not available, we used 9am data in the Korean market.

[6] For simplicity, we reduced the number of the major currencies from three to two in the following discussions.

assuming that all of countries S, A, and J keep their money supply constant under the flexible exchange rate (that is, $\Delta m_S = \Delta m_A = \Delta m_J = 0$), equation (2) leads to the changes in the log of country i's, country A's, and country J's exchange rates as follows

(3a) $\Delta e_{i,S} = \Delta m_i + \varepsilon_i - \varepsilon_S$,

(3b) $\Delta e_{A,S} = \varepsilon_A - \varepsilon_S$,

(3c) $\Delta e_{J,S} = \varepsilon_J - \varepsilon_S$.

Therefore, when country i is a country the currency of which we need to measure the basket weights, the Frankel-Wei method suggests the estimation of the following equation:

(4) $\Delta e_{i,S} = \alpha \Delta e_{A,S} + \beta \Delta e_{J,S}$.

The method then concludes that country i's currency is fixed to country A's currency if $\alpha = 1$ and $\beta = 0$, is independently floating if $\alpha = \beta = 0$, and is in an intermediate regime if α and β lie between 0 and 1.

When country i's *de facto* regime is the fixed exchange rate regime that pegs its currency to country A's currency, it holds that $\Delta m_i = \varepsilon_A - \varepsilon_i$ because Δm_i is adjusted so as to satisfy that $\Delta e_{iA} = 0$. By using (3a), (3b), and (3c), equation (4) is thus equivalent to estimating

(5) $\varepsilon_A - \varepsilon_S = \alpha (\varepsilon_A - \varepsilon_S) + \beta (\varepsilon_J - \varepsilon_S)$.

It is easy to see that the estimates of (5) by the ordinary least squares lead that $\alpha = 1$ and $\beta = 0$. This indicates that the Frankel-Wei method can identify the regime correctly when country i's currency adopts the fixed exchange regime.

In contrast, when country i's *de facto* regime is the flexible exchange rate regime that allows its

currency independently floating, it holds that $\Delta m_i = 0$. By using (3a), (3b), and (3c), equation (4) is then equivalent to estimating

(6) $\varepsilon_i - \varepsilon_S = \alpha (\varepsilon_A - \varepsilon_S) + \beta (\varepsilon_J - \varepsilon_S)$.

It is easy to show that the estimates of (6) by the ordinary least squares lead to

(7a) $\alpha = \sigma_J^2 \sigma_S^2 / \left[\sigma_A^2 \sigma_J^2 + (\sigma_A^2 + \sigma_J^2)\sigma_S^2\right]$,

(7b) $\beta = \sigma_A^2 \sigma_S^2 / \left[\sigma_A^2 \sigma_J^2 + (\sigma_A^2 + \sigma_J^2)\sigma_S^2\right]$,

where $\sigma_S^2 = E\ \varepsilon_S^2$, $\sigma_A^2 = E\ \varepsilon_A^2$, and $\sigma_J^2 = E\ \varepsilon_J^2$. In general, both α and β lie between zero and one. This indicates that the Frankel-Wei method tends to misinterpret the pure flexible exchange regime as an intermediate regime. A source of the biases is the country-specific shock in numéraire currency S. In fact, if $\sigma_S^2 = 0$, (7a) and (7b) imply that $\alpha = \beta = 0$, so that the Frankel-Wei method can identify the flexible exchange regime correctly.

In the following analysis, we remove the possible estimation biases by using the intra-daily data. The basic idea is that we could identify the exchange rate regime correctly during the time zones when there is no country-specific shock in numéraire currency. In our estimation, we use the Swiss franc as a numéraire. The exchange rates denominated by the Swiss franc would thus show spurious correlations in equation (1) when there is an idiosyncratic shock on the Swiss franc. The spurious correlations are more likely when European markets are open because news on the Swiss franc tends to be revealed during the time zone when the local market is open. However, they are less likely when European markets are closed. Our estimation could therefore identify the exchange rate regime more appropriately during two alternative time zones: (1) the time zone when the US market is open but when both the East Asian and the European markets are closed and (2) the time zone when the East Asian market is open but when both the US and the European markets are

closed.

4. The Alternative Sample Periods

We estimate equation (1) for two alternative time zones in four alternative sample periods: (i) from January 7th 1997 to June 15th 1997, (ii) from February 2nd 1998 to the end of August 1998, (iii) from the September 2nd 1998 to December 29th 1999, and (iv) from January 4th 2000 to December 30th 2002. The period (i) is the pre-crisis period. We chose this period in order to see whether the previous results during the pre-crisis period are still confirmed by our intra-daily data. We break the post-crisis period into (ii), (iii), and (iv). In the post-crisis period, two structural breaks are assumed to arise when Malaysia introduced the fixed exchange rate regime and when some ASEAN countries introduced inflation targeting.

The first break is a natural choice because the Malaysian regime shift was the only drastic switch of the exchange rate regime in the post-crisis East Asian countries. Before shifting to the fixed exchange rate regime, Malaysia was under managed float after the crisis. In particular, since early 1998, the Malaysian government had explored a new economic policy, including the stabilization policy of real effective exchange rates of the ringgit.[7] The introduction of the fixed exchange rate on September 1st 1998 was therefore a dramatic regime shift in Malaysia (see Figure 1). In the following analysis, we start the estimation period of (ii) from the beginning of February 1998. This is because except for the Indonesian Rupiah, most of the East Asian countries almost stabilized the exchange rates after the end of January 1998.

The choice of the second structural break may be controversial. However, the regime shift in monetary policy can affect the exchange rate policy. In particular, when the share of imports in consumption goods is large, it is important to control exchange rates to achieve the inflation target.

[7] For example, the National Economic Action Council (NEAC), which was established by Prime Minister Mahathir in December 1997, announced the National Economic Recovery Plan (NERP) in August 1998. The plan stressed the importance of stabilizing the real "effective" exchange rates and proposed the adoption of a trade weighted basket system as a desirable exchange rate regime. The plan was based on the idea that the *de facto* pegs to the U.S. dollar sometimes destabilized the real "effective" exchange rates.

Among ASEAN countries, Indonesia announced inflation targeting at the beginning of 2000 and so did Thailand in May 2000. It is therefore highly possible that there was a structural break of monetary policy in Indonesia and Thailand in early 2000.

In the following analysis, we investigate whether there were structural breaks in equation (1). In particular, we explore the existence of structural changes not only in the country that had a regime shift in monetary policy but also in other countries that did not. The motivation is to see whether a regime switch in an ASEAN country had a significant impact on the exchange rates of the other ASEAN countries that had no regime switch. If economic linkages among the ASEAN countries are tight in monetary and real transactions, a regime switch in a country would have a strong impact on its neighboring economies and that the affected economies would have another impact on their neighboring economies.

Table 2 summarizes mean and standard deviation of the growth rate of each exchange rate for alternative time zones and sample periods. All exchange rates are less volatile when only the US market is open [New York time 12:00-18:00] and are more volatile when only Sidney and Tokyo markets are open [Tokyo time 8:00-10:00]. The Japanese Yen and other East Asian currencies are more volatile when the East Asian market is open but when both the US and the European markets are closed [Tokyo time 10:00-18:30], while the Sterling Pound is more volatile when the European market is open [London Time 9:30-17:00]. Reflecting the crisis, East Asian currencies are more volatile from Feb. 2 to Aug. 31 in 1998. However, all exchange rates are generally volatile enough for all time zones throughout the sample periods.

5. The Estimation Results

(i) From January 7th 1997 to June 15th 1997

Based on the intra-daily exchange rates, we first estimate equation (1) for the two alternative time zones from January 7th 1997 to June 15th 1997. We made the estimations to see whether the previous results during the pre-crisis period are still confirmed by our intra-daily data. Our

estimations are different from previous studies not only in the sample period but also in the data frequency. The results can thus be different from previous ones that were estimated based on less frequency data such as daily, weakly, or monthly data.

Table 3 summarizes the estimation results. In all of the ASEAN countries, the estimated coefficient of the US dollar was significantly positive and large. In particular, it was close to one when the US market was open. The estimated coefficients of the Japanese yen and the sterling pound were, in contrast, very small for both time zones in all of the ASEAN countries. In Thailand and Malaysia, the coefficient of the Japanese yen was not significantly positive for any time zone. Even in Singapore, the U.S. dollar had the dominant weight in the currency basket of the Singapore dollar. The results imply that the ASEAN currencies had strong links to the US dollar in the pre-crisis period.

However, when the East Asian market was open, the links to the US dollar was not as strong as those when the US market was open. When the East Asian market was open, the estimated coefficient of the US dollar was between 0.62 and 0.73. In Malaysia, the sterling pound had significantly positive weights. In Singapore, both the Japanese yen and the sterling pound had significantly positive weights. The results imply that even in the pre-crisis period, the strong links of the ASEAN currencies to the US dollar does not necessarily mean *de facto* pegs to the US dollar during the time zone when the intervention is active.

The adjusted R^2's of the estimated equations were large in most estimates, implying that the degree of idiosyncratic flexibility was limited in the pre-crisis period. The adjusted R^2 for the Thai baht was relatively low when the US market was open. The result may reflect the fact that the Thai baht had several modest devaluations in the first half of 1997 before experiencing devastating currency attacks.

(ii) From February 2nd 1998 to the end of August 1998

We next estimate equation (1) for the two alternative time zones in the post-crisis period before the

Malaysian government shifted its exchange rate regime from managed float to the fix exchange rate. After the Thai crisis in July 1997, several East Asian countries experienced serious currency devaluations. During the crisis, the market values of the Malaysia ringgit and the Thai baht that had moved to managed float dropped to nearly half of the pre-crisis level until January 1998. It was after the end of January 1998 when these currencies were almost stabilized. We thus estimate equation (1) from February 2nd 1998 to the end of August 1998.[8]

Table 4 summarizes the estimation results. Compared with those in Table 3, the adjusted R^2's dropped down dramatically in all of the ASEAN countries. This implies that the ASEAN currencies increased their idiosyncratic flexibility after the crisis. Compared with those in the pre-crisis period, the coefficient of the U.S. dollar declined, while that of the Japanese yen increased. The coefficient of the sterling pound became insignificant. The estimated coefficients, however, showed different changes depending on the time zones, which contrast the exchange rate movements when the intervention is active with those when the intervention is not active.

During the time zone when the US market is open and when the East Asian market is closed, the changes in the estimated parameters were relatively moderate in Singapore and Thailand. In these countries, the coefficient of the US dollar remained high above that of the yen after the crisis. In contrast, during the time zone when the East Asian market is open, there were drastic changes in the estimated parameters in all of the ASEAN countries. The statistically significant coefficient of the Japanese yen lay between 0.62 and 0.78. The coefficient of the U.S. dollar was, on the other hand, smaller than that of the Japanese yen in all of the ASEAN countries and was not significantly positive in Thailand and Malaysia.

Table 5 summarizes the results of our structural break test. Pooling the data from January 7th 1997 to June 15th 1997 and from February 2nd 1998 to the end of August 1998, we tested the null hypothesis that each coefficient did not change after the crisis. In the test, a heteroskedasticity and autocorrelation is adjusted by the method of Newey and West. The table reports the changes of the

[8] In case of Malaysia, we started the estimation from February 17th to exclude exchange rate turbulences in early February 1998.

estimated coefficients between the regimes and their standard errors. If there was no structural break, the change in each coefficient would not be significantly different from zero. During the time zone when the US market is open, the test could find no significant structural break in Thailand although the test showed a structural break in Singapore. In contrast, during the time zone when the East Asian market is open, the test showed significant structural breaks in all of the countries: a significant decline in the coefficient of the US dollar and a significant increase in the coefficient of the Japanese yen. Among the three countries, the coefficient of the Japanese yen increased most in Malaysia after the crisis.

The above results have three noteworthy implications. The first is that a structural break occurred even in Singapore. Compared with the other countries, Singapore experienced relatively modest currency devaluation during the crisis and consequently did not have an explicit shift of the exchange regime after the crisis. Our results, however, suggest that regime switches in other East Asian countries had a large impact on the Singapore dollar that had no regime switch.

The second is that the structural break was more conspicuous when the East Asian market was open. To the extent that the government intervenes in the foreign exchange market when its local market is open, the impacts of the ASEAN government interventions would be reflected more in the changes of exchange rates when the East Asian market was open than those when the East Asian market was closed. Contrasting our empirical results in the two time zones thus support the view that the interventions by the ASEAN governments increased the link of the East Asian currencies to the Japanese yen and decreased the link to the US dollar after the crisis.

The third is that the most dramatic structural change occurred in Malaysia. In Malaysia, the coefficient of the Japanese yen was significantly positive even when the US market was open, while that of the US dollar was not significant in both time zones. The result probably reflects the fact that the Malaysian government explored a new economic policy, including the stabilization policy of real effective exchange rates before fixing the ringgit to the US dollar.

(iii) From the September 2nd 1998 to December 29th 1999

On September 1st 1998, the Malaysian government suddenly changed its exchange rate to the fixed exchange rate. It was the only drastic switch of the exchange rate regime that occurred in the post-crisis East Asian countries. In this sub-section, we estimate our basic equation after the Malaysian government shifted its exchange rate regime. Since $\alpha_1 = 1$ and $\alpha_2 = \alpha_3 = 0$ in Malaysia after September 1998, we estimated equation (1) only for Singapore and Thailand. The motivation is to investigate how the dramatic regime shift in Malaysia affected the exchange rates of these ASEAN countries that had no explicit regime switch.

Table 6 summarizes the estimation results. During the time zone when the US market is open, the two ASEAN currencies kept having strong correlations with the U.S. dollar. The coefficient of the U.S. dollar was close to one in both currencies, while the coefficient of the yen was not significant in the Thai baht. Even in Singapore, the significant coefficient of the yen was very small. In contrast, during the time zone when the East Asian market is open, the link to the U.S. dollar remained relatively moderate and the coefficients of the yen and the Sterling pound were still statistically different from zero in both countries. However, the coefficient of the yen became much smaller than that of the U.S. dollar. The coefficient of the U.S. dollar was statistically significant, although it was around 0.5. Compared with those in Table 4, we can see that the adjusted R^2's became larger after the regime shift in Malaysia. This suggests that the ASEAN currencies reduced their idiosyncratic flexibility and increased correlations with the U.S. dollar after the regime shift.

Table 7 reports the results of our structural break test after Malaysia introduced the fixed exchange rate regime. Pooling the data from February 2nd 1998 to the end of August 1998 and from the September 2nd 1998 to December 29th 1999, we examined changes of the estimated coefficients between the regimes by Newey and West robust t-statistics. During the time zone when the US market is open, the test showed a marginally significant structural break in Singapore but could find no significant break in Thailand after the Malaysian regime shift. In contrast, during the time zone when the East Asian market is open, the test showed significant structural breaks in both Singapore

and Thailand: a significant increase in the coefficient of the US dollar and a significant decrease in the coefficient of the Japanese yen.

Comparing the results of two time zones suggest that the interventions by the ASEAN governments still kept some degree of links to the Japanese yen and the Sterling pound in their currencies in the sample period. But even during the time zone when the intervention is active, the ASEAN currencies reduced the correlations with the Japanese yen and increased the correlations with the U.S. dollar after the regime shift in Malaysia. This implies that the structural break in Malaysia had a large impact on the exchange rates of the other ASEAN countries that had no regime switch but whose economic linkages with Malaysia had been very tight.

(iv) From January 4th 2000 to December 30th 2002.

The introduction of inflation targeting is in principle a regime shift of domestic monetary policy. However, in a small open economy where the share of imports in consumption goods is large, it can have a strong impact on the exchange rate policy. This is because the import prices are a key determinant of targeted inflation in such an economy. In particular, when the U.S. dollar has been dominant in invoice currencies in their imports, the introduction of inflation targeting might have increased their incentives to stabilize their exchange rates against the U.S. dollar. For example, in the appendix of Inflation Report (July 2002), the Bank of Thailand showed a simulation result that 10% depreciation of the Thai baht against the U.S. dollar would cause about 0.9% increase of core inflation rate. It suggests that the exchange rate stability against the U.S. dollar is a critical factor to achieve the targeted inflation in Thailand.

Inflation targeting was introduced in Indonesia and Thailand in early 2000. We thus estimate equation (1) from January 4th 2000 to December 30th 2002 for two alternative time zones in Singapore and Thailand. Table 8 summarizes the estimation results. The adjusted R^2's were larger than those in Table 6 and were almost comparable to those in the pre-crisis period in all countries. The coefficient of the Sterling pound became less than 0.1 in both time zones. When

the US market was open, the results are almost comparable to those before inflation targeting was introduced. However, when the East Asian market was open, the coefficient of the US dollar went up to more than 0.6. The results suggest that the government interventions increased further the links of the ASEAN currencies to the US dollar after early 2000 during the time zone when the intervention is active. The coefficient of the Japanese yen was, however, significantly positive in both currencies for the two time zones. The result is in marked contrast with that in the pre-crisis period where the Japanese yen had no significantly positive coefficient except for the East Asian time zone in Singapore. This implies that the increased links to the U.S. dollar after early 2000 were accompanied by some degree of flexibility where the Japanese yen had a significant weight.

Table 9 reports the results of our structural break test after the introduction of inflation targeting. Newey and West robust t-statistics are applied for the structural beak test pooling the data from the September 2nd 1998 to December 29th 1999 and from January 4th 2000 to December 30th 2002. During the time zone when the US market is open, the test could find no structural break in both countries. However, when the East Asian market was open, the coefficient of the US dollar went up significantly in Singapore. It is noteworthy that the changes occurred even in Singapore that had no regime switch of monetary policy. This implies the existence of a strong linkage among the ASEAN exchange rates. However, the coefficient of the Japanese yen went up significantly in Thailand. When intruding inflation targeting, the Thai baht increased its link to the Japanese yen significantly.

6. Comparison of the Exchange Rate Volatility

In the last section, we investigated how and when the ASEAN currencies changed their correlations with the U.S. dollar and the Japanese yen. Our basic finding was that the ASEAN currencies temporarily increased correlations with the Japanese yen after the crisis but that two structural breaks increased correlations with the U.S. dollar. The high correlations with the U.S. dollar, however, did not necessarily mean that the ASEAN currencies have *de facto* pegs against the

U.S. dollar. The increased correlations with the U.S. dollar after early 2000 were accompanied by some degree of flexibility and significant correlation with the Japanese yen both of which did not exist in the pre-crisis period.

To support this view, this section explores how the structural breaks affected the volatility of exchange rates in the post-crisis period by using the daily data. For the growth rate and the logged level, we calculate the standard errors of each ASEAN exchange rate against the U.S. dollar normalizing by its mean. For the long-term data, the standard error of the logged exchange rates may be less desirable than those of the growth rates because the exchange rates usually have unit roots. But the exchange rates sometime fluctuate around a constant par value in the short-run. The ratios of standard errors for the logged levels may thus be an alternative measure that provides some information of short-term volatility. We assume the standard error of each ASEAN exchange rate in the pre-crisis period (that is, the standard error from January 7th 1997 to June 15th 1997) as the benchmark. We then explore how the standard errors changed from the benchmark in three sample periods: (i) from February 2nd 1998 to the end of August 1998, (ii) from September 2nd 1998 to December 29th 1999, and (iii) from January 4th 2000 to September 5th 2002.

For each sub-sample period, Table 10-1 reports the ratios of the standard errors to the benchmark for the growth rates. The results are consistent with the view that the ASEAN currencies increased correlations with the U.S. dollar after two structural breaks. Comparing the ratios in the table, we see dramatic increases of the standard errors in the period (i). The increases occurred partly because the ASEAN currencies still experienced some turbulence and partly because ASEAN currencies increased correlations with the Japanese yen. The standard errors, however, declined steadily after September 1998. In particular, in period (iii), the ratios became lower than one in Thailand and close to one in Singapore. This implies that in terms of the growth rates, the ASEAN exchange rates after 2000 had stability against the U.S. dollar that is almost comparable to those in the pre-crisis period.

Table 10-2 reports the ratios of standard errors to the benchmark for the logged level. Except for

period (iii), the basic messages remain the same even when we look at the level of each exchange rate. Comparing the ratios in the table, we see that the standard errors, which increased dramatically in the period (i), were partially stabilized in period (ii). This suggests that the ASEAN exchange rates increased their link to the U.S. dollar in period (ii). The standard errors, however, slightly increased in period (iii) in both Singapore and Thailand. In terms of the levels, the Singapore dollar and the Thai baht increased their flexibility against the U.S. dollar after 2000. The increased link to the U.S. dollar, that was observed in the growth rates, was accompanied by some degree of flexibility in the logged levels after 2000.

7. Alternative Interpretations

Until the last sections, we have demonstrated that the ASEAN currencies had changed their correlations with the U.S. dollar and the Japanese yen in September 1998 and in early 2000. We interpreted that the structural breaks arose when Malaysia introduced the fixed exchange rate regime and when some East Asian countries introduced inflation targeting. However, several other interpretations may be possible.

One interpretation is that a change of macroeconomic correlation altered the correlations of the ASEAN exchange rates with the U.S. dollar and the Japanese yen. Throughout the late 1990s, the U.S. economy was booming, while the Japanese economy experienced a long stagnation. Since the ASEAN economies still stagnated in early 1998, their macroeconomic fundamentals had a strong positive correlation with those of Japan in the first half of 1998. However, since the ASEAN countries made a sharp recovery after the middle of 1998, their fundamentals came to have a strong positive correlation with those of the United States after the latter half of 1998. To the extent that macroeconomic fundamentals affect exchange rates, this may provide a partial explanation on the sources of the structural change in September 1998. However, we see no conspicuous change in macroeconomic correlation in early 2000. Moreover, the structural changes of the exchange rates had different features between two different time zones. Structural changes of macroeconomic

correlations are hard to explain the different features between two different time zones.

The other interpretation is that a structural change of the Japanese yen/U.S. dollar exchange rate changed the correlations of the ASEAN exchange rates. The Japanese yen/U.S. dollar exchange rate had series of structural breaks during the past decade. Figure 2 draws the movements of the yen/dollar exchange rates from January 1994 to December 2001. It shows that the yen had steadily depreciated against the U.S. dollar since the middle of 1995 and that the rate of depreciation was accelerated after November 1997. The trend of the depreciation had continued until the end of July 1998. However, after August 1998, the yen, in turn, started appreciating against the U.S. dollar and that the appreciation had continued until the end of December 1999. This indicates that if the ASEAN currencies had asymmetric responses to appreciation and depreciation of the yen/dollar exchange rates, they could have had different correlations with the U.S. dollar and the Japanese yen before and after September 1998.

The yen/dollar exchange rates, however, had a tendency to depreciate again after early 2000. If the asymmetric responses to the yen/dollar exchange rates were important, the estimated correlations after early 2000 would have been reversed and became similar to those before September 1998 in the post-crisis period. We, however, found that the estimated correlations never returned to those before September 1998. Instead, the ASEAN currencies increased correlations with the U.S. dollar after early 2000. The yen/dollar exchange rates are thus not satisfactory in explaining why large structural changes were observed in early 2000.

8. Concluding remarks

In this paper, we investigated the determinants of the post-crisis exchange rates of three ASEAN countries: Singapore, Thailand, and Malaysia. Based on the intra-daily observations, we examined how and when the ASEAN currencies changed their correlations with the U.S. dollar and the Japanese yen. A noteworthy implication from our empirical results was that a regime switch in an ASEAN country had an enormously large impact on the exchange rates of other ASEAN countries

that had no regime switch. This probably reflects the fact that economic linkages among ASEAN countries are tight in monetary and real transactions. A regime switch in an ASEAN country can have a strong impact on its neighboring economies and that the affected economies can have another impacts on their neighboring economies in ASEAN. Our empirical studies supported this view and suggest that the exchange rate linkage was very important to see why the post-crisis ASEAN countries had a tendency reverting back to *de facto* pegs against the U.S. dollar.

In recent literature, many economists based in the IMF and the US universities advocated the so-called "two-corner solution" (see, among others, Fischer, 2001). According to the view, there are only two stable exchange rate regimes, free floating and hard peg such as the currency board and dollarization. Any exchange rate regime between the hard peg and the free floating regime would be unstable and would eventually move to one of the extremes. A supporting argument was the fact that Hong Kong and Argentina that had been adopting the dollar-peg, currency board survived the Mexican currency crisis of 1994-95 and the Asian currency crisis of 1997-98. Other scholars were, however, more skeptical on the argument of the two-corner solution. Critics argued that the middle-ground regime may be stable and that two corners may not be as robust as the two-corner solution advocates might think. Frankel (1999) discussed that no single currency regime is right for all countries or at all times. An appropriate exchange rate regime depends on economic conditions.

Out of 186 economies, the IMF, as of December 31, 2001, classified 41 as independently floating, 48 as following rigid pegs (exchange arrangements with no separate legal tender or currency board arrangements), and 35 as conventional pegs against a single currency fixed peg arrangements including *de facto* peg arrangements and pegged exchange rates within horizontal bands). This, however, leaves 62 economies following intermediate regimes (pegs against a composite, crawling pegs, exchange rates within bands, and managed floating). The implication is that many countries still choose something in between rigid fixity and free float.

After the crisis, several ASEAN countries adopted different types of exchange rate regimes. After experiencing some transitional regime, Malaysia started pegging to the U.S. dollar on

September 1st 1998, while Thailand and Indonesia adopted managed float since the crisis. Singapore kept the undisclosed basket peg. Bayoumi, Eichengreen, and Mauro (2000, 2001) showed that on economic criteria, ASEAN appears less suited for a regional currency arrangement than Europe before the Maastricht Treaty, although the difference is not large. However, the *de facto* pegs to the U.S. dollar may destabilize the real "effective" exchange rates of these currencies. The basket currency system that is advocated by Williamson (2000) is, to be precise, a basket band crawling system where the basket value is a reference rate. The central bank is advised to keep the exchange rate fluctuation within a certain band around the reference rate. The reference rate may move if the rates of inflation and the productivity increase are different from those of the trading partners. To avoid another crisis in East Asia, it is an urgent issue to reconsider what is the desirable exchange rate regime in East Asian from a view of regional cooperation.

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Table 1. The Classification of the Time Zones

		New York Time	Tokyo Time	London Time
(1)	The Time Zone when the US Market is Open but when the East Asian and the European Markets are Closed	12:00-18:00	2:00-8:00	17:00-23:00
(2)	The Time Zone when the East Asian Market is Open but the US and the European Markets are Closed	20:00-4:30	10:00-18:30	1:00-9:30
(3)	The Other Time Zone I	4:30-12:00	18:30-2:00	9:30-17:00
	The Other Time Zone II	18:00-20:00	8:00-10:00	23:00-1:00

Note) In case of Malaysia, the time zone when the East Asian market is open starts from NY time 19:00 (Tokyo time 9:00) because of data availability.

Table 2. Basic Statistic of Growth Rates of Exchange Rates

(1) U.S. Dollar-Swiss Fanc Rate

		12:00-18:00 in NY time	10:00-18:30 in Tokyo time	9:30 - 17:00 in London time	8:00 - 10:00 in Tokyo time
Jan. 7, 1997 - June.15, 1997	Mean	0.036%	-0.054%	-0.044%	0.062%
	STD	0.331%	0.390%	0.522%	0.701%
Feb. 2, 1998 - Aug. 31, 1998	Mean	0.039%	-0.016%	-0.011%	-0.012%
	STD	0.206%	0.576%	0.647%	0.564%
Sep. 2, 1998 - Dec. 29, 1999	Mean	0.023%	0.002%	-0.051%	0.027%
	STD	0.325%	0.652%	0.622%	0.677%
Jan. 4, 2000 - Dec. 30, 2002	Mean	0.074%	0.048%	-0.092%	-0.031%
	STD	0.315%	0.599%	0.422%	0.671%

(2) Japanese Yen - Swiss Franc Rate

		12:00-18:00 in NY time	10:00-18:30 in Tokyo time	9:30 - 17:00 in London time	8:00 - 10:00 in Tokyo time
Jan. 7, 1997 - June.15, 1997	Mean	0.004%	-0.173%	0.011%	0.157%
	STD	0.276%	0.434%	0.417%	0.643%
Feb. 2, 1998 - Aug. 31, 1998	Mean	0.022%	0.035%	0.006%	-0.063%
	STD	0.317%	0.682%	0.692%	0.869%
Sep. 2, 1998 - Dec. 29, 1999	Mean	0.009%	-0.111%	-0.088%	0.190%
	STD	0.392%	0.851%	0.664%	0.970%
Jan. 4, 2000 - Dec. 30, 2002	Mean	0.063%	0.002%	-0.070%	0.005%
	STD	0.317%	0.648%	0.478%	0.740%

(3) Sterling Pound - Swiss Franc Rate

		12:00-18:00 in NY time	10:00-18:30 in Tokyo time	9:30 - 17:00 in London time	8:00 - 10:00 in Tokyo time
Jan. 7, 1997 - June.15, 1997	Mean	0.016%	-0.007%	-0.017%	0.008%
	STD	0.305%	0.403%	0.514%	0.700%
Feb. 2, 1998 - Aug. 31, 1998	Mean	0.011%	0.021%	-0.021%	-0.012%
	STD	0.222%	0.374%	0.418%	0.479%
Sep. 2, 1998 - Dec. 29, 1999	Mean	-0.006%	0.040%	-0.058%	0.024%
	STD	0.258%	0.522%	0.513%	0.575%
Jan. 4, 2000 - Dec. 30, 2002	Mean	0.030%	0.037%	-0.036%	-0.031%
	STD	0.263%	0.470%	0.381%	0.549%

Note STD = standard deviation.

Table 2. Basic Statistic of Exchange Rates (continued)

(4) Singapore Dollar-Swiss Fanc Rate

		12:00-18:00 in NY time	10:00-18:30 in Tokyo time	9:30 - 17:00 in London time	8:00 - 10:00 in Tokyo time
Jan. 7, 1997 - June.15, 1997	Mean	0.013%	-0.034%	-0.003%	0.024%
	STD	0.318%	0.366%	0.479%	0.660%
Feb. 2, 1998 - Aug. 31, 1998	Mean	-0.023%	0.085%	-0.005%	-0.056%
	STD	0.364%	0.706%	0.706%	0.912%
Sep. 2, 1998 - Dec. 29, 1999	Mean	0.000%	0.014%	-0.074%	0.060%
	STD	0.342%	0.541%	0.489%	0.694%
Jan. 4, 2000 - Dec. 30, 2002	Mean	0.053%	0.052%	-0.049%	-0.056%
	STD	0.325%	0.569%	0.409%	0.650%

(5) Thai Baht - Swiss Franc Rate

		12:00-18:00 in NY time	10:00-18:30 in Tokyo time	9:30 - 17:00 in London time	8:00 - 10:00 in Tokyo time
Jan. 7, 1997 - June.15, 1997	Mean	-0.053%	0.108%	0.020%	-0.061%
	STD	0.351%	0.730%	0.522%	0.933%
Feb. 2, 1998 - Aug. 31, 1998	Mean	-0.202%	0.262%	0.178%	-0.238%
	STD	0.491%	1.334%	0.905%	1.424%
Sep. 2, 1998 - Dec. 29, 1999	Mean	-0.046%	0.087%	0.023%	-0.063%
	STD	0.462%	0.721%	0.630%	0.803%
Jan. 4, 2000 - Dec. 30, 2002	Mean	0.023%	0.176%	-0.030%	-0.169%
	STD	0.360%	0.646%	0.460%	0.730%

(6) Malaysia Ringgit - Swiss Franc Rate

		12:00-18:00 in NY time	10:00-18:30 in Tokyo time	9:30 - 17:00 in London time	8:00 - 10:00 in Tokyo time
Jan. 7, 1997 - June.15, 1997	Mean	0.032%	-0.041%	-0.028%	0.037%
	STD	0.324%	0.403%	0.474%	0.700%
Feb. 2, 1998 - Aug. 31, 1998	Mean	-0.048%	-0.031%	0.121%	-0.124%
	STD	0.423%	1.141%	0.983%	1.347%

Note STD = standard deviation.

Table 3. The Estimation in the Pre-crisis Period (The Sample Period: Jan.7- June 15 in 1997)

(1) The Time Zone when the US Market is Open

	Singapore dollar	Thai baht	Malaysia ringgit
Constant	-0.0002 ***	-0.0006 *	0.0000
	(0.0001)	(0.0003)	(0.0001)
US dollar	0.9095 ***	1.0928 ***	0.9492 ***
	(0.0001)	(0.2080)	(0.0340)
Japanese Yen	0.0320	-0.1187	0.0061
	(0.0293)	(0.0981)	(0.0022)
Sterling pound	0.0245	0.1400 *	0.0208
	(0.0294)	(0.0816)	(0.0294)
adj. R2	0.9494	0.6434	0.9619
DW	1.7037	1.2095	2.1666

(2) The Time Zone when the East Asian Market is Open

	Singapore dollar	Thai baht	Malaysia ringgit
Constant	0.0003	0.0020 **	-0.0002
	(0.0002)	(0.0009)	(0.0001)
US dollar	0.6207 ***	0.7212 ***	0.6395 ***
	(0.0782)	(0.1554)	(0.0332)
Japanese Yen	0.1526 ***	0.2691	0.0545
	(0.0405)	(0.2618)	(0.0611)
Sterling pound	0.1662 **	0.0889	0.2561 ***
	(0.0665)	(0.1376)	(0.0719)
adj. R2	0.7293	0.8598	0.7455
DW	2.0016	1.9807	2.0553

Notes 1) We added a dummy to remove irregular changes of Thai baht on May 16th 1997.
2) ***: significant at 1% level, **: significant at 5% level, *: significant at 10% level.
3) Figures in parentheses are standard errors of those coefficient estimates.

Table 4. The Estimation before Malaysia Introduced the Fixed Exchange Regime

(The Sample Period: Feb. 2 - Aug. 31 in 1998)

(1) The Time Zone when the US Market is Open

	Singapore dollar	Thai baht	Malaysia ringgit
Constant	-0.0005 *	-0.0024 ***	-0.0006 **
	(0.0003)	(0.0004)	(0.0003)
US dollar	0.6351 ***	0.8902 ***	0.2258
	(0.0971)	(0.1982)	(0.1979)
Japanese Yen	0.2317 ***	0.0684	0.4500 ***
	(0.0760)	(0.1879)	(0.0823)
Sterling pound	-0.0642	-0.2188	0.1434
	(0.1530)	(0.1554)	(0.2236)
adj. R2	0.2147	0.1187	0.1955
DW	1.5665	1.8619	1.9549

(2) The Time Zone when the East Asian Market is Open

	Singapore dollar	Thai baht	Malaysia ringgit
Constant	0.0006	0.0024 ***	-0.0006
	(0.0004)	(0.0009)	(0.0008)
US dollar	0.2078 **	0.1384	0.0680
	(0.0989)	(0.1245)	(0.1642)
Japanese Yen	0.6769 ***	0.6274 ***	0.7876 ***
	(0.0589)	(0.1327)	(0.1277)
Sterling pound	0.0161	-0.0985	0.0829
	(0.1274)	(0.2195)	(0.3288)
adj. R2	0.5540	0.1289	0.1518
DW	2.0582	1.9984	2.4522

Notes 1) In case of Malayais, the estimation period starts from February 17th, 1998 to exclude exchange rate turbulances in early February 1998.
2) ***: significant at 1% level, **: significant at 5% level, *: significant at 10% level.
3) Figures in parentheses are standard errors of those coefficient estimates.

Table 5. The Structural Break Test Statistics After the Crisis

(1) The Time Zone when the US Market is Open

	Singapore dollar	Thai baht	Malaysia ringgit
Changes in the coeff. of US dollar	-0.2980 *** (0.0961)	-0.3300 (0.2936)	-0.7670 *** (0.1910)
Changes in the coeff. of Japanese Yen	0.203 ** (0.0806)	0.204 (0.2184)	0.452 *** (0.0862)
Changes in the coeff. of Sterling pound	-0.085 (0.1545)	-0.342 * (0.1861)	0.134 (0.2243)

(2) The Time Zone when the East Asian Market is Open

	Singapore dollar	Thai baht	Malaysia ringgit
Changes in the coeff. of US dollar	-0.407 *** (0.1292)	-0.634 *** (0.2015)	-0.604 *** (0.1647)
Changes in the coeff. of Japanese Yen	0.516 *** (0.0753)	0.391 * (0.2366)	0.692 *** (0.1323)
Changes in the coeff. of Sterling pound	-0.135 (0.1394)	-0.159 (0.2698)	-0.517 ** (0.2220)

Notes 1) The data is from January 7th 1997 to June 15th 1997 and from February 2nd 1998 to the end of August 1998. In Malayais, the latter period starts from February 17th, 1998.
2) ***: significant at 1% level, **: significant at 5% level, *: significant at 10% level.
3) Figures in parentheses are standard errors of those coefficient estimates.

Table 6. The Estimation after Malaysia Introduced the Fixed Exchange Regime

(The Sample Period: Sep. 2 in 1998 - Dec. 29 in 1999)

(1) The Time Zone when the US Market is Open

	Singapore dollar	Thai baht
Constant	-0.0002 **	-0.0007 ***
	(0.0001)	(0.0002)
US dollar	0.8714 ***	0.9382 ***
	(0.0695)	(0.1171)
Japanese Yen	0.1268 ***	-0.0032
	(0.0390)	(0.0584)
Sterling pound	-0.0470	-0.0267
	(0.0596)	(0.0758)
adj. R2	0.7770	0.4246
DW	1.8314	1.7114

(2) The Time Zone when the East Asian Market is Open

	Singapore dollar	Thai baht
Constant	0.0002	0.0009 ***
	(0.0001)	(0.0003)
US dollar	0.4630 ***	0.5237 ***
	(0.0562)	(0.0775)
Japanese Yen	0.1663 ***	0.1152 ***
	(0.0413)	(0.0341)
Sterling pound	0.1982 ***	0.1836 **
	(0.0679)	(0.0927)
adj. R2	0.5780	0.3552
DW	2.0382	1.9279

Note 1) ***: significant at 1% level, **: significant at 5% level, *: significant at 10% level.
2) Figures in parentheses are standard errors of those coefficient estimates.

Table 7. The Structural Break Test Statistics After Malaysia Introduced the Fixed Regime

(1) The Time Zone when the US Market is Open

	Singapore dollar	Thai baht
Changes in the coeff. of US dollar	0.266 ** (0.1143)	0.206 (0.2250)
Changes in the coeff. of Japanese Yen	-0.106 (0.0850)	-0.075 (0.2039)
Changes in the coeff. of Sterling pound	0.004 (0.1584)	0.122 (0.1860)

(2) The Time Zone when the East Asian Market is Open

	Singapore dollar	Thai baht
Changes in the coeff. of US dollar	0.259 ** (0.1170)	0.398 *** (0.1539)
Changes in the coeff. of Japanese Yen	-0.513 *** (0.0726)	-0.519 *** (0.1422)
Changes in the coeff. of Sterling pound	0.172 (0.1437)	0.250 (0.2321)

Notes 1) The data is from February 2nd 1998 to the end of August 1998 and from the September 2nd 1998 to December 29th 1999.
2) ***: significant at 1%, **: significant at 5%, *: significant at 10%.
3) Figures in parentheses are standard errors.

Table 8. The Estimation after the Introduction of Inflation Targeting

(The Sample Period: Jan. 4 in 2000 - Dec. 30 in 2002)

(1) The Time Zone when the US Market is Open

	Singapore dollar	Thai baht
Constant	-0.0002 ***	-0.0005 ***
	(0.0000)	(0.0001)
US dollar	0.8085 ***	0.8677 ***
	(0.0546)	(0.0643)
Japanese Yen	0.1631 ***	0.1116 **
	(0.0383)	(0.0485)
Sterling pound	0.0440	0.0942 **
	(0.0374)	(0.0374)
adj. R2	0.8780	0.7875
DW	1.9007	1.9066

(2) The Time Zone when the East Asian Market is Open

	Singapore dollar	Thai baht
Constant	0.0002 **	0.0014 ***
	(0.0001)	(0.0001)
US dollar	0.6534 ***	0.6361 ***
	(0.0819)	(0.0937)
Japanese Yen	0.2380 ***	0.2529 ***
	(0.0332)	(0.0423)
Sterling pound	0.0743	0.0890
	(0.0575)	(0.0722)
adj. R2	0.8501	0.6648
DW	1.9724	2.0687

Note 1) ***: significant at 1% level, **: significant at 5% level, *: significant at 10% level.
2) Figures in parentheses are standard errors of those coefficient estimates.

Table 9. The Structural Break Test Statistics After the Introduction of Inflation Targeting

(1) The Time Zone when the US Market is Open

	Singapore dollar	Thai baht
Changes in the coeff. of US dollar	-0.061 (0.0872)	-0.058 (0.1402)
Changes in the coeff. of Japanese Yen	0.036 (0.0546)	0.116 (0.0758)
Changes in the coeff. of Sterling pound	0.090 (0.0701)	0.112 (0.0864)

(2) The Time Zone when the East Asian Market is Open

	Singapore dollar	Thai baht
Changes in the coeff. of US dollar	0.190 * (0.0992)	0.115 (0.1227)
Changes in the coeff. of Japanese Yen	0.071 (0.0529)	0.128 ** (0.0536)
Changes in the coeff. of Sterling pound	-0.124 (0.0892)	-0.085 (0.1180)

Notes 1) The data is from the September 2nd 1998 to December 29th 1999 and from January 4th 2000 to December 30th 2002.
2) ***: significant at 1%, **: significant at 5%, *: significant at 10%.
3) Figures in parentheses are standard errors.

Table 10-1. The Ratios of the Standard Errors to the Benchmark: The Case of Growth Rates

	(i) 1998.2.2-1998.8.31	(ii) 1998.9.2-1999.12.29	(iii) 2000.1.4-2002.12.30
Singapore	4.41578	2.13228	1.30648
Thai baht	2.83548	1.12223	0.72192
Malaysia	7.82866		

Table 10-2. The Ratios of the Standard Errors to the Benchmark: The Case of Logged Level

	(i) 1998.2.1-1998.8.31	(ii) 1998.9.1-1999.12.31	(iii) 2000.1.4-2002.12.31
Singapore	2.4662	1.27306	1.63465
Thai baht	2.3013	1.39702	2.27272
Malaysia	5.8750		

Figure 1. Movements of the Malaysia Ringgit after the Crisis (Ringgit/$)

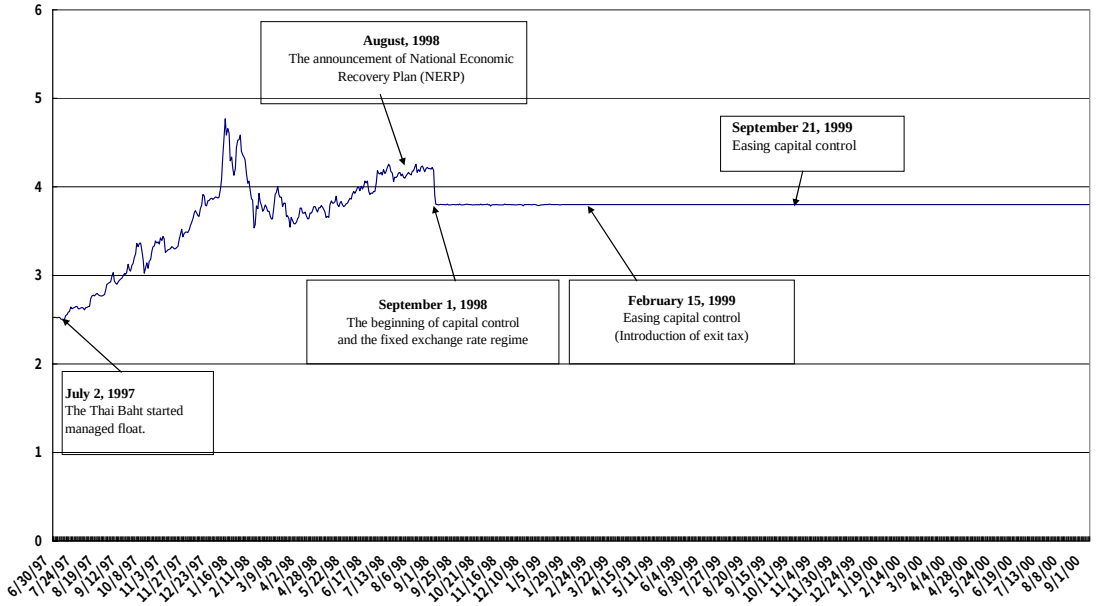

Figure 2. Movements of the Yen/the U.S. Dollar Exchange Rate (Yen/$)