Misalignment of the Baht and its Trade Balance Consequences for Thailand in the 1980s and 1990s

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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 2 July, 1997, devaluation of the Thai baht, has invariably focused attention on the Thai economy and subsequent crisis. Studies have found that most of the key economic variables in Thailand were on definite downward/deteriorating trends since mid-1996 (Berg, 1999; Kaminsky, 1999; Lauridsen, 1998; and Rajan, 2001). Among the weak macro fundamentals in Thailand that have been frequently pointed out as the main causes of the crisis 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 six and eight per cent in the first half of the 1990s (Table 1).

While acknowledging that the causes of the crisis in Thailand and other East Asian countries were multidimensional (involving banking weaknesses, poor corporate governance, acute liquidity problems, and suchlike), this paper focuses narrowly on Thailand's exchange rate policy, specifically examining 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,

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TABLE 1
Selected Thailand Key Macroeconomic Indicators

	Average 1985–90	*Average 1991–95*	*1995*	*1996*	*1997*	*1998*	*1999*
GDP Growth (Per cent)	9.4	8.6	8.8	5.5	−0.4	−10.2	3.3
Inflation Rate (Per cent)	3.7	4.8	5.8	5.8	5.6	8.1	0.3
Trade Balance (billion US$)	−2.185	−5.228	−7.968	−9.488	1.551	16.041	13.477
Trade Balance (Per cent of GDP)	−1.94	−5.17	−6.73	−6.78	1.39	15.94	12.64
Current Account (billion US$)	−2.182	−8.375	−13.554	−14.692	−3.024	14.230	10.139
Current Account Balance (Per cent of GDP)	−3.13	−6.42	−8.07	−8.08	−2.01	12.68	8.03
Unemployment Rate (Per cent)	3.3	1.6	1.1	1.1	0.9	3.4	n.a.
Exchange Rate (baht/US$)	25.7	25.32	25.19	25.61	47.25	36.69	37.52
Exchange Rate (baht/100 yen)	5.14	4.22	4.20	4.27	7.88	6.11	6.25

Note:
n.a. = Not Available.

Source: IFS-CD Rom.

the US and Japan. We estimate currency misalignment as the difference between actual and 'equilibrium' exchange rates. Acknowledging that there is no universally accepted definition of 'equilibrium exchange rate', we use three alternative estimates in the case of the Thai baht: (a) the real effective equilibrium exchange rate (REER) of the Thai baht against its twenty-two major trading partners; (b) the bilateral real equilibrium exchange rate of the baht against the US dollar; and (c) the bilateral real equilibrium exchange rate of the baht against the Japanese yen. Our sample period spans two decades (Q1: 1981 to Q3: 1999).

Previous literature on this topic is rather thin. Two papers of direct relevance are Montiel (1997) and Lim (2000). Montiel (1997) concentrates on the real effective exchange rate of Thailand and other Southeast Asian economies of Indonesia, Malaysia, Philippines and Singapore. The key objective of the study is to empirically test whether 'the recent behaviour of the real exchange rate in these countries is or is not an equilibrium phenomenon' (p. 256). The study covers the period 1960–94 using annual data and employs a sequence of time-series tests, *viz*. the Unit Root test and the Johansen cointegrating test. Montiel fails to find any significant and persistent misalignments during the period of the 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.[1]

Lim (2000) is an extension of Clark and MacDonald (1999) who distinguish between the fundamental equilibrium exchange rate (FEER) and the behavioural 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, *viz*. the level of foreign debt and the cumulative sum of real interest rate differentials. The study covers the period January 1988 to 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 fairly 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 the real exchange rate of the Thai baht against the Japanese yen (RERJP) we are also able to identify persistent and significant misalignments of 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. This paper therefore adds further weight to the argument by Ito et al. (1998), Ito and Ogawa (2002) and others regarding the 'ineffectiveness' of the soft US dollar pegged system adopted by Thailand (also see Rajan, 2002).

The remainder of this paper is organised as follows. By way of background, the next section highlights Thailand's pre-crisis exchange rate policy and trends in the various real exchange rates. Section 3 estimates the equilibrium exchange rate of the Thai baht by operationalising the concept of the 'natural equilibrium exchange rate' or NATREX *à la* Stein (1994 and 1996) and establishes the

[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 used in the study are: world inflation rate, terms of trade, government expenditure to GDP, an index for commercial openness of the domestic economy, and time trends.

degree of misalignment of the baht pre-crisis. Section 4 goes on to consider, in particular, the implications of the pre-1997 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 offers a summary by way of concluding the paper.

2. CAPITAL FLOWS AND EXCHANGE RATE POLICIES AND TRENDS IN THAILAND PRE-CRISIS

a. Pre-crisis Capital Inflows

Speculative attacks on emerging market currencies have almost always been preceded by very large private capital inflows (Dooley, 2000). More specifically, Radelet and Sachs 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 (1998, p. 8).

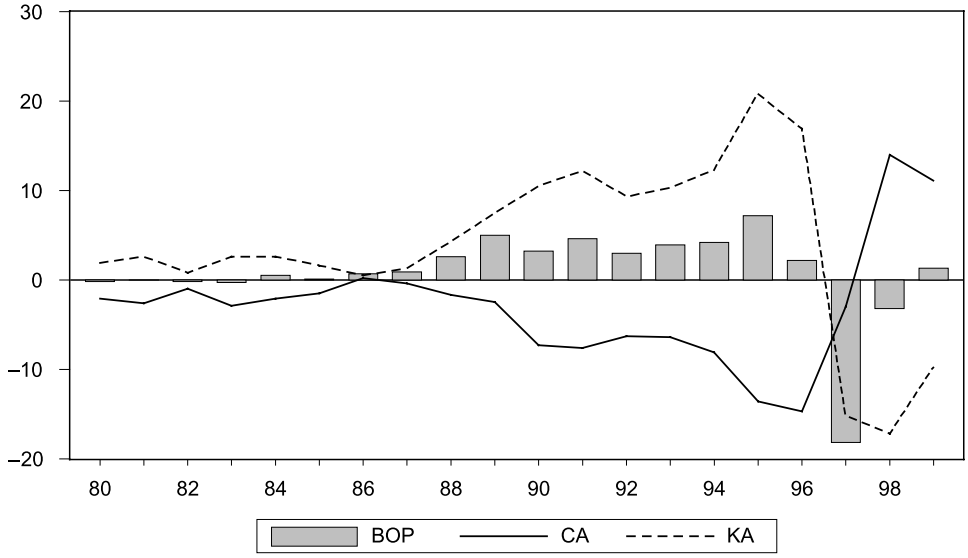
A proper perspective of the East Asian crisis may therefore only be gained by considering the pre-crisis boom period.[2]

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).[3] 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 (Bird and Rajan, 2001b).

[2] For a more detailed discussion of the dynamics of capital flows to East Asia in the 1990s, see Rajan and Siregar (2002).

[3] 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 authorised 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 (Rajan, 2002; and Sirivedhin, 1997).

FIGURE 1
Balance of Payments
(in billions of US$)



Note:
BOP = Balance of Payments; CA = Current Account; KA = Capital Account.

Source: IFS, IMF (various years).

TABLE 2
Composition of Capital Flows to Thailand (Per cent of GDP)

	1989–95[a]	*1994*	*1995*	*1996*	*1997*
Net Private Capital Flows	10.2	8.6	12.7	9.3	–10.9
Net Direct Investment	1.5	0.7	0.7	0.9	1.3
Net Portfolio Investment	1.3	0.9	1.9	0.6	0.4
Other Net Investment	7.4	7.0	10.0	7.7	–12.6
Net Official Flows	0	0.1	0.7	0.7	4.9

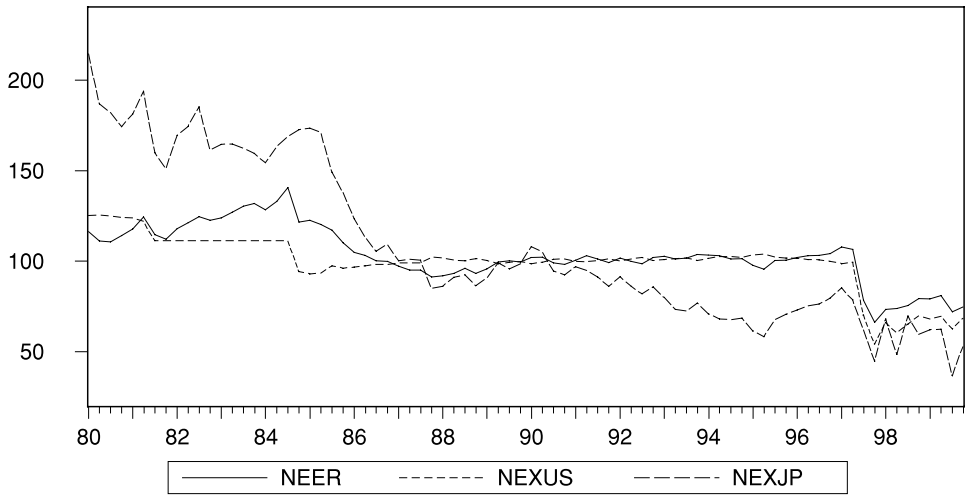
Note:
[a] Annual averages.

Source: IMF.

b. Pre-crisis Exchange Rate Policy

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 seemed to have been important contributory factors for these capital inflows and the consequent build-up of external debt, most of which was uncovered in view of the expectations of

FIGURE 2
Nominal Exchange Rate (foreign currency per baht)
(Average 1990 = 100)



Source: Computed by authors from IFS, IMF (various years).

the durability of the US dollar-based peg (Bird and Rajan, 2002; and Rajan, 2002).[4]

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 East Asia. In reality, the US dollar had the overwhelming weight *de facto* (Table 3), leading McKinnon (2001) and Ohno (1998) to refer to East Asia's 'dollar standard' and 'soft dollar zone', respectively. The reasons for this dollar peg remain uncertain.[5] Regardless, the dominance of the US dollar

[4] 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 liberalisation (even after accounting for potential default and devaluation risk premia) is an important empirical puzzle (Bird and Rajan, 2001a; and Rajan and Bird, 2002). Rajan, Siregar and Sugema (2003) estimate the uncovered interest rate parity for the 3-month interest rates of the commercial banks of Thailand against banks in the US and Japan and find that the interest rates offered by commercial banks in Thailand were 4–5 per cent over their counterparts in the two industrial countries.

[5] 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 dollar 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, 1998). Bénassy-Quéré et al. (2001) also emphasise the importance of exchange rate stability for attracting FDI.

TABLE 3
The Southeast Asian Dollar Standard (daily nominal exchange rate)

Regression Model:[a]

$$\%(\Delta\text{Local Currency/SWF}) = \beta_1 + \beta_2(\%\Delta\text{USD/SWF}) + \beta_3(\%\Delta\text{JPY/SWF}) + \beta_4(\%\Delta\text{DEM/SWF}) + e_t$$

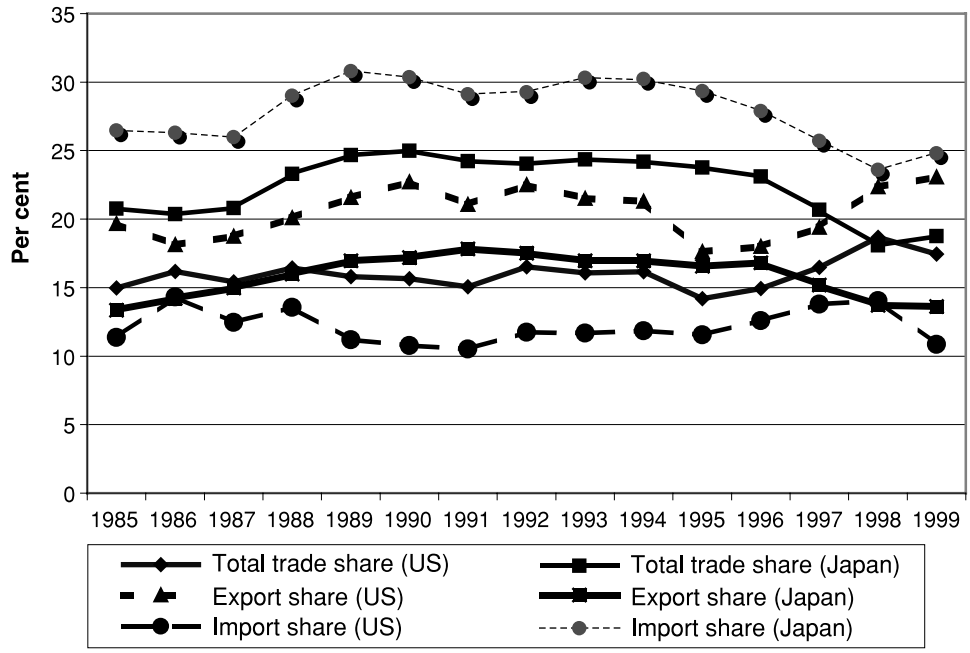
Pre-Crisis Period (January 1994–May 1997) *Currencies*	*USD Coefficient: β_2 (standard error)*	*R-square*
Indonesian Rupiah	0.999 (0.008)	0.965
Malaysian Ringgit	0.886 (0.014)	0.889
Philippines Peso	0.987 (0.018)	0.836
Singapore Dollar	0.817 (0.012)	0.905
Thailand Baht	0.955 (0.012)	0.923
Crisis Period (June 1997–December 1998) *Currencies*	*USD Coefficient: β_2 (standard error)*	*R-square*
Indonesian Rupiah	0.550 (0.388)	0.038
Malaysian Ringgit	0.755 (0.138)	0.161
Philippines Peso	0.788 (0.125)	0.196
Singapore Dollar	0.727 (0.061)	0.447
Thailand Baht	0.688 (0.165)	0.107
Post-Crisis Period (January 1999–May 2000) *Currencies*	*USD Coefficient: β_2 (standard error)*	*R-square*
Indonesian Rupiah	0.848 (0.163)	0.182
Malaysian Ringgit	1.000 (0.000)	1.000
Philippines Peso	0.945 (0.040)	0.741
Singapore Dollar	0.818 (0.026)	0.848
Thailand Baht	0.858 (0.049)	0.639

Notes:
USD = US$; JPY = Japanese yen; DEM = German DM; and SWF: Swiss Franc.

Source: McKinnon (2000).

continued in the 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, and a substantial share of external debt to the region was denominated in yen. These intensive economic linkages between Thailand and Japan suggests *a priori* that the Japanese yen was significantly under-represented in Thailand's currency basket (Rajan, 2002).

FIGURE 3
Comparison of Trade Shares of Thailand's Trade with the US and Japan



Source: IFS, IMF (various issues).

c. Trends in Real Exchange Rates

The nearly 50 per cent nominal appreciation of the US dollar relative to the yen between June 1995 and 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 the end of December 1996 and into mid-1997 over 1995 (Figure 4).[6] 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 US dollar peg operated by Thailand, as previously noted (also see Figure 5).[7] After a sharp

[6] 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.
[7] 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:

FIGURE 4
Real Exchange Rate (Foreign currency/baht)
(Average 1990 = 100)

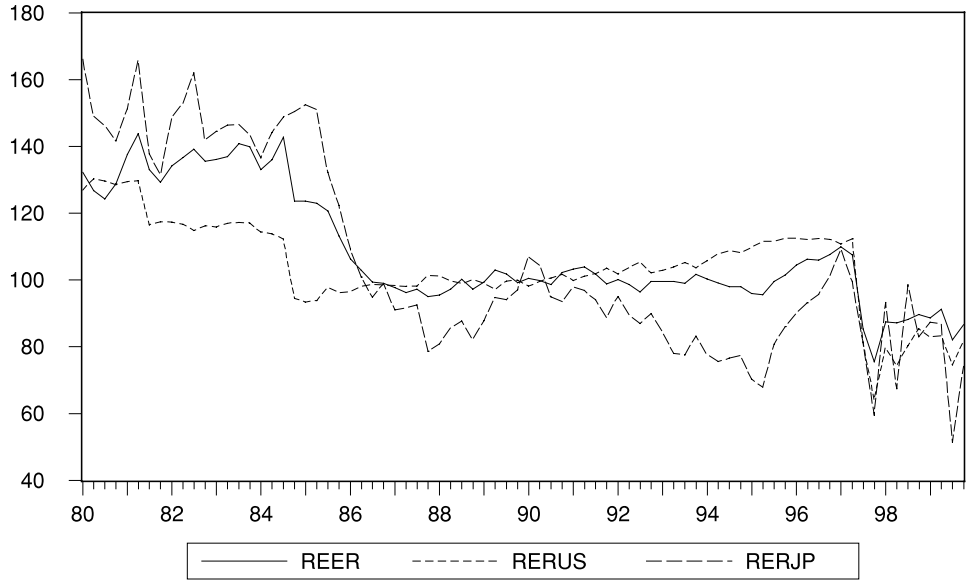
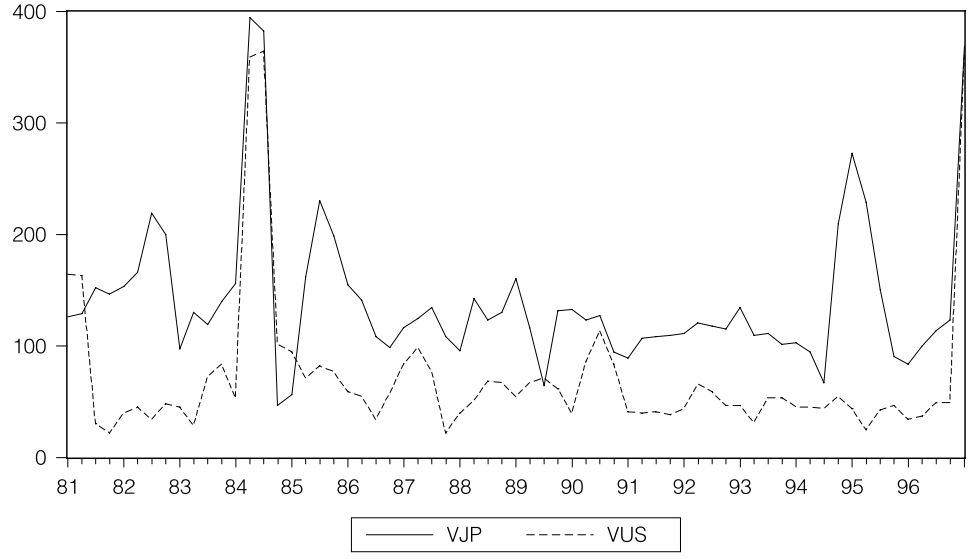


FIGURE 5
Volatility Index (Average 1990 = 100)



Notes:
VJP is the volatility index of the RERJP. VUS is the volatility index of the RERUS.

Source: Computed by authors.

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.

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 non-tradables sectors, the so-called Balassa-Samuelson theorem (Neuhas and Associates, 1998), a relative increase in the demand for non-tradables over tradables (Arndt, 1990 and 1997), or changes in 'equilibrium' patterns of capital flows.[8] We need 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 operationalise the concept of a Natural Equilibrium Real Exchange Rate (NATREX) model developed by Jerome Stein (1994 and 1996).

3. MEASURING EXCHANGE RATE MISALIGNMENT: THE NATREX MODEL

a. General Overview of 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 (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 optimise 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 and 1712).

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

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 Lastrapes (1989) and Chowdhury (1993).

[8] Empirical tests by Ito et al. (1996 and 1997) suggest that the experiences of Malaysia and Thailand provide counter-examples to the Balassa-Samuelson hypothesis. Also see Chinn (2000).

Since the theoretical background of the NATREX model has been extensively discussed elsewhere (see Stein, 1994 and 1996; and Stein and Paladino, 1998), we focus instead on a general working model of the concept.

b. 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:

$$natrex_t = f(z_t) \tag{1}$$

The lowercase letters represent natural logs. Vector $natrex_t$ represents the equilibrium real exchange rate for *reer*, *rerjp*, *rerus*. Vector z consists of the fundamentals in the economy $\{g, r^*, r_{thai}, tot \text{ and } prd\}$, where: g is real government spending; r^* is world real interest rate; r_{thai} is the domestic interest rate in Thailand; *prd* is productivity; and *tot* is the terms of trade. Since $natrex_t$ is not directly observable, we estimate the following set of equations:[9]

$$reer_t = \beta_0 + \beta_1 g_t + \beta_2 (r_{thai\ t} - r_t^*) + \beta_3 tot_t + \beta_4 prd_t + \varepsilon_t, \tag{2}$$

$$rerjp_t = \alpha_0 + \alpha_1 g_t + \alpha_2 (r_{thai\ t} - r_{jpn\ t}) + \alpha_3 tot_t + \alpha_4 prd_t + \varepsilon_t, \tag{3}$$

$$rerus_t = \gamma_0 + \gamma_1 g_t + \gamma_2 (r_{thai\ t} - r_{us\ t}) + \gamma_3 tot_t + \gamma_4 prd_t + \varepsilon_t. \tag{4}$$

Equations (2)–(4) seek the best fit of the *reer*, *rerus* and *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 summarised in Table 4.

c. Coefficient Estimates: What Does Theory Tell Us?

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

(a) Government Expenditure (g): Following Obstfeld and Rogoff (1996), we assume that government expenditure is disproportionately devoted to non-tradables. As g rises, the relative demand for non-tradables also goes

[9] Such single equation econometric models are commonly used in the literature on the determination of equilibrium real exchange rates (Edwards and Savastano, 1999). The choices of the fundamental variables are generated from the NATREX model and also consistent with the nature of the Thai economy.

TABLE 4
Descriptions of Variables

Variable	*Description*	*Source*
reer	Real Effective Exchange Rate (against around 22 of Thailand's major trading partners' currencies). An increase in REER implies a real appreciation of the Thai baht.	J. P. Morgan Web-Site
rerus	Real Exchange Rate of baht against the US dollar: $RERUS = [NEX_{US\$/baht}] * [CPI_{Thai}/CPI_{us}]$; 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.	IFS – CD Rom (IMF)
rerjp	Real Exchange Rate of baht against the Japanese yen: $RERJP = [NEX_{JPN\ Yen/baht}] * [CPI_{Thai}/CPI_{JPN}]$; 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.	IFS – CD Rom (IMF)
Tot	Terms of trade = (unit value of export)/(unit value of import)	IFS – CD Rom (IMF)
G	Ratio of government spending over GDP = Government spending/GDP	IFS – CD Rom (IMF)
prod	Productivity index (GDP per capita)	Econometric Study Unit-Data Base of the National University of Singapore
$(r_{thai} - r_{us})$	Real interest rate differential: r_{thai} = Thailand three month real deposit rate. r_{us} = US$ three month real libor rate.	IFS – CD Rom (IMF)
$(r_{thai} - r_{jpn})$	Real interest rate differential: r_{thai} = Thailand three month real deposit rate. r_{jpn} = Japan three month real deposit rate.	IFS – CD Rom (IMF)

up, triggering an increase in price of non-tradables or a real appreciation, i.e. $\beta_1 > 0$; $\alpha_1 > 0$; and $\gamma_1 > 0$.

(b) Interest Rate Differentials $(r_{thai} - r^*)$, $(r_{thai} - r_{us})$ and $(r_{thai} - r_{jpn})$: International interest rate arbitrage implies that when the return for foreign currency dominated assets (r^*, r_{us} and r_{jpn}) exceeds local currency dominated assets (r_{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 $\gamma_2 > 0$.

(c) 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 $\gamma_3 > 0$.
(d) 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 $\gamma_4 > 0$.[10]

d. Empirics

The data sources used in this study are presented in Table 4. 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 relationships among all variables in equations (2)–(4).

(i) The unit root test

To determine the order of integration of each variable, we use the standard ADF regression:

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 t + \sum_{i=1}^{k} \alpha_1 \Delta Y_{t-i} + \varepsilon_t \tag{5}$$

where: $Y = \{reer, rerus, rerjp, tot, g, prd, (r\text{-}rus),$[11] $(r\text{-}rjp)\}$, 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 5). The Akaike Criteria test determines the appropriate number of lag periods.

(ii) Johansen maximum likelihood cointegration test

Since all variables are $I(1)$, we proceed to conduct the Johansen cointegration test procedures on all the single equation models. Since the observation set spans over the post-1997 crisis period, we also include a crisis dummy in the regressions.[12] In addition, due to a possible presence of deterministic time trend in the long-run macroeconomic variables such as exchange rate, following Enders (1995) and Montiel (1997) and others we also include a time trend in our cointegration regression equations.

[10] As described in Table 4, due to the lack of data to proxy the productivity rate, we employ GDP per capita series. The advantage of using untrended GDP per capita series, is that we are also able to capture the possible consequences of the output cycle on the movements of the real (effective) exchange rate (Mills and Pentecost, 2001; and Stockman, 1998).
[11] (*r-rus*) equals $(r - r^*)$.
[12] The crisis dummy equals zero from 1981 to quarter 1, 1997, and one otherwise.

TABLE 5
ADF Unit-Root Test

Variable[a]	*Level [I(0)]*	*First-Difference [I(1)]*
reer	−1.9557 (2)[b]	−5.2440 (2)
rerus	−2.6515 (2)	−7.0919 (2)
rerjp	−2.4196 (1)	−6.0126 (1)
Tot	−3.2084 (4)	−3.9307 (4)
G	−1.8930 (2)	−13.2353 (2)
prod	−1.2187 (2)	−3.7248 (2)
$(r_{thai} - r_{us})$[c]	−2.6289 (3)	−10.7782 (3)
$(r_{thai} - r_{jpn})$	−2.5448 (1)	−9.6296 (1)

Notes:
5 per cent 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 $(r_{thai} - r^*)$.

TABLE 6a
Cointegration-Test Results for REER

Observation Period: Q1: 1981 – Q3: 1999

Eigenvalue	*Likelihood-Ratio*	*1 Per Cent Critical Value*	*Hypothesised No. of CE(s)*
0.4774	114.31[a]	96.58	None
0.3433	65.64	70.05	At most 1
0.1820	34.10	48.45	At most 2
0.1802	19.03	30.45	At most 3
0.0536	4.13	16.26	At most 4

Note:
[a] Likelihood-Ratio indicates one cointegrating equation at the 1 per cent significance level.
The Normalised Cointegrating Coefficients:

$$reer = -3.848 + 1.152g_t + 0.102\,(r_{thai(t)} - r^*_{(t)}) + 0.613prd_t + 0.758tot_t - 0.026t$$

(0.181) (0.038) (0.156) (0.333) (0.003) (Std Errors)
(40.37) (7.06) (15.44) (5.18) (75.11) (Chi-square)

Chi-square critical values: at 1% = 6.6349; at 5% = 3.8415; and at 10% = 2.7055.

The trace statistics (likelihood-ratio) indicate that there is one cointegrating relationship (significant at the 5 per cent level) in each of the single equation models (Tables 6a–6c). More importantly, all the fundamental variables have significant and theoretically consistent coefficient estimates at 1 per cent and 5 per cent Chi-square critical values, except for the interest rate differential for the case of real exchange rate of the baht against the US dollar. We excluded the crisis dummy variable from the regressions as the estimated coefficients are statistically insignificant. Furthermore, the inclusion of the dummy variable only worsens the overall results of the cointegration tests. We retain the time

TABLE 6b
Cointegration-Test Results for RERUS

Observation Period: Q1: 1981 – Q3: 1999

Eigenvalue	*Likelihood-Ratio*	*1 Per Cent Critical Value*	*Hypothesised No. of CE(s)*
0.4314	108.35[a]	96.58	None
0.3784	67.69	70.05	At most 1
0.2294	33.46	48.45	At most 2
0.1170	14.69	30.45	At most 3
0.0766	5.73	16.26	At most 4

Note:
[a] Likelihood-Ratio indicates one cointegrating equation at the 1 per cent significance level.
The Normalised Cointegrating Coefficients:

$$rerus = -17.32 + 1.298g_t + 0.023(r_{thai(t)} - r_{us(t)}) + 0.523prd_t + 1.779tot_t - 0.017t$$

(0.355) (0.053) (0.256) (0.591) (0.004) (Std Errors)
(13.37) (0.18) (4.17) (9.06) (18.06) (Chi-squares)

Chi-square critical values: at 1% = 6.6349; at 5% = 3.8415; and at 10% = 2.7055.

TABLE 6c
Cointegration-Test Results for RERJP

Observation Period: Q1: 1981 – Q3: 1999

Eigenvalue	*Likelihood-Ratio*	*1 Per Cent Critical Value*	*Hypothesised No. of CE(s)*
0.4139	102.63[a]	96.58	None
0.3296	62.56	70.05	At most 1
0.2122	32.58	48.45	At most 2
0.1182	14.68	30.45	At most 3
0.0675	5.24	16.26	At most 4

Note:
[a] Likelihood-Ratio indicates one cointegrating equation at 1 per cent significance level.
The Normalised Cointegrating Coefficients:

$$rerjp = -16.35 + 2.003g_t + 0.394(r_{thai(t)} - r_{jpn(t)}) + 0.494prd_t + 1.911tot_t - 0.035t$$

(0.409) (0.119) (0.245) (0.837) (0.007) (Std Errors)
(23.95) (10.92) (4.07) (5.23) (25.00) (Chi-squares)

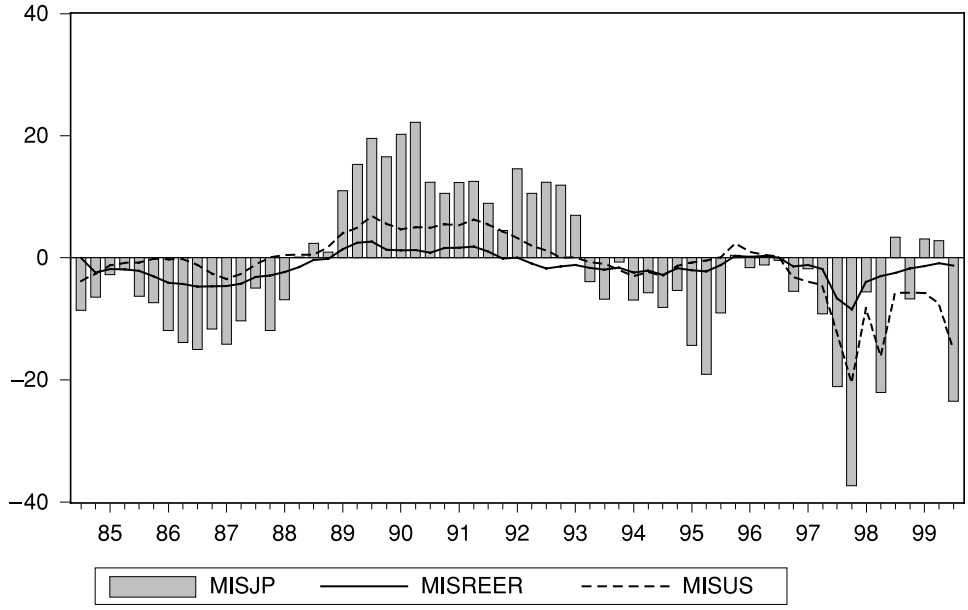
Chi-square critical values: at 1% = 6.6349; at 5% = 3.8415; and at 10% = 2.7055.

trend (t) as the coefficient estimates are significant in all cases. We next construct the equilibrium rate for REER, RERUS and RERJP by using the estimated coefficients.

e. Estimation of Baht Misalignment

We are specifically interested in the question of whether there has been any misalignment in baht's REER, RERUS and RERJP during the period of 1980 to

FIGURE 6
Misalignments
(Per cent)

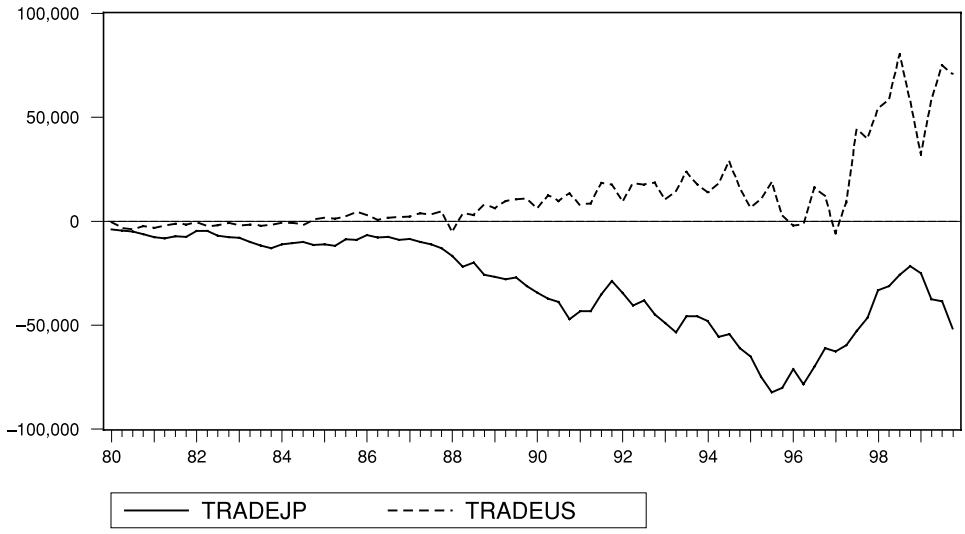


Notes:
MISJP = Misalignment for the real exchange rate of the baht against the yen.
MISREER = Misalignment for the real effective exchange rate.
MISUS = Misalignment for the real exchange rate of the baht against the US$.
The degree of misalignment is calculated using the following standard formula:
For the case of MISREER = ((REER – NATREX)/NATREX) * 100
where a positive (negative) number implies an overvaluation (undervaluation).

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 misaligned, that is overvalued or undervalued, when its observed real or real effective rate is higher or lower than its natural real equilibrium exchange rate – ($reer_t$ – $natrex_t$) is greater or less than zero.

Figure 6 plots the misalignment rates throughout the observation period for REER, RERUS and RERJP. The results reveal that the sizes of the misalignment for the REER and the RERUS are relatively smaller than for the RERJP. While the baht was persistently overvalued in all three cases (REER, RERJP and RERUS) during the period of 1988–99, the greatest degree of overvaluation occurred in the case of the RERJP. In contrast, between 1993–mid-1995 and 1997–mid-1998, all three measurements of baht suggest that the currency was undervalued, with the RERJP experiencing the largest undervaluation.

FIGURE 7
Thailand's Bilateral Trade Balance Against Japan (TradeJP)
and the US (TradeUS)
(in millions of baht)



Source: IFS, IMF (various issues).

4. IMPACT OF BAHT MISALIGNMENT ON THAILAND'S BILATERAL TRADE BALANCES *VIS-À-VIS* THE US AND JAPAN

While Thailand's bilateral trade balance against the US has largely been in surplus, it experienced a trade deficit against Japan since 1980, with the largest deficit occurring in late 1995–early 1996 (Figure 7). The widening of the trade deficit against the Japanese market took place between 1987 and 1996. In contrast, Thailand's bilateral trade *vis-à-vis* the US has been in persistent surplus, though this changed in late 1995 and early 1996. From Figure 7, it is clear that the overall deficit of the Thai trade balance has primarily been a result of a widening bilateral deficit with Japan.

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 – had undoubtedly adversely affected the Asian Newly Industrialising Economies (ANIEs), such as Singapore, South Korea and Taiwan, along with the next-tier ANIEs of Malaysia and especially Thailand (World Bank, 2000b).[13]

[13] The price of 16-megabyte DRAM chips slumped from US$54 at the end of 1995 to US$13 in 1996 and then US$3 by mid-1997 (World Bank, 2000b).

TABLE 7
Settlement of Currency Composition of Exports and Imports for Thailand (Per cent)

	Exports		*Imports*	
	1996	*1997*	*1996*	*1997*
US Dollar	91.7	91.8	80.1	80.4
Baht	1.3	1.2	0.8	0.8
Yen	4.5	4.5	9.6	9.7
Others	2.5	2.5	9.5	9.1

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

Given that a relatively larger proportion of imports were denominated in yen compared to exports (Table 7), 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 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 (2002, p. 34).

To further analyse the effects of the baht misalignment, we consider data on Thailand's bilateral merchandise trade with its two main economic partners in some detail.

a. Analysis of Trade Data

(i) 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 per cent each). As such, the share of the US in Thailand's total trade remained at about 15 per cent between 1985 and 1996, while the share of Japan in Thailand's trade was about 23 per cent. 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 per cent (Figure 3). As discussed, Thailand has reported a persistently 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 per cent) consistently outpaced that of Thailand's global exports and Thailand's exports to the US (about 20 per cent each). Thai exports to Japan recorded negative growth for three consecutive years between 1996 and 1998, 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 per cent between 1985 and 1994. Having fallen off sharply in 1995, the share

of Thai exports to the US relative to Thailand's global exports has risen sharply since then. Japan's export share rose gradually from about 13 per cent in 1985 to about 16 per cent over the entire period until 1996 but has declined since then.[14]

In the pre-crisis period, the average growth rates of Thai imports from the US and Japan were almost identical (15 per cent). The share of US imports in Thailand's global imports ranged between 10 and 15 per cent 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 per cent, 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 per cent of total FDI). Much of this Japanese FDI to Thailand has been directed towards the manufacturing industry, which in turn heavily source intermediate inputs from Japan.

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 favour 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 favour of Japan.[15] The marked decline of Japan in Thailand's overall trade since then has coincided with a fall in the size of Thailand's bilateral deficit with Japan (Figure 7).

(ii) 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.[16] These indices essentially seek to establish

[14] Manufactured products, including chemical, machinery and metal manufactures were the principal commodities that contributed to a high surplus in Japan's trade with Thailand (see Appendix Table A1). Among the machinery products, electronic and electrical products, *viz*. Telecom and Electrical equipment and Transportation equipments, contributed significantly to Thailand's high bilateral trade deficit with Japan pre-crisis.

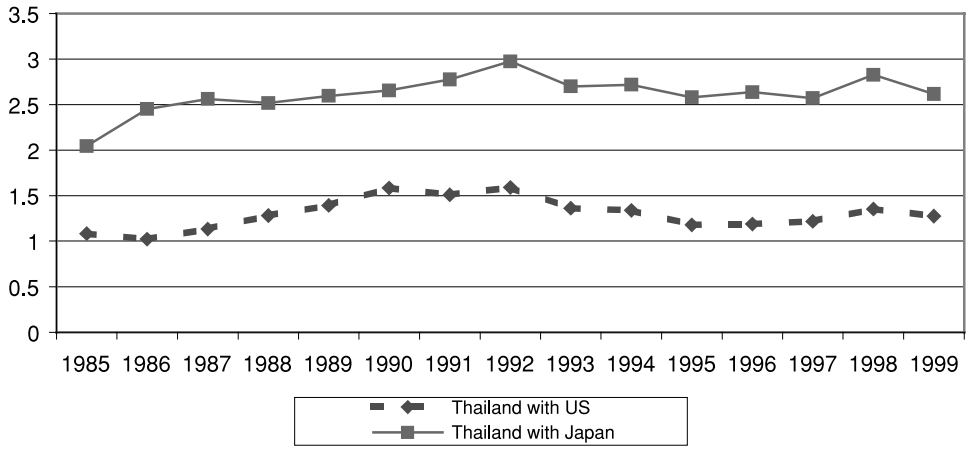
[15] Over the period 1986 to 1995, Thailand's trade deficit with Japan increased continuously and sharply by nearly US$11 billion (with the exception of 1991). In contrast, Thailand's trade surplus with the US increased relatively less by only about US$3 billion during 1986–94.

[16] The calculation for the bilateral trade intensity index for total trade is as follows:

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

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;

FIGURE 8
Comparison of Thailand's Export Intensity with Japan and the US



Source: Computed by authors.

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 first consider the export intensity index (Figure 8).[17] Thailand's bilateral export intensity for Japan declined from its peak of about 3 in 1990 to a trough of

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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.

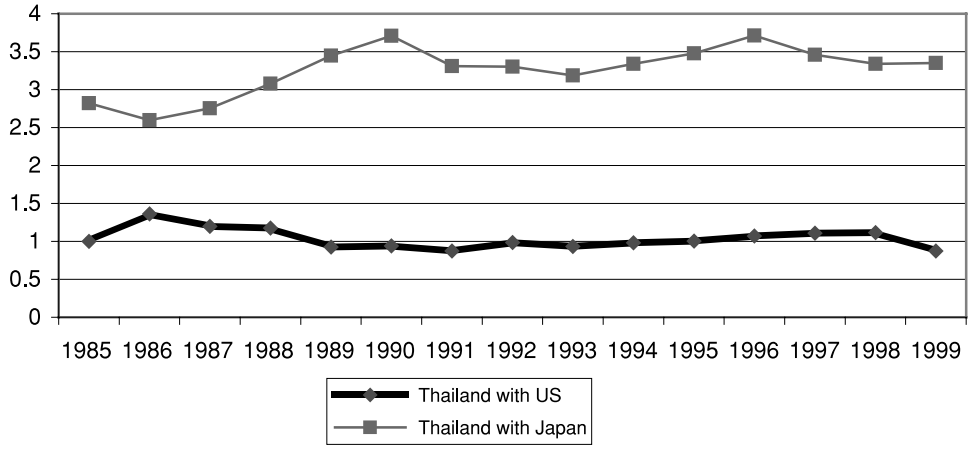
This index is interpreted as a relative measure of two ratios. The numerator represents the share of bilateral trade between country i and j as a percentage of total trade of country i. This forms the numerator of the total trade intensity index. The second ratio in the denominator represents the total 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. For the sake of brevity, we do not report the bilateral trade index. They can be made available upon request from the authors. Instead, we will report both export and import intensity index (Figures 8 and 9).

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

$$X^a_{ij} = [X_{ij}/X_i]/[(M_j - M_{ji})/(M_w - M_i)]$$

where, in addition to the notations in the bilateral trade intensity index, M_j = Total imports of country j and M_{ji} = 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.

FIGURE 9
Comparison of Thailand's Import Intensity with Japan and the US



Source: Computed by authors.

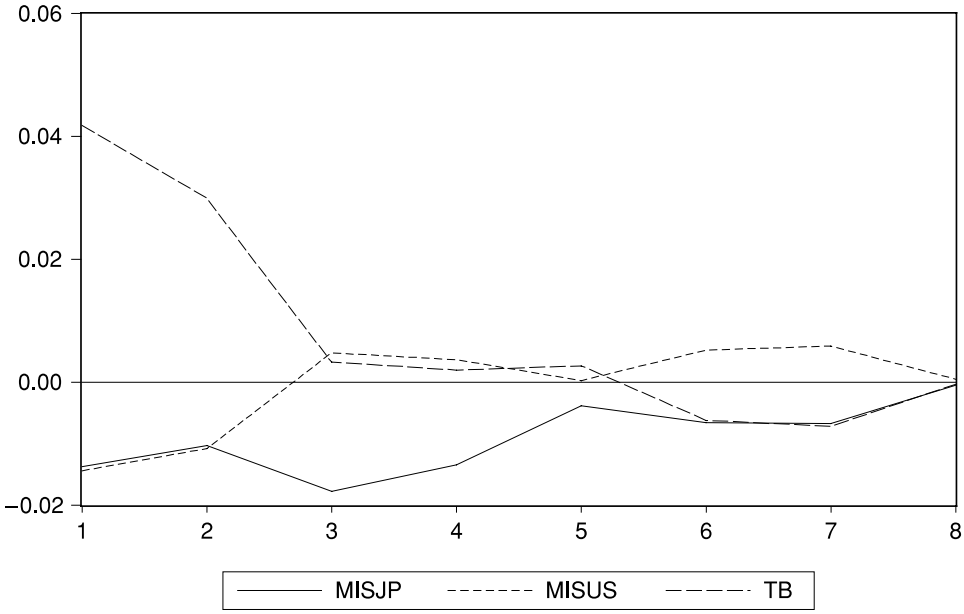
about 2.5 in 1997. In contrast, Thailand's export intensity for the US remained more or less stable at just above 1 between 1993 and 1997, though down from the peak of 1.5 between 1990 and 1992. In the case of import intensity indices (Figure 9), while Thailand's import intensity with the US remained 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.[18] Overall, it can be inferred that Japan has generally 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 market, 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 its 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 trading partners in general.

[18] The import intensity index may be stated as follows:

$$M^{a}_{ij} = [M_{ij}/M_i]/[(X_j - X_{ji})/(X_w - X_i)]$$

where, in addition to the notations in the bilateral trade intensity index, X_j = Total exports of country j; and X_{ji} = 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.

FIGURE 10
Impulse Response Test[a]
(Response of trade balance (TB) to one S.D. innovation)



Notes:
[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).
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.

b. 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 (1987–96). A one standard deviation shock to the misalignment of the RERJP leads 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 10). 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.[19] We

[19] The *t*-statistics for RERJP and RERUS remain significant at the 5 per cent significance level during the first four lags. However, for the rest of the four lags, the *t*-statistics for both RERJP and RERUS are significant only at the 10 per cent level.

TABLE 8
Variance Decomposition of the Total Trade Balance Q1: 1987 – Q1: 1996 (Per cent)
VAR ordering: (Misalignment RERJP, Misalignment RERUS, and Trade Balance)[a]

Period	*Misalignment RERJP*	*Misalignment RERUS*	*Trade Balance*
1	8.81	9.73	81.46
2	9.06	9.97	80.97
3	16.91	9.64	73.45
4	20.77	9.48	69.74
5	21.04	9.43	69.53
6	21.55	9.86	68.59
7	21.96	10.39	67.64
8	21.97	10.40	67.63

Notes:
[a] Refer to Hamilton (1994) for the ordering of the VAR (pp. 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.

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 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 8). 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 Thailand's trade performance.

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) and 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 Thailand's trade deficits between 1990 and 1996 just prior to the crisis in 1997. This 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 minimises the volatility of a country's trade balance, when the yen-dollar exchange rate fluctuates, Thailand's *de facto* dollar peg was clearly sub-optimal.

APPENDIX

TABLE A1
Major Commodity Groups of Thailand's Trade with Japan (in millions of US$)

Product Group	*Japanese Exports by Major Commodity Group*					*Japanese Imports by Major Commodity Group*				
	1993	*1995*	*1996*	*1997*	*1998*	*1993*	*1995*	*1996*	*1997*	*1998*
Agricultural products	122	111	83	107	118	2,196	2,792	2,561	2,328	2,072
Crude materials excl. fuels	90	160	125	103	82	670	1,174	1,078	956	657
Mineral fuels	38	51	46	40	13	13	16	20	54	6
Chemical manufactures	942	1,630	1,419	1,195	982	201	235	257	288	288
Machinery manufactures	8,160	13,100	12,259	9,314	5,501	1,476	3,033	3,319	3,223	2,858
Office and computing	364	421	426	401	412	375	1,047	1,262	1,118	869
Telcomm & electric	2,126	3,603	3,353	3,207	2,616	658	1,350	1,376	1,428	1,364
Transportation	2,436	3,644	3,385	1,719	444	23	32	37	69	105
Other manufactures	2,814	4,495	4,042	3,551	2,416	1,765	2,512	2,561	2,374	1,946
Textlies, apparel, etc.	215	237	218	197	171	490	673	680	609	452
Wood, furniture, paper, etc.	223	299	262	200	126	309	490	475	462	365
Metals	1,503	2,457	2,134	1,841	1,237	291	360	349	319	269
Not classified	138	197	289	274	254	194	361	416	351	351
Total	12,304	19,744	18,263	14,583	9,366	6,515	10,121	10,212	9,574	8,178

Source: ICSEAD (2000).

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