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ABSTRACT

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This paper examines Thailand’s exchange rate policy, focusing on the degree of the country’s real exchange rate misalignment pre-crisis, and their consequent effects on Thailand’s trade balance with its two large trading partners, the US and Japan. We estimate misalignment as the difference between actual and “equilibrium” exchange rates. We use three key “equilibrium” exchange rates of the Thai baht, viz. the real effective equilibrium exchange rate of the Thai baht against its twenty two major trading partners; the bilateral real equilibrium exchange rates of the baht against the US dollar; and the bilateral real equilibrium exchange rate of the baht against the Japanese yen. Our sample period spans two decades (Q1: 1981 to Q3: 1999).

Keywords: Japan, real exchange rate, Thailand, trade, US

JEL codes: F30, F32, F34

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1. Introduction

Just as the Tequila crisis of 1994-95 has inspired a great deal of interest in the Mexican economy, the East Asian debacle of 1997-98, triggered by the July 2nd, 1997 devaluation of the Thai baht, has invariably focused attention on the Thai economy and crisis. Detailed studies of the Mexican and Thai debacles have reached a broadly similar conclusion, viz. that these crises ought most appropriately to be seen as consisting of two distinct but related components: an initial crisis-induced devaluation followed by a post-devaluation economic collapse. The initial Thai devaluation in turn was largely a case of “bad fundamentals”, both financial and economic (Rajan, 2000a). For instance, most of the key economic variables in Thailand were on definite downward/deteriorating trends since mid 1996. Paralleling this worsening of economic fundamentals were rising concerns by market participants about the near term prospects of the Thai economy (Lauridsen, 1998).

Also of importance is the fact that the empirical studies that have attempted to develop indicators of currency crises have been able to “predict” the Thai crisis with a fairly high probability *ex-post* (Rajan, 2000a). Kaminsky (1999) for example refers to Thailand as constituting “the perfect picture of the typical financial crisis” and finds that the probability of a currency crisis rose from a low of 20 percent in 1995 to about 100 percent in mid 1997”. Berg (1999) has concluded that “(t)he Thai crisis was predictable on the basis of a variety of macroeconomic and microeconomic weaknesses. Moreover, the situation was deteriorating through 1996 and the first part of 1997. It is thus not surprising that most models that are designed to predict currency crises, even those formulated and estimated on pre-1997 data, are able to identify Thailand as a country at risk of crisis in 1996” (p.46).

Among the weak macro fundamentals in Thailand that have been frequently pointed out are the sharp real exchange rate appreciation of the Thai baht between mid 1995 and 1997 and the accompanying burgeoning current account deficit which averaged between 6 and 8 percent in the first half of the 1990s (Table 1). This paper
examines Thailand’s exchange rate policy, focusing on the degree of the country’s real exchange rate misalignment pre-crisis and their consequent effects on Thailand’s trade balance with its two single largest trading partners, the US and Japan. We estimate misalignment as the difference between actual and “equilibrium” exchange rates. We use three key “equilibrium” exchange rates of the Thai baht, viz. the real effective equilibrium exchange rate (REER) of the Thai baht against its twenty two major trading partners; the bilateral real equilibrium exchange rates of the baht against the US dollar; and the bilateral real equilibrium exchange rate of the baht against the Japanese yen. Our sample period spans two decades (Q1: 1981 to Q3: 1999).

**Connection to Related Literature**

How is this paper related to previous literature? Two papers of direct relevance are Montiel (1997) and Lim (2000). Montiel (1997) concentrates on the real effective exchange rate of Thailand as well as the other Southeast Asian economies of Indonesia, Malaysia, Philippines and Singapore. The key objective of the Montiel study is to empirically test whether “the recent behavior of the real exchange rate in these countries is or is not an equilibrium phenomenon” (p.256). The study covers the period of 1960-1994 using annual data, and employs a sequence of time-series testing, viz. the Unit Root test and the Johansen cointegrating test. Montiel fails to find any significant and persistent misalignments during the period of late 1980s and early 1990s. The results provide statistical support that the paths followed by actual real effective exchange rates of Thailand and the other regional economies have closely followed their respective equilibrium ones.

The Lim (2000) paper is an extension of the Clark and MacDonald (1999) who distinguish between the fundamental equilibrium exchange rate (FEER) and the

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1 The long run equilibrium real effective exchange rate is determined by the values of a set of fundamental variables. For the case of Thailand, the fundamentals are: world inflation rate; terms of trade; government expenditure to GDP; an index for commercial openness of the domestic economy; and time trends.
behavioral equilibrium exchange rate (BEER). The study finds two significant fundamental variables to have determined the equilibrium real exchange rate of the Thai baht against the US dollar - the level of foreign debt and the cumulative sum of real interest rate differentials. The study covers the period between January 1988 and December 1996 (i.e. pre-crisis period). Having tested the Unit Root properties of the variables, Lim proceeded to undertake three types of cointegration tests, viz. the Engle-Granger test, the Johansen test and the Phillips-Loretan Test. The results reveal that the estimated long run equilibrium real exchange rate of the Thai baht tracks the actual real exchange rate quite well.

Applying the standard Johansen cointegration test to the Natural Real Exchange Rate (NATREX) model developed by Stein (1994 and 1996), our findings support the conclusions of the earlier studies for the REER and the bilateral real exchange rate cases against the US dollar. However, by extending our coverage to the case of real exchange rate of the Thai baht against the Japanese yen (RERJP), we are also able to identify persistent and significant misalignments with the RERJP. In addition, the results of the unrestricted vector autoregressive (VAR) Impulse-Response and Variance Decomposition tests clearly underscore the contribution of the RERJP misalignment in generating large and growing trade imbalances in Thailand, particularly during the late 1980s until the mid 1990s. Detailed analysis of Thailand’s bilateral trade relations with Japan and the US further supports the conclusion regarding the trade balance consequences of the misalignment of the baht, particularly with reference to the yen. Hence, this paper adds further weight to the argument by Ito et al. (1999), Ito and Ogawa (2000) and others regarding the “ineffectiveness” of the soft US dollar pegged system adopted by Thailand.

Roadmap of the Paper

The remainder of this paper is organized as follows. The next section focuses on Thailand’s pre-crisis exchange rate policy and trends in the various real exchange rates. Section 3 estimates the equilibrium exchange rate of the baht by
operationalizing the concept of the “natural equilibrium exchange rate” or NATREX *a la* Stein (1994, 1996) and establishes the degree of misalignment of the baht pre-crisis. Section 4 goes on to consider the implications of the pre-devaluation exchange rate policies on Thailand’s bilateral trade balance with two of its most important trading partners, the US and Japan. The final section provides a summary by way of concluding the paper.

2. Exchange Rate Policies and Trends in Thailand Pre-crisis

Speculative attacks on emerging market currencies have almost always been preceded by very large private capital inflows (Dooley, 2000). More specifically, Radelet and Sachs (1998) have observed “at the core of the (East) Asian financial crisis were the massive capital inflows that were attracted into the region during the 1990s” (p.8). A proper perspective of the East Asian crisis may therefore only be gained by considering the pre-crisis boom period.

Referring to balance of payments data based on the IMF’s *World Economic Outlook* data set, we see that net private capital inflows to the Asia-5 economies were positive and exceeded the corresponding current account deficit, resulting in a sustained accumulation of international reserves (Figure 1). This accumulation was particularly high in Thailand, which was among the ten largest emerging market recipients of net private capital flows (together with Malaysia and Indonesia) during the period under consideration (Lopez-Mejia, 1999 and World Bank, 1997). This boom period coincided with relaxation of controls of capital flows. In Thailand, the now notorious Bangkok International Banking Facility (BIBF) was established in early 1993. Financial institutions under the BIBF were authorized to accept deposits and loans from abroad in foreign currency and extend loans to both overseas and local markets, as well as engage in cross-currency foreign currency trading and loan syndication (Sirivedhin, 1997).

With regard to components of capital inflows, it is revealing that, on average,
the “other net investment” component constituted the largest share of overall capital flows (Table 2). This category of capital flows includes syndicated bank lending, trade financing, along with some other smaller items. It therefore captures movements in bank financing and has consistently been found to be the most interest sensitive and volatile component of capital flows in the balance of payments account. The stability of the bilateral exchange rates vis-à-vis the US dollar (Figure 2) as well as the interest rate premium offered by Thailand (Table 3) seemed to have been important contributory factors for these capital inflows and the consequent build-up of external debt (Table 4). Given the expectations about the durability of the US dollar-based peg, most of this external debt accumulation was short-term in maturity and was left exposed (i.e. unhedged) to foreign currency fluctuations.

In principle Thailand and the other regional economies were supposed to have adopted basket peg systems, with the US dollar, yen and other currencies receiving appropriate weights consistent with their respective significance in economic linkages with the East Asia. However in reality the US dollar had the overwhelming weight de facto (Table 5), leading McKinnon (1990) and Ohno (1998) to refer to East Asia’s “dollar standard” and “soft dollar zone”, respectively. The reasons for this dollar peg remain uncertain. Regardless, the dominance of the US

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2 Short-term indebtedness has been found to be a robust predictor of financial crises (Rodrik and Velasco, 1999 and World Bank, 2000a). The reason for the relatively high (and sustained) interest rate premium offered by an economy that has undertaken international financial liberalization (even after accounting for potential default and devaluation risk premia) is an important empirical puzzle (Bird and Rajan, 2000a).

3 For instance, Kasajima and Lewis (1998) claim the reason for the dollar peg was the dominance of the US dollar as the international transaction settlement currency, and the potential capital loss on the part of borrowers of mostly the US dollar denominated debt (due to variations in the baht-US$ rate). Others have noted that Thailand and other regional economies viewed a stable and competitive exchange rate as key to remaining attractive as a destination for Japanese FDI (Goldberg and Klein, 1997). Bénassy-Quéré et al. (1999) also emphasize the importance of exchange rate stability for attracting FDI.
dollar continued in 1990s, despite the fact that Japan was Thailand’s largest export market, and Thailand’s dominant import source (of intermediate goods) along with the US (Figure 3). Japan was also Thailand’s largest single creditor (Table 6), and a substantial share of external debt to the region was denominated in yen (Table 7). These intensive economic linkages between Thailand and Japan suggests a priori that the Japanese yen was significantly under-represented in Thailand’s currency basket. There have in fact been a number of recent studies that have attempted to measure optimal currency baskets in Southeast Asia (Table 8). A simple average of the various studies reveals the optimal weight of the Japanese yen to be in the range of 40 percent, the remainder being divided between the US dollar, euro and/or regional currencies (depending on the type of study)\(^4\).

2.1 Trends in Real Exchange Rates

The nearly fifty percent nominal appreciation of the US dollar relative to the yen between June 1995 to April 1997 led to a rise in the value of the regional currencies vis-à-vis the yen. This in turn contributed to a marked appreciation of the real effective exchange rates (REERs) of most of the East Asian economies (including Thailand) by end December 1996 and into mid 1997 over 1995 (Figure 4)\(^5\). This was in sharp contrast to the decade preceding that period when the REER of the baht was quite stable. The same degree of stability is found in the case of the real exchange rate of the baht against the US dollar (RERUS). In contrast, the real exchange rate of the baht against the Japanese yen (RERJP) has been significantly more volatile, as would be expected given the above-noted dollar peg operated by

\(^4\) Needless to say that there remains much work to be done on refining the methodologies and assumptions used in the determination of optimal currency baskets (Rajan, 2000b and Williamson, 1999).

\(^5\) To be precise, REER appreciations were experienced by the Southeast Asian economies only, South Korea’s REER being relatively stable during the period under consideration.
the Thailand (Figure 5). After a sharp depreciation of the baht against the yen (following the Plaza Accord in 1985), the baht appreciated gradually from 1989 and 1990 against the yen before depreciating again from 1990 to late 1995 (when the yen appreciated sharply against the US dollar). This trend was suddenly reversed with a sharp nominal appreciation of the US dollar relative to the yen between mid-1995 and 1997.

It is in this sense that it is often suggested that if Thailand had given greater weight to the yen in their baskets pre-crisis there would have been lesser degrees of regional real exchange rate misalignments. Williamson (2000) has gone so far as to conclude “the yen/dollar exchange rate had a statistically significant impact on output growth in the Asian economies. A strengthening of the yen depreciated their real effective exchange rates, given their de facto dollar pegs, and thus accelerated their growth, while a weakening of the yen had the opposite effects” (p.6).

A REER appreciation does not necessarily denote currency misalignments (overvaluation). For instance, it may reflect a secular trend in the “fundamental” or “equilibrium” real exchange rate. This in turn could be due to a number of reasons, including differing rates of technological change between the tradables and nontradables sectors, the so-called Balassa-Samuelson theorem (Neuhas and Associates, 1998), a relative increase in the demand for non-tradables over tradables (Arndt, 1990, 1998), or changes in “equilibrium” patterns of capital flows. We need

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6 Similar conclusions are drawn if the focus is on nominal exchange rates. Real exchange rate volatility is constructed by the moving sample standard deviation of the growth rate of the real exchange rate:

\[ V_t = \left( \frac{1}{m} \sum_{i=1}^{m} (\log Q_{t+i-1} - Q_{t+i-2})^2 \right)^{1/2} \]

where \( Q \) is the real exchange rate and \( m = 6 \). This index has been used in previous studies including Kenen and Rodrik (1986), Koray and Lastreps (1989) and Chowdhury (1993).

7 McKinnon (2000) refers to the yen/US dollar exchange rate as the “loose cannon” in East Asia pre-crisis.

8 Empirical tests by Ito et al. (1996, 1997) do suggest that the experiences of Malaysia and Thailand provide counterexamples to the Balassa-Samuelson hypothesis. Also see Chinn
therefore to first ascertain some sort of “equilibrium benchmark” in order to determine the consistency (or lack thereof) of the observed real exchange rates of the baht against the fluctuations of the economies’ key economic fundamentals. To do so we operationalize the concept of a Natural Equilibrium Real Exchange Rate (NATREX) model developed by Jerome Stein (1994, 1996).

3. Measuring Exchange Rate Misalignment: The NATREX Model

The NATREX is the rate that is determined by the prevailing real economic fundamentals in the economy. Unlike the Purchasing Power Parity (PPP) model, the NATREX model does not require that the observed REER and the real equilibrium rate be stationary and (Edwards and Savastano, 1999). In fact the NATREX will vary through time depending on the changes in the underlying fundamentals. In other words, it is a moving equilibrium exchange rate that “is directly amenable to empirical testing, without making any subjective judgments of what is: anticipated or unanticipated, permanent or transitory changes. It is based upon the attempt of micro agents, who make independent saving, investment, import and export decisions, to optimize when they know that there is significant uncertainty…The NATREX model is positive not normative..(it)..is precisely the real exchange rate associated with both internal and external balance” (Stein and Paladino, 1998, pp.1688-89 & 1712).

Since Stein (1994, 1996), Stein and Paladino (1998) and others have extensively discussed the theoretical background of the NATREX model, we focus instead on a general working model of the concept (see Appendix A).

3.1 Single Equation Estimation Working Model

The NATREX approach begins with the assumption that there is a vector of fundamentals (z) which determines an economy’s NATREX or a vector of equilibrium real exchange rate (ERER):

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\[ \text{erer}_t = f(z_t) \]  

(1)

The small letters represent natural logs. Vector erer represents (rer, rerjp, rerus). Vector z consists of the fundamentals in the economy \( \{ g, r^*, \text{tot} \text{and} \text{prd} \} \), where: \( g \) is real government spending; \( r^* \) is world real interest rate; \( \text{prd} \) is productivity; and \( \text{tot} \) is the terms of trade. Since the erer is not observable, we estimate the following set of equations:

\[ \text{rer}_t = \beta_0 + \beta_1 g_t + \beta_2 (r_{\text{thai} t} - r^*_t) + \beta_3 \text{tot}_t + \beta_4 \text{prd}_t + \beta_5 t + \varepsilon_t \]  

(2)

\[ \text{rerj}_t = \alpha_0 + \alpha_1 g_t + \alpha_2 (r_{\text{thai} t} - r_{\text{jp}n} t) + \alpha_3 \text{tot}_t + \alpha_4 \text{prd}_t + \alpha_5 t + \varepsilon_t \]  

(3)

\[ \text{rerus}_t = \gamma_0 + \gamma_1 g_t + \gamma_2 (r_{\text{thai} t} - r_{\text{us} s} t) + \gamma_3 \text{tot}_t + \gamma_4 \text{prd}_t + \gamma_5 t + \varepsilon_t \]  

(4)

Eqs. 2 to 4 seek the best fit of the \( \text{rer} \), \( \text{rerus} \) and \( \text{rerjp} \) on the economies' relevant exogenous economic fundamentals. We construct the equilibrium effective exchange rate for each economy's currency using the coefficient estimates obtained from regressing the above three equations. The variables used are summarized in Table 9. Following Montiel (1997), a time trend \( (t) \) is introduced to capture the effects of missing fundamentals.

3.2 Coefficient Estimates: What Does Theory Tell us?

We briefly highlight the prior signs of the coefficients to be expected based on the theoretical literature.

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9 Such single equation econometric models are commonly used in the literature on the determination of equilibrium real exchange rates (Edwards and Savastano, 1999).
Government Expenditure (g): Following Obstfeld and Rogoff (1996), we assume that government expenditure is disproportionately devoted to nontradables. As g rises, the relative demand for nontradables also goes up, triggering an increase in price of nontradables or a real appreciation, i.e. $\beta_1 > 0$; $\alpha_1 > 0$ and $\gamma_1 > 0$.

Interest Rate Differentials ($r_{\text{thai}} - r^*$), ($r_{\text{thai}} - r_{\text{us}}$) and ($r_{\text{thai}} - r_{\text{jpn}}$): International interest rate arbitrage implies that when the return for foreign currency dominated assets ($r^*$, $r_{\text{us}}$ and $r_{\text{jpn}}$) exceeds local currency dominated assets ($r_{\text{thai}}$), investors shift their portfolios away from local assets to foreign assets. In turn, the local currency will depreciate, i.e. $\beta_2 > 0$; $\alpha_2 > 0$ and $\gamma_2 > 0$

Terms of Trade (tot): An improvement in the terms of trade will cause a capital inflow into the tradable sector, creating a real appreciation. Thus $\beta_3 > 0$; $\alpha_3 > 0$ and $\gamma_3 > 0$.

Productivity (prd): An increase in productivity is expected to appreciate the domestic currency via the Balassa-Samuelson condition, i.e. $\beta_4 > 0$; $\alpha_4 > 0$; and $\gamma_4 > 0$.

3.3 Empirics

The data sources used in this study is presented in Table 9. We conduct two stages of sequential tests. The first is the Unit Root test. If the variables are all found to be integrated of order 1 (I(1)), the Johansen Cointegration test will be applied to check for existence of cointegration relationship(s) among all variables in Eqs. 2 - 4.

The Unit Root test

To determine the order of integration of each variable, we use the standard ADF regression:
\[
\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 t + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-i} + \epsilon_t
\]  
(5)

where: \( Y = \{ \text{reer, rerus, rerjp, tot, g, prd, (r-rus)}^{10}, (r-rjp) \} \), with all variables in logs, and \( t \) denotes a time trend. The ADF test reveals all the variables to be integrated of order 1 (Table 10). The Akaike Criteria test determines the appropriate number of lag periods.

**Johansen Maximum Likelihood cointegration test**

Given all variables are I(1), we proceed to conduct the Johansen cointegration test procedures on all the single equation models. The trace statistics (likelihood-ratio) indicate that there is one cointegrating relationship (significant at 5 percent level) in each of the single equation models (Table 11a–11c). More importantly, all the fundamental variables have significant and theoretically consistent coefficient estimates. We next construct the equilibrium rate for REER, RERUS and RERJP by using the estimated coefficients.

### 3.4 Estimation of Baht Misalignment

We are expressly interested in the question of whether there has been any misalignment in baht’s REER, RERUS and RERJP during the period of 1980 to 1997/98 just prior to the crisis. We examine whether the degree of misalignment of the baht’s RERUS was less than that of the RERJP, which may be expected *a priori* in view of the *de facto* US dollar peg. A currency is overvalued when its observed real (effective) rate is higher than its equilibrium exchange rate (for example \([\text{reer} - \text{rer}] > 0\) ). Figures 6-8 plot the actual REER, RERUS and RERJP against the NATREX rate, respectively. The results reveal that the size of the misalignment for the REER and the RERUS is relatively smaller than for the RERJP (Figure 9). While the baht was overvalued in all three cases (REER, RERJP and RERUS) during the

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10 \((r-rus)\) equals to \((r-r^*)\).
period of 1988-1999, the greatest degree of overvaluation occurred in the case of the RERJP.

4. Impact of Baht Misalignment on Thailand’s Trade Balance

What were the economic consequences of the baht’s misalignment on Thailand’s trade balance?

First, a cyclical slow-down in regional export growth due in large part to a global glut in the semiconductor industry in 1996 and a sharp deterioration in the terms of trade - mainly caused by falling prices of computer chips and electronic components - adversely affected the Asian Newly Industrializing Economies (ANIEs), such as Singapore, South Korea and Taiwan, along with the next-tier ANIEs of Malaysia and especially Thailand (World Bank, 2000b). Given that a relatively larger proportion of imports were denominated in yen compared to exports (Table 12), the weakening of the US dollar against the yen and other currencies in 1994-1996 induced import prices to rise faster than export prices, further deteriorating the terms of trade. Ito and Ogawa (2000) have noted, “one of the important triggers that caused sudden reversal of capital (or an attack by speculators) in Thailand was the large current account deficit…partly caused by the overvalued baht. The trade balance is important since it affects the confidence of the exchange rate regime” (p.34).

Second, while the trade balance against the US has largely been in surplus, Thailand experienced a trade deficit against Japan since 1980, with the largest deficit occurring in late 1995-early 1996 (Figure 10). The widening of the trade deficit against the Japanese market took place between 1987 and 1996 when the Thai baht was depreciating against the Japanese yen. The overall deficit of the Thai trade balance has primarily been a result of a widening bilateral deficit with Japan (Figure 11). In contrast, the Thailand’s bilateral trade vis-à-vis the US has been in persistent surplus, though this changed in late 1995 and early 1996 as an acute glut in semiconductor production capacity developed which resulted in an outright collapse
in US dollar prices as noted previously. In addition to the loss of competitiveness of Thai exports to Japan, it may have contributed to a loss of export market share of Thai exports to its competitors in third markets. To further analyze the effects of the baht misalignment, we consider data on Thailand’s bilateral merchandise trade with its two main economic partners in some detail.

4.1 Analysis of Trade Data

Trade Shares

In the decade prior to the crisis, Thailand’s overall merchandise trade slightly outpaced the growth in trade with the US and Japan (about 12 percent each). As such, the share of the US in Thailand’s total trade remained at about 15 percent between 1985 and 1996, while the share of Japan in Thailand’s trade was about 23 percent. However the US trade share has risen between 1995 and 1998, while trade with Japan has fallen off sharply since 1994. Thus by 1998, Thailand’s trade shares with both countries were virtually identical at 17-18 percent (Figure 3). As discussed, Thailand has consistently reported a high trade deficit with Japan and a surplus with the US.

During the pre-crisis years of 1986-96, the average growth rate of Thai exports to Japan (24 percent) consistently outpaced that of Thailand’s global exports and Thailand’s exports to the US (about 20 percent each). Thai exports to Japan recorded negative growth for three consecutive years from 1996-98, as compared to exports to the US which recorded a slight negative growth only in 1996. The share of the US in Thai exports has generally hovered around 20 percent between 1985 and

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12 See World Bank (2000b) for a brief discussion of the growing complementarity of trade structures of East Asian economies. Thailand’s manufactured export structures (at a three digit SITC level) were highly correlated with all regional economies in East Asia except for Indonesia.
1994. Having fallen off sharply in 1995, the share of exports to the US relative to Thailand’s global exports has risen sharply since then. Japan’s export share rose gradually from about 13 percent in 1985 to about 16 percent over the entire period until 1996. However the share has since declined.

In the pre-crisis period, the average growth rates of Thai imports from the US and Japan were almost identical (15 percent). The share of US imports in Thailand’s global imports ranged between 10 and 15 percent over the period, with a slightly upward trend between 1995 and 1998. In comparison, the share of Japan’s imports was much higher over the period, ranging between 25 and 30 percent, peaking in 1989 but declining sharply from 1994. Regardless, Japan has been a more important import source for Thailand than the US. This is generally attributed to the high share of Japanese FDI in Thailand (about 35 percent of total FDI). Much of this Japanese FDI has been directed towards the manufacturing industry, a major area of Japanese trade with Thailand, and intermediate inputs have been sourced from their home country.

To sum up, the stability of the US in Thailand’s overall global trade between 1985 and 1995 was matched by a small but slightly rising bilateral trade balance in favor of Thailand. The sharp increase in the economic significance of the US in Thailand’s overall trade between 1995 and 1998 coincided with a major rise in Thailand’s trade surplus with the US. In contrast, the stability of Japan’s trade share with Japan between 1987 and 1996 corresponded to a persistent and widening trade imbalance in favor of Japan. The marked decline of Japan in Thailand’s overall

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13 It is useful to note that manufactured products including chemical, machinery and metal manufactures were the principal commodities that contributed to a high surplus in Japan’s trade with Thailand (Table A1). Among the machinery products, electronic and electrical products viz. Telecom and Electrical equipment and Transportation equipments contributed significantly to a high deficit for Thailand in its bilateral trade with Japan pre-crisis.

14 Over the period 1986 to 1995, Thailand’s trade deficit with Japan increased continuously and sharply by nearly US$11 billion (with the exception of 1991). In contrast, Thailand’s trade surplus with the US increased relatively less by only about US$ 3 billion during 1986-94.
trade since then has coincided with a fall in the size of Thailand's bilateral deficit with Japan (Figure 10).

Trade Intensities

Trade shares as measures of the extent of trade linkages could be misleading as they fail to account for the extent to which each of the Asia-5 economies trade with the rest of the world (ROW). Accordingly, we have also computed conventional bilateral trade intensity indices (Appendix B). These indices essentially seek to establish the relative importance of a trading partner (country j) in relation to country i’s trade with the ROW. The IMF’s Direction of Trade Statistics is used to calculate the bilateral trade intensity indices for 1985-99.

We consider the export intensity index first (Figure 12). Thailand's bilateral export intensity for Japan declined from its peak of about 3 in 1990 to a trough of about 2.5 in 1997. In contrast, Thailand's export intensity for the US remained more or less stable at just above 1 between 1993 and 1997, though down from the peak of 1.5 between 1990 and 1992. In the case of import intensity indices (Figure 13), while Thailand's import intensity with the US remained quite stable at about 1 between 1985 and 1997, that with Japan rose from a trough of about 2.6 in 1986 to a peak of about 3.7 by 1996. Overall, it can be inferred from the preceding that on average, Japan has been relatively “over-represented” as Thailand’s trading partner (both as an export market and import source). While the US has been slightly over-represented as an export markets, this was far less than the case of Japan. Notably, Thailand’s bilateral trade intensities in recent years have not changed as discernibly in comparison to bilateral trade shares. This suggests that the recent variations (1995/96 to 1998) in Thailand’s bilateral trade shares with the US and Japan were not unique to Thailand but merely reflected variations in trading patterns and trends of its two trade partners in general.

More precisely, there was a sharp rise in Thailand's import intensity index between 1986 and 1990, declined sharply between 1990 and 1993, before appreciating since until 1996.
4.2 VAR Tests

To further evaluate the impact of real exchange rate misalignments as a factor in variations of Thailand’s bilateral trade deficits with Japan and the US, we conduct an unrestricted vector autoregressive (VAR) Impulse-Response test for the trade imbalance period (1987-1996). A one standard deviation shock to the misalignment of the RERJP lead to a larger and more persistent impact than does the RERUS misalignment on the total trade balance. Between two and five quarters, the impacts of the RERJP misalignment on Thailand’s overall trade balance (TB) are much larger than those of the RERUS (Figure 14). Moreover the negative impact of higher misalignments (overvaluations) of the RERJP on the level of trade balance lasts for about eight quarters or two years\textsuperscript{16}. We conclude from this that the overvaluation of the Thai baht against the Japanese yen until late 1992 or early 1993 contributed to the worsening of the Thailand’s trade imbalance pre-crisis.

Unrestricted-VAR Variance Decomposition tests for the same period reveal that over one-fifth of the variance in the trade deficit variable can be explained by the variance of the real exchange rate misalignment against the Japanese yen within two years (or eight quarters) (Table 13). The misalignment in the real exchange rate against the US dollar contributes to only about one-tenth of the variance in the trade deficit variable. Equally important, the results indicate that while the share of the variance of RERUS misalignment has been relatively stable during the eight lags, the rise in the share of RERJP misalignment is relatively sharp during the first four quarters (lags), before abating during the last four quarters. Consistent with the Impulse Response Test results, the Variance-Decomposition test underscores the importance of the RERJP misalignment in explaining the trade performance of Thailand.

\textsuperscript{16} The t-statistics for RERJP and RERUS remain significant at the 5 percent significant level during the first four lags. However for the rest of the four lags, the t-statistics for both RERJP
5. Conclusion

This paper has examined, in some detail, three key equilibrium exchange rates for the Thai baht: a) real effective equilibrium exchange rate of the Thai baht against its twenty two major trading partners; b) bilateral real equilibrium exchange rates of the baht against the US dollar; and c) bilateral real equilibrium exchange rates of the baht against the Japanese yen over the last two decades (Q1: 1981 to Q3: 1999). While the results suggest moderate misalignments for the real effective exchange rate case and the bilateral real exchange rate against the US dollar, the most significant misalignment was found with respect to the bilateral real exchange rate against the Japanese yen. The misalignment in the bilateral real exchange rate against the Japanese yen is consistent with a significant widening of the Thai trade deficits between 1990 and 1996 just prior to the crisis in 1997, which in turn was primarily due to Thailand’s bilateral trade relations with Japan. To the extent that an “optimal exchange rate regime” is defined as one that minimizes the volatility of a country’s trade balance, when the yen-dollar exchange rate fluctuates, Thailand’s *de facto* dollar peg was clearly not optimal (Ito et al., 1999). In light of this, the recent retreat by Thailand and other regional economies to a *de facto* dollar peg (Calvo and Reinhart, 2000a,b and McKinnon, 2000) must be cause for some concern.

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and RERUS are significant only at 10 percent level.
Appendix A: The NATREX Model in Brief

The basic structural equations of the NATREX model are the followings.

\[ S(k, F; Z, u) - I(k, y, R, r; Z, u) = CA(R, y, F, r; Z, u); u = 0, \]  \hspace{1cm} (A.1)

\[ r + (t) = r^*; (t) = E\{ R^* [Z(t)] \}, \]  \hspace{1cm} (A.2)

\[ \frac{dF}{dt} = -A(R, y, F, r; Z, u) = L(R, k, F, r; Z), \quad L = I - S, \]  \hspace{1cm} (A.3)

\[ \frac{dK}{dt} = I \]  \hspace{1cm} (A.4)

where: \( R \) = real exchange rate; \( r \) = domestic real interest rate; \( r^* \) = foreign real interest rate; \( S \) = saving; \( I \) = investment; \( k \) = capital stock; \( F \) = foreign debt; \( CA \) = Current Account; \( y \) = productivity; \( u \) = deviation of rate of capacity utilization; \( (t) \) = risk premium; \( Z \) = the vector of fundamental variables. This vector \( Z \) includes mainly real exogenous fundamental variables explaining the movements of real exchange rate and current account variable.

Eq. (A.1) is the macroeconomic balance equation. It simply states that excess investment over saving \((I - S)\) equals to current account deficit. The equilibrium real exchange rate will adjust to ensure that the current account deficit equals to investment \((I)\) less saving \((S)\). \((I-S) > 0\). Eq. (A.2) is the uncovered interest rate parity (UIP) model with Asymptotically Rational Expectation \textit{a la} Stein (1994). It is basically the portfolio balance equation. Eqs (A.3) and (A.4) capture the changes in the foreign debt level and the investment level respectively over the period.

Thus the NATREX model adds dynamic stock - flow interactions to the standard macroeconomic balance model. The inclusion of the dynamic equations allows the NATREX to vary over time, reflecting the changes on the fundamental variables. In the medium run, an economy may face a current account imbalance. In the long run, however, the foreign debt and capital stabilize. The evolution of the real exchange rate under the NATREX model can therefore be captured as follows:
\[
\frac{dR}{dt} = [R_k \frac{dk}{dt} + R_F \frac{dF}{dt}] + R_Z \frac{dZ}{dt} \tag{A.5}
\]

where \( R_k, R_F, \) and \( R_Z \) are partial derivatives with respect to capital, debt, and fundamental variables, respectively.

Given \( k \) and \( F \) are functions of the fundamental variables \( Z \) - see Eq. A.1 and A.4, the trajectory of the real exchange rate under this model can therefore be expressed in terms of the fundamental variables.

\[
\frac{dR}{dZ} = \frac{\partial R}{\partial Z} + [ (\frac{\partial R}{\partial k}) \frac{dk}{dZ} + (\frac{\partial R}{\partial F}) \frac{dF}{dZ}] \tag{A.6}
\]

where \( \frac{\partial R}{\partial Z} \) is direct effect of the fundamental variables to the real exchange rate variable. \([ (\frac{\partial R}{\partial k}) \frac{dk}{dZ}] \) and \([ (\frac{\partial R}{\partial F}) \frac{dF}{dZ}] \) are the effects of fundamental variables to the real exchange rate through their impacts on \( k \) and \( F \) (indirect effects).

In summary, the impacts of the fundamental variables on the trajectory of the real exchange rate under the NATREX model can be explained through a direct and an indirect way. What is important for the empirical application of the model is to find the appropriate set of fundamental variables included in vector \( Z_t \). For most applications of the NATREX, the vector \( Z_t \) includes the terms of trade, productivity variable, world interest rate and saving/expenditure.
Appendix B: Trade Intensity Indices

B.1 Total Trade Intensity

The bilateral trade intensity index for total trade is as follows:

\[
T_{ij} = \frac{(X_{ij} + M_{ij})/(X_i + M_i)'}{(X_{wj} + M_{wj})' - (X_{ij} + M_{ij})}/((X_w + M_w) - (X_i + M_i))
\]

where: \(T_{ij}\) = Total trade intensity index of country i with country j; \(X_{ij}\) = Exports of country i to j; \(M_{ij}\) = Imports of country i from j; \(X_i\) = Total exports of country i; \(M_i\) = Total imports of country i; \(X_{wj}\) = Total world exports to country j; \(M_{wj}\) = Total world imports from country j; and \(X_w\) = Total world exports; \(M_w\) = Total world imports

This index is interpreted as a relative measure of two ratios. The numerator represents the share of bilateral trade between country i and j as a percentage of total trade of country i. This forms the numerator of the total trade intensity index. The second ratio in the denominator represents the total trade of country j with the world excluding country i as a share of total world trade excluding country i. This forms the denominator of the total trade intensity index.

If the numerator exceeds the denominator, i.e. if the value of \(T_{ij} > 1\), then it implies that the bilateral trade intensity for country i with country j is greater than in comparison to country i’s trade with the rest of the world (ROW). Thus for instance, if Thailand is regarded as country i and country j is represented by its trading partners, viz. US / Japan, then a value of \(T_{ij} > 1\) implies that Thailand prefers to trade more intensely with them than trading with the rest of the world.

B.2 Export Intensity Index

The bilateral export intensity index among country i and country j may be stated as:

\[
T_{ij} = \frac{(X_{ij} + M_{ij})/(X_i + M_i)'}{(X_{wj} + M_{wj})' - (X_{ij} + M_{ij})}/((X_w + M_w) - (X_i + M_i))
\]
\[ X_i^a = \frac{[X_{ij}/X_i]}{[( M_j - M_{ji})/( M_w - M_i)]} \]

where, in addition to the notations in the bilateral trade intensity index, \( M_j \) = Total imports of country \( j \) and \( M_{ij} \) = Imports of country \( j \) from country \( i \). A value of this index above unity implies that country \( i \)'s relative share of exports to country \( j \) exceeds country \( j \)'s share of imports from the ROW. This implies an over-representation of country \( j \) in country \( i \)'s export market. From country \( i \)'s point of view, the value of greater than one indicates that country \( i \) has relatively more intense preference for exporting to country \( j \) as compared to country \( j \)'s imports from the ROW.

B.3 Import Intensity Index

The import intensity index may be stated as follows:

\[ M_{ij}^a = \frac{[M_{ij}/M_j]}{[( X_i - X_{ji})/( X_w - X_i)]} \]

where, in addition to the notations in the bilateral trade intensity index, \( X_j \) = Total exports of country \( j \); and \( X_{ij} \) = Exports of country \( j \) to country \( i \). A value of this index above unity implies that country \( i \)'s relative share of imports to country \( j \) exceeds country \( j \)'s share of exports to the ROW. This implies an over-representation of country \( j \) in country \( i \)'s import market. From country \( i \)'s point of view, the value of greater than one indicates that country \( i \) has relatively more intense preference for importing from country \( j \) as compared to country \( j \)'s exports to the ROW.
Bibliography


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### Table 1
**Selected Thailand Key Macroeconomic Indicators**

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GDP Growth (%)</strong></td>
<td>9.4</td>
<td>8.6</td>
<td>8.8</td>
<td>5.5</td>
<td>-0.4</td>
<td>-10.2</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Inflation Rate (%)</strong></td>
<td>3.7</td>
<td>4.8</td>
<td>5.8</td>
<td>5.8</td>
<td>5.6</td>
<td>8.1</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Trade Balance (% of GDP)</strong></td>
<td>-1.94</td>
<td>-5.17</td>
<td>-6.73</td>
<td>-6.78</td>
<td>1.39</td>
<td>15.94</td>
<td>12.64</td>
</tr>
<tr>
<td><strong>Current Account Balance (% of GDP)</strong></td>
<td>-3.13</td>
<td>-6.42</td>
<td>-8.07</td>
<td>-8.08</td>
<td>-2.01</td>
<td>12.68</td>
<td>8.03</td>
</tr>
<tr>
<td><strong>Unemployment Rate (%)</strong></td>
<td>3.3</td>
<td>1.6</td>
<td>1.1</td>
<td>1.1</td>
<td>0.9</td>
<td>3.4</td>
<td>n.a.</td>
</tr>
<tr>
<td><strong>Exchange Rate (baht/US$)</strong></td>
<td>25.7</td>
<td>25.32</td>
<td>25.19</td>
<td>25.61</td>
<td>47.25</td>
<td>36.69</td>
<td>37.52</td>
</tr>
<tr>
<td><strong>Exchange Rate (baht/100 yen)</strong></td>
<td>5.14</td>
<td>4.22</td>
<td>4.20</td>
<td>4.27</td>
<td>7.88</td>
<td>6.11</td>
<td>6.25</td>
</tr>
</tbody>
</table>

n.a. = Not Available  
Source: IFS-CD Rom

### Table 2
**Composition of Capital Flows to Thailand**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net Private Capital Flows</strong></td>
<td>10.2</td>
<td>8.6</td>
<td>12.7</td>
<td>9.3</td>
<td>-10.9</td>
</tr>
<tr>
<td><strong>Net Direct Investment</strong></td>
<td>1.5</td>
<td>0.7</td>
<td>0.7</td>
<td>0.9</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Net Portfolio Investment</strong></td>
<td>1.3</td>
<td>0.9</td>
<td>1.9</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Other Net Investment</strong></td>
<td>7.4</td>
<td>7.0</td>
<td>10.0</td>
<td>7.7</td>
<td>-12.6</td>
</tr>
<tr>
<td><strong>Net Official Flows</strong></td>
<td>0</td>
<td>0.1</td>
<td>0.7</td>
<td>0.7</td>
<td>4.9</td>
</tr>
</tbody>
</table>

<sup>a</sup> Annual averages  
Source: IMF
### Table 3

**Average Real Interest Rate Differentials**  
(Percent)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_{thai} - r_{us}$</td>
<td>0.53</td>
<td>4.33</td>
</tr>
<tr>
<td>$r_{thai} - r_{jpn}$</td>
<td>5.60</td>
<td>6.92</td>
</tr>
</tbody>
</table>

Source: IFS – CD Roam, IMF  
Note: $r_{thai}$ is 3-month Thailand’s real deposit rate; $r_{us}$ is 3-month U.S. real libor rate; $r_{jpn}$ is 3-month Japanese real deposit rate (see Table 11). The real interest rate is the nominal rate adjusted by the inflation rate.

### Table 4

**External Debt in Thailand**  
(millions of US)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Outstanding Debt $^a$</td>
<td>64,866</td>
<td>82,568</td>
<td>90,536</td>
<td>93,416</td>
<td>86,160</td>
<td>80,655</td>
</tr>
<tr>
<td>Outstanding Medium- and Long-term Debt $^b$</td>
<td>35,687</td>
<td>41,472</td>
<td>52,923</td>
<td>59,158</td>
<td>62,637</td>
<td>63,088</td>
</tr>
<tr>
<td>Outstanding Short-term Debt</td>
<td>29,179</td>
<td>41,096</td>
<td>37,613</td>
<td>34,258</td>
<td>23,523</td>
<td>17,567</td>
</tr>
</tbody>
</table>

Notes:  
$^a$ First half of the year  
$^b$ Excludes loans (estimated at about US$ 4 billion at end-1997) contracted by Thai corporations but not brought into Thailand.

Source: Rajan (2000a)
Table 5
The Southeast Asian Dollar Standard (daily nominal exchange rate)

Regression Model\(^a\):
\[ \% (\Delta \text{Local Currency/SWF}) = \beta_1 + \beta_2 (\% \Delta \text{USD/SWF}) + \beta_3 (\% \Delta \text{JPY/SWF}) + \beta_4 (\% \Delta \text{DEM/SWF}) + e_t \]

<table>
<thead>
<tr>
<th>Pre-Crisis Period (January 1994 - May 1997)</th>
<th>USD coefficient: (\beta_2) (standard error)</th>
<th>R-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesian Rupiah</td>
<td>0.999 (0.008)</td>
<td>0.965</td>
</tr>
<tr>
<td>Malaysian Ringgit</td>
<td>0.886 (0.014)</td>
<td>0.889</td>
</tr>
<tr>
<td>Philippines Peso</td>
<td>0.987 (0.018)</td>
<td>0.836</td>
</tr>
<tr>
<td>Singapore Dollar</td>
<td>0.817 (0.012)</td>
<td>0.905</td>
</tr>
<tr>
<td>Thailand Baht</td>
<td>0.955 (0.012)</td>
<td>0.923</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crisis Period (June 1997 - December 1998)</th>
<th>USD coefficient: (\beta_2) (standard error)</th>
<th>R-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesian Rupiah</td>
<td>0.550 (0.388)</td>
<td>0.038</td>
</tr>
<tr>
<td>Malaysian Ringgit</td>
<td>0.755 (0.138)</td>
<td>0.161</td>
</tr>
<tr>
<td>Philippines Peso</td>
<td>0.788 (0.125)</td>
<td>0.196</td>
</tr>
<tr>
<td>Singapore Dollar</td>
<td>0.727 (0.061)</td>
<td>0.447</td>
</tr>
<tr>
<td>Thailand Baht</td>
<td>0.688 (0.165)</td>
<td>0.107</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-Crisis Period (January 1999 - May 2000)</th>
<th>USD coefficient: (\beta_2) (standard error)</th>
<th>R-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesian Rupiah</td>
<td>0.848 (0.163)</td>
<td>0.182</td>
</tr>
<tr>
<td>Malaysian Ringgit</td>
<td>1.000 (0.000)</td>
<td>1.000</td>
</tr>
<tr>
<td>Philippines Peso</td>
<td>0.945 (0.040)</td>
<td>0.741</td>
</tr>
<tr>
<td>Singapore Dollar</td>
<td>0.818 (0.026)</td>
<td>0.848</td>
</tr>
<tr>
<td>Thailand Baht</td>
<td>0.858 (0.049)</td>
<td>0.639</td>
</tr>
</tbody>
</table>

Notes: USD = US$; JPY = Japanese yen; DEM = German DM and SWF: Swiss Franc
Source: McKinnon (2000)
### Table 6
Total Japanese and the U.S. Banking Loans to Thailand  
(millions of US dollar)

<table>
<thead>
<tr>
<th></th>
<th>U.S. Banks</th>
<th>Japanese Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>End June 1997</td>
<td>4008 (5.81%*)</td>
<td>37749 (54.41%*)</td>
</tr>
<tr>
<td>End June 1998</td>
<td>1757 (3.75%*)</td>
<td>26120 (55.81%*)</td>
</tr>
<tr>
<td>End June 1999</td>
<td>1232 (3.55%*)</td>
<td>18278 (52.68%*)</td>
</tr>
</tbody>
</table>

Notes: (* ) indicates percentage of the Japanese and the US bank loans in terms of the total foreign bank loans to Thailand.  
Source: Rajan and Siregar (2000)

### Table 7
Composition of Thailand’s Long-Term External Debt  
(percent of total)

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Dollar</td>
<td>17</td>
<td>32.1</td>
</tr>
<tr>
<td>Japanese Yen</td>
<td>43.2</td>
<td>45.4</td>
</tr>
<tr>
<td>Others</td>
<td>39.8</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Source: Siregar and Isidoro (1999)

### Table 8
Optimal Weights of the Japanese yen in Southeast Asian Currency Baskets

<table>
<thead>
<tr>
<th></th>
<th>Indonesian rupiah</th>
<th>Malaysian ringitt</th>
<th>Philippine peso</th>
<th>Thai baht</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Q (1999)</td>
<td>0.30</td>
<td>0.21</td>
<td>0.23</td>
<td>0.29</td>
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<tr>
<td>Ito et al. (1998)a</td>
<td>0.56</td>
<td>n.a.</td>
<td>0.72</td>
<td>0.52</td>
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<tr>
<td>Eiji (1999)</td>
<td>0.45</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Kusukawa (1999)a</td>
<td>0.39</td>
<td>0.36</td>
<td>0.31</td>
<td>0.40</td>
</tr>
<tr>
<td>Kusukawa (1999)a,b</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
</tr>
<tr>
<td>Williamson (1999)b</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>Bird and Rajan (2000b)</td>
<td>0.59</td>
<td>0.46</td>
<td>0.35</td>
<td>0.59</td>
</tr>
<tr>
<td>Simple Average</td>
<td>0.42</td>
<td>0.35</td>
<td>0.38</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Notes: a) Based on the simple average of stated ranges  
b) Based on a common basket which include the four Southeast Asian countries plus Singapore, South Korea, Singapore, P.R.C. China, Hong Kong and Taiwan  
Source: Rajan (2000b)
Table 9
Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source</th>
</tr>
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<tbody>
<tr>
<td>reer</td>
<td>Real Effective Exchange Rate (against around 22 Thailand's major trading partners' currencies). An increase in REER implies a real appreciation of the Thai baht.</td>
<td>J.P. Morgan Web-Site</td>
</tr>
<tr>
<td>rerus</td>
<td>Real Exchange Rate of baht against the US dollar: ( RERUS = [NEX_{US$/baht}] \times [\frac{CPI_{Thai}}{CPI_{US}}] ); where CPI is the consumer price index, and NEX is the nominal exchange rate. An increase in RERUS implies a real appreciation of the Thai baht against the US dollar.</td>
<td>IFS – CD Roam (IMF)</td>
</tr>
<tr>
<td>rerjp</td>
<td>Real Exchange Rate of baht against the Japanese yen: ( RERJP = [NEX_{JPN,Yen/baht}] \times [\frac{CPI_{Thai}}{CPI_{JPN}}] ); where CPI is the consumer price index, and NEX is the nominal exchange rate. An increase in RERJP implies a real appreciation of the Thai baht against the Japanese yen.</td>
<td>IFS – CD Roam (IMF)</td>
</tr>
<tr>
<td>Tot</td>
<td>Terms of trade = ( \frac{\text{unit value of export}}{\text{unit value of import}} )</td>
<td>IFS – CD Roam (IMF)</td>
</tr>
<tr>
<td>G</td>
<td>Real government spending = ( \frac{\text{Government spending}}{\text{GDP}} )</td>
<td>IFS – CD Roam (IMF)</td>
</tr>
<tr>
<td>prod</td>
<td>Productivity index (GDP per capita)</td>
<td>Econometric Study Unit-Data Base of the National University of Singapore</td>
</tr>
<tr>
<td>( (r_{thai} - r_{us}) )</td>
<td>Real interest rate differential: ( r_{thai} = ) Thailand three month real deposit-rate. ( r_{us} = ) US$ three month real libor rate.</td>
<td>IFS – CD Roam (IMF)</td>
</tr>
<tr>
<td>( (r_{thai} - r_{jpn}) )</td>
<td>Real interest rate differential: ( r_{thai} = ) Thailand three month real deposit rate. ( r_{jpn} = ) Japan three month real deposit rate.</td>
<td>IFS – CD Roam (IMF)</td>
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Source: Compiled by authors
Table 10
ADF Unit-Root Test

<table>
<thead>
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<th>Variable</th>
<th>Level [l(0)]</th>
<th>First-Difference [l(1)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reer</td>
<td>-1.9557 (2)</td>
<td>-5.2440 (2)</td>
</tr>
<tr>
<td>Rerus</td>
<td>-2.6515 (2)</td>
<td>-7.0919 (2)</td>
</tr>
<tr>
<td>Rerjp</td>
<td>-2.4196 (1)</td>
<td>-6.0126 (1)</td>
</tr>
<tr>
<td>Tot</td>
<td>-3.2084 (4)</td>
<td>-3.9307 (4)</td>
</tr>
<tr>
<td>G</td>
<td>-1.8930 (2)</td>
<td>-13.2353 (2)</td>
</tr>
<tr>
<td>prod</td>
<td>-1.2187 (2)</td>
<td>-3.7248 (2)</td>
</tr>
<tr>
<td>(rthai – rus)</td>
<td>-2.6289 (3)</td>
<td>-10.7782 (3)</td>
</tr>
<tr>
<td>(rthai – r jpn)</td>
<td>-2.5448 (1)</td>
<td>-9.6296 (1)</td>
</tr>
</tbody>
</table>

Notes: 5 percent ADF-critical value = -3.4696
a) All variables are in the log-form.
b) ( ) captures the number of lags based on the Akaike Information Criteria.
c) also represents \((\text{r}_{\text{thai}} - \text{r}_{\text{us}})\)

Table 11a
Cointegration-Test Results for REER

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eigenvalue</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>0.4774</td>
</tr>
<tr>
<td>0.3433</td>
</tr>
<tr>
<td>0.1820</td>
</tr>
<tr>
<td>0.1802</td>
</tr>
<tr>
<td>0.0536</td>
</tr>
</tbody>
</table>

Note: a) Likelihood-Ratio indicates one cointegrating equation at 1 percent significance level

The Normalized Cointegrating Coefficients:

\[
\text{reer} = -3.848 +1.152 \, g_t + 0.102 \, (r_{\text{thai}}(t) - r_{*}(t)) + 0.613 \, prd_t + 0.758 \, tot_t - 0.026 \, t \\
(0.1813) \quad (0.0384) \quad (0.1563) \quad (0.3329) \quad (0.0032)
\]

( ) represents the standard errors
### Table 11b
#### Cointegration-Test Results for RERUS

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood-Ratio</th>
<th>1 Percent Critical value</th>
<th>Hypothesized No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4314</td>
<td>108.35¹</td>
<td>96.58</td>
<td>None</td>
</tr>
<tr>
<td>0.3784</td>
<td>67.69</td>
<td>70.05</td>
<td>At most 1</td>
</tr>
<tr>
<td>0.2294</td>
<td>33.46</td>
<td>48.45</td>
<td>At most 2</td>
</tr>
<tr>
<td>0.1170</td>
<td>14.69</td>
<td>30.45</td>
<td>At most 3</td>
</tr>
<tr>
<td>0.0766</td>
<td>5.73</td>
<td>16.26</td>
<td>At most 4</td>
</tr>
</tbody>
</table>

Note: a) Likelihood-Ratio indicates one cointegrating equation at 1 percent significance level

**The Normalized Cointegrating Coefficients:**

\[
reru = -17.32 + 1.298 g_t + 0.023 (r_{thai(t)} - r_{rus(t)}) + 0.523 prd_t + 1.779 tot_t - 0.017 t
\]

( ) represents the standard errors

### Table 11c
#### Cointegration-Test Results for RERJP

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood-Ratio</th>
<th>1 Percent Critical value</th>
<th>Hypothesized No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4139</td>
<td>102.63¹</td>
<td>96.58</td>
<td>None</td>
</tr>
<tr>
<td>0.3296</td>
<td>62.56</td>
<td>70.05</td>
<td>At most 1</td>
</tr>
<tr>
<td>0.2122</td>
<td>32.58</td>
<td>48.45</td>
<td>At most 2</td>
</tr>
<tr>
<td>0.1182</td>
<td>14.68</td>
<td>30.45</td>
<td>At most 3</td>
</tr>
<tr>
<td>0.0675</td>
<td>5.24</td>
<td>16.26</td>
<td>At most 4</td>
</tr>
</tbody>
</table>

Note: a) Likelihood-Ratio indicates one cointegrating equation at 1 percent significance level

**The Normalized Cointegrating Coefficients:**

\[
reer = -16.35 + 2.003 g_t + 0.394 (r_{thai(t)} - r_{jpn(t)}) + 0.494 prd_t + 1.911 tot_t - 0.035 t
\]

( ) represents the standard errors
Table 12
Settlement of Currency Composition of Exports and Imports for Thailand (percent)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>US Dollar</td>
<td>91.7</td>
<td>91.8</td>
<td>80.1</td>
<td>80.4</td>
</tr>
<tr>
<td>Baht</td>
<td>1.3</td>
<td>1.2</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Yen</td>
<td>4.5</td>
<td>4.5</td>
<td>9.6</td>
<td>9.7</td>
</tr>
<tr>
<td>Others</td>
<td>2.5</td>
<td>2.5</td>
<td>9.5</td>
<td>9.1</td>
</tr>
</tbody>
</table>

Source: Bank of Thailand and Siregar and Isidoro (1999)

Table 13
Variance Decomposition of the Total Trade Balance, Q1: 1987 – Q1: 1996 (percent)

VAR ordering: (Misalignment RERJP, Misalignment RERUS, and Trade Balance)\(^a\)

<table>
<thead>
<tr>
<th>Period</th>
<th>Misalignment RERJP</th>
<th>Misalignment RERUS</th>
<th>Trade Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.81</td>
<td>9.73</td>
<td>81.46</td>
</tr>
<tr>
<td>2</td>
<td>9.06</td>
<td>9.97</td>
<td>80.97</td>
</tr>
<tr>
<td>3</td>
<td>16.91</td>
<td>9.64</td>
<td>73.45</td>
</tr>
<tr>
<td>4</td>
<td>20.77</td>
<td>9.48</td>
<td>69.74</td>
</tr>
<tr>
<td>5</td>
<td>21.04</td>
<td>9.43</td>
<td>69.53</td>
</tr>
<tr>
<td>6</td>
<td>21.55</td>
<td>9.86</td>
<td>68.59</td>
</tr>
<tr>
<td>7</td>
<td>21.96</td>
<td>10.39</td>
<td>67.64</td>
</tr>
<tr>
<td>8</td>
<td>21.97</td>
<td>10.40</td>
<td>67.63</td>
</tr>
</tbody>
</table>

Note: a) Refer to Hamilton (1994) for the ordering of the VAR (page 323-330). Based on the knowledge that most of the trade deficit comes from the trade with Japan, the misalignment RERJP (against the Japanese yen) should therefore be a more dominant force than the misalignment RERUS in explaining the trade deficits. The more dominant variable is less likely to respond contemporaneously to innovation in the other variables.
<table>
<thead>
<tr>
<th>Product group</th>
<th>Japanese Exports by Major commodity Group</th>
<th>Japanese Imports by major commodity Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural products</td>
<td>122</td>
<td>111</td>
</tr>
<tr>
<td>Crude materials excl. fuels</td>
<td>90</td>
<td>160</td>
</tr>
<tr>
<td>Mineral Fuels</td>
<td>38</td>
<td>51</td>
</tr>
<tr>
<td>Chemical manufactures</td>
<td>942</td>
<td>1630</td>
</tr>
<tr>
<td>Machinery manufactures</td>
<td>8160</td>
<td>13100</td>
</tr>
<tr>
<td>Office and computing</td>
<td>364</td>
<td>421</td>
</tr>
<tr>
<td>Telecomm &amp; electric</td>
<td>2126</td>
<td>3603</td>
</tr>
<tr>
<td>Transportation</td>
<td>2436</td>
<td>3644</td>
</tr>
<tr>
<td>Other manufactures</td>
<td>2814</td>
<td>4495</td>
</tr>
<tr>
<td>Textiles, apparel, etc.</td>
<td>215</td>
<td>237</td>
</tr>
<tr>
<td>Wood, furniture paper, etc.</td>
<td>223</td>
<td>299</td>
</tr>
<tr>
<td>Metals</td>
<td>1503</td>
<td>2457</td>
</tr>
<tr>
<td>Not classified</td>
<td>138</td>
<td>197</td>
</tr>
<tr>
<td>Total</td>
<td>12304</td>
<td>19744</td>
</tr>
</tbody>
</table>

Source: ICSEAD (2000)
Figure 1
Balance of Payments
(in billions of US$)

Note: BOP = Balance of Payment; CA = Current Account; KA = Capital Account
Source: IFS, IMF (various years).

Figure 2
Nominal Exchange Rate (foreign currency per baht)
(average 1990 = 100)

Source: Computed by authors from IFS, IMF (various years).
Figure 3
Comparison of Trade Shares of Thailand’s Trade with US and Japan

Source: IFS, IMF (various issues)

Figure 4
Real Exchange Rate (foreign currency/ baht)
(average 1990 = 100)
Figure 5
Volatility Index
(average 1990 = 100)

Computed by authors. VJP is the volatility index of the RERJP. VUS is the volatility index of the RERUS.

Figure 6
REER and NATREX
(average 1990 = 100)
Figure 7
RERUS and NATREX
(average 1990 = 100)

Figure 8
RERJP and NATREX
(average 1990 = 100)
Figure 9
Misalignments

(Percent)

Note:
- MISJP = Misalignment for the real exchange rate of the baht against the yen.
- MISREER = Misalignment for the real effective exchange rate.
- MISUS = Misalignment for the real exchange rate of the baht against the US$.

The degree of misalignment is calculated using the following standard formula:
For the case of MISREER = \((\text{REER} - \text{NATREX})/\text{NATREX}\) * 100
Where a positive (negative) number implies an overvaluation (undervaluation).

Figure 10
Thailand’s Bilateral Trade Balance against Japan (TradeJP) and the US (Trade-US)
(in millions of baht)

Source: IFS, IMF (various issues)
Figure 11
Total Trade Balance
(in billions of baht)

Source: IFS, IMF (various issues)

Figure 12
Comparison of Thailand’s Export Intensity with Japan and the US

Source: Computed by authors
Note: a) VAR ordering: (MISJP, MISUS, TB) following Hamilton (1994). This result (larger and more persistent impacts of the MISJP than of the MISUS on the trade balance (TB)) holds when we switch the ordering into (MISUS, MISJP, TB). Note: MISJP = misalignment of the bilateral real exchange rate of the Thai baht against the Japanese yen. MISUS = misalignment of the bilateral real exchange rate of the Thai baht against the US dollar. TB = Trade Balance (total export – total import) of Thailand.
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