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Competitive Devaluations—Bitter Pill or Bad Medicine?

The Case of Thailand

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Devaluation and crises in emerging economies have tended to be followed by an outright economic collapse. This post-devaluation economic contraction is inconsistent with the conventional view that devaluation is expansionary/inflationary and needs to be accompanied by demand deflationary monetary and fiscal policy. This paper undertakes a detailed empirical analysis to determine whether real devaluation is contractionary rather than expansionary in the case of Thailand, which was the "trigger" country in the East Asian crisis of 1997–98.

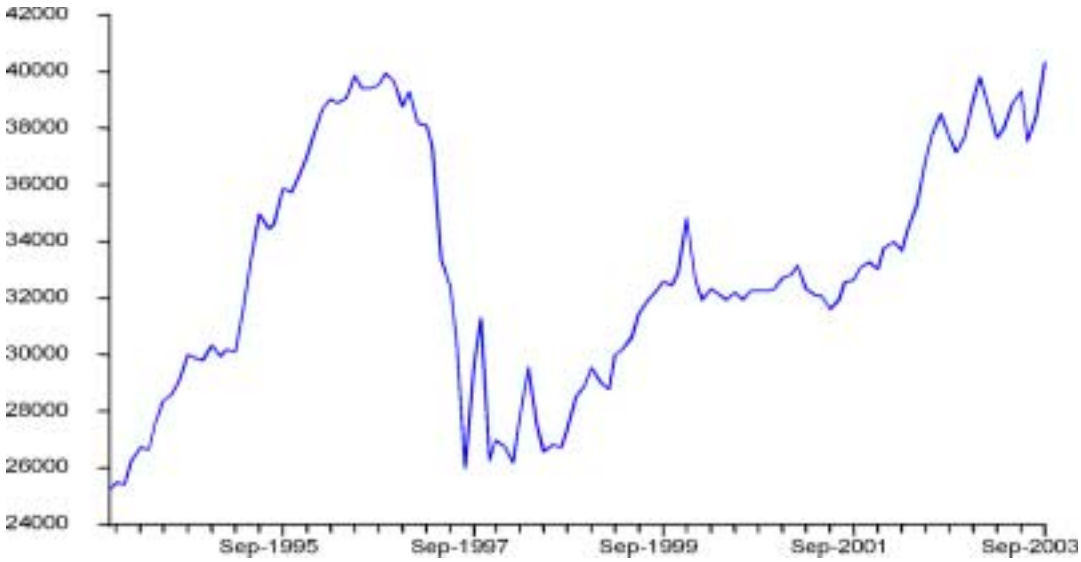
I. Introduction

An orthodox policy prescription in response to a financial crisis is that of a competitive devaluation. Yet, this panacea has been heavily criticized not just by the financial press and regional political leaders but also by the central banking community. In the aftermath of the Asian financial crisis, with the benefit of hindsight, even some Fund economists (Boorman et al. 2000, p. 6) have admitted that:

> [i]t was … not foreseen at the outset that these economies would adjust in a dysfunctional way of reduced external financing — largely through a collapse of private domestic demand rather than a boom in exports. This adjustment reflected in large part the harsh balance-sheet effects of the currency depreciations that occurred, given the unhedged foreign currency exposures of banks and corporations.

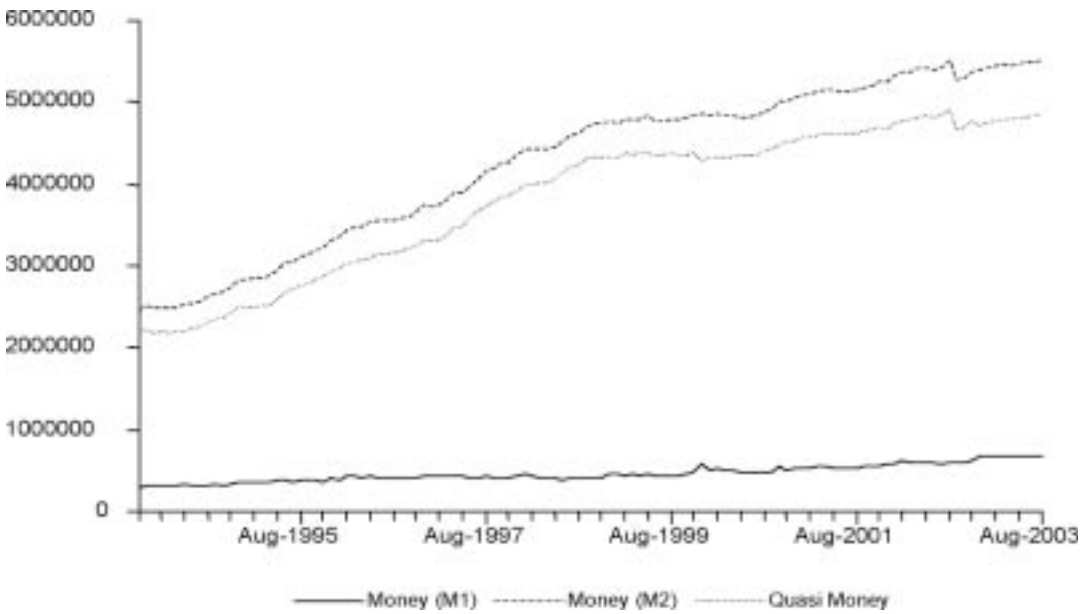
Indeed, the reality of this inconsistency was borne out in the way events played out in Thailand, the country widely viewed as the genesis of the 1997–98 crisis. The Thai scenario was characterized by the sterilization of reserve outflows by the Bank of Thailand (BOT), so as to ensure the smooth growth of money supply over the crisis period (World Bank 1999). As a result, despite the fall in reserves due to the crisis, the monetary base sharply increased over the period. As clearly evidenced in Figures 1 and 2, which respectively track the international reserve position and money supply of Thailand over the pre- to post-crisis period, the initial decline in reserves was accompanied by a concomitant rise in domestic credit.[1]

FIGURE 1
Thailand: International Reserves, November 1993–September 2003
(In US$ million)



SOURCE: Bank of Thailand.

FIGURE 2
Thailand: Money Supply, November 1993–August 2003
(In million baht)



SOURCE: Bank of Thailand.

However, the unsustainability of such a strategy was succinctly captured by MacIntyre (1999, p. 14):

> [a] side effect of injecting large scale emergency funding into the … failing finance companies was blowing out the money supply…. This served to sharpen the fundamental contradiction in the government's overall macroeconomic position. At the same time as it was pumping money into insolvent finance companies to keep them afloat, the central bank was also spending down reserves to prop up the exchange rate … [T]his was not a sustainable strategy.

Why, then, did Thailand choose to pursue such a course of action? To understand this, one needs to recognize the moral hazard problem facing entrepreneurial activity in developing countries. Since informational asymmetry surrounding these projects effectively impose an upper ceiling on investment *vis-à-vis* the full-information outcome, investment financing in most developing economies is largely dependent on bank lending.

Thailand is no exception. As illustrated in Table 1, bank credit constitutes the overwhelming majority of financing activity.[2] It was believed, therefore, that any sustained fall in bank lending would have led to detrimental spillover effects on real economic activity. As such, it was no surprise that, in the event of crisis, the BOT chose to support domestic financial institutions through a major liquidity injection (Table 2).

Nonetheless, in spite of the fairly supportive macroeconomic policy pursued by the Thai authorities over the crisis episode (Boorman et al. 2000; Lane et al. 1999), output in Thailand fell sharply in the interim. With regard to monetary policy, the hesitation of the Thai central bank to adopt the conventional response of raising interest rates at the onset of the crisis arguably led to a deeper crisis.[3] Furthermore, fiscal policy was also largely in line with supporting the flagging economy; the sustained fiscal deficit of the Thai Government post-1996 attests to this fact (IMF 2000*b*).[4]

These factors suggest that the effect of devaluation, far from being expansionary, might instead have been contractionary. For the case of Thailand, the supposed boost to competitiveness that would accrue from currency devaluation clearly failed to materialize, and any stimulus to real economic activity, if at all, only manifested itself after a significant lag. In the words of Dooley and Walsh (1999, p. 3), "[w]e are … unsure why some crises are followed by … economic recession while others are not".

This apparent failure in the standard policy prescription, together with the ambiguity surrounding

TABLE 1
Selected Indicators of Financial Sector Development in East Asia, 1994–96
(Percent of GDP)

	Credit of Banking System (1995)	*Bank Assets (1994)*	*Bank Share in Financial Intermediation (1994)*[a]	*Stock Market Capitalization (1996)*	*Bond Market Capitalization (1996)*
Indonesia	50	57	91	10	6
S. Korea	70	75	38	43	24
Malaysia	132	100	64	33	56
Philippines	63	54	N.A.	N.A.	39
Thailand	137	110	75	4	14

NOTE: a. Assets of banks as a percent of the assets of banks and non-bank financial institutions.
SOURCES: Compiled from various sources.

TABLE 2
Claims by Monetary Authorities on Domestic Financial Institutions
Q1:1996 – Q3:199[a]

	Q1:96	*Q2:96*	*Q3:96*	*Q4:96*	*Q1:97*	*Q2:97*	*Q3:97*	*Q4:97*
Indonesia[b]	15,295	15,930	16,531	15,182	16,084	19,154	21,245	67,313
Malaysia[c]	6,585	6,867	5,679	5,249	5,325	5,284	5,411	5,032
Philippines[d]	13.1	13.2	13.6	14.2	14.3	16.1	20.0	34.5
Thailand[e]	38.4	66.0	72.0	90.1	194.0	353.9	597.9	723.4

NOTES: a. end of period; b. billions of rupiah; c. millions of ringgit; d. billions of peso; e. billions of baht.
SOURCE: Computed from IMF data.

the existing theoretical literature, form the basis for the motivation for this present paper: to empirically examine the case for or against currency devaluation. In particular, the study will apply a range of econometric tests to study the post-devaluation output collapse in Thailand, the "trigger" country in the Asian financial crisis.

The paper is organized as follows. In the two sections that follow, the economics that underlie currency devaluation is briefly reviewed, and, in light of this literature, a heuristic review of the data, with an emphasis on capital flow dynamics, is attempted. This is followed by a detailed empirical investigation of the impact of real exchange depreciation on Thai output, before a final section concludes the paper.

II. The Economics of Currency Devaluation[5]

Despite the importance of the subject matter, economic theory offers little by way of resolution of the conundrum surrounding an appropriate response to a financial crisis. The conventional view, adhered to by the majority of economists (and standard fare in international economics texts),[6] remains that devaluations are a key component of a post-crisis stabilization programme. According to this view, assuming that the economy is not at full employment, devaluations motivate expenditure switching, which in turn spurs tradables production (and, by extension, exports). This adjustment process results in a strengthening of the country's external balance.

However, a trade-off this entails might be a negative impact of the devaluation on total output. This contrarian school of thought, which has come to be known as the "contractionary devaluation critique" (Edwards 1986), argues that there are at two main channels by which this may occur. Devaluations may squeeze aggregate demand, through either a negative wealth effect due to inflationary pressures, or income redistribution from savers to dissavers, or a deterioration in the trade balance (Frenkel and Johnson 1976; Krugman and Taylor 1978). Alternatively, devaluations may induce a leftward shift in aggregate supply due to the expenditure reducing effect dominating the expenditure switching effect; this would likewise generate recessionary results (van Wijnbergen 1986).[7]

Among the many channels proposed in the contractionary devaluation literature, of particular interest to the Asian episode is the balance sheet effect, or the so-called double mismatch, of unhedged short-term foreign currency denominated debt financing long-term repayments (Krugman 2000; Mishkin 1998).

More formally, Aghion, Bacchetta, and Banerjee (2000) show, within a similar monetary framework, how there exists a tension between the two competing effects of raising domestic nominal interest rates post crisis: an increase in the debt burden faced by domestic firms, on one hand, and the enhanced finances of domestic firms that have debt denominated in foreign currency, on the other. In particular, given the condition for interest

parity in the money market, obtain[8]

$$E_1 = \frac{1 + i^*}{1 + i_1} \cdot \frac{M_2}{L(Y_2, i_2)} \qquad (1)$$

where 1 and 2 are time subscripts and E, M, Y, i and i^* are variables for the exchange rate, money supply, output, and interest rate at home and foreign, respectively. This can be combined with the equation representing entrepreneurs' cash flow

$$Y_2 = \sigma[1 + \mu(i_1)](1 - \alpha)[Y_1 - (1 + r_0)D^c - (1 + i^*)\frac{E_1}{P_1}(D_1 - D^c)] \qquad (2)$$

where D and D^c are the firms' borrowing and constrained borrowing, P is the price level, and r_o is the real interest rate on domestic debt. σ and μ are parameters, the first of which scales an (assumed) linear production technology and the second being the proportionality factor for entrepreneurs' wealth. In equilibrium, it is possible to show that it is optimal to increase the interest rate i_1 when

$$\frac{\mu'(i_1)P_1[Y_1 - (1 - r_0)D^c - (1 + i^*)\frac{E_1}{P_1}(D_1 - D^c)]}{[1 + \mu(i_1)](1 + i^*)(D_1 - D^c)} < \frac{E_1}{1 + i_1} \qquad (3)$$

Therefore, depending on the values that, in particular, $\mu'(i_1)$ and $(D_1 - D^c)$ take on, the optimal policy response to a currency crisis is indeterminate.

Extending this line of analysis, Krugman (2000) has shown that for small variations in the exchange rate, the pro-competitive effects of a devaluation will dominate, resulting in the devaluation being expansionary; whereas for large deviations, balance sheet effects dominate, leading to output contraction. However, since such models are typically characterized by multiple equilibria, a conundrum arises — even a seemingly small devaluation might possibly lead to sharp capital outflows and outright collapse, as the economy moves from one equilibrium to another.[9]

The emerging market crises of the 1990s have been distinguished by a set of striking empirical regularities; so much so that these have come to be known as the stylized facts of "sudden stops".[10] Although the theoretical literature in this area is in its nascent stages, most studies attempt to rationalize the phenomenon within a partial equilibrium framework, and are premised on the existence of financial frictions. One class of models is driven by the debtor's ability to pay, usually through the imposition of a collateral constraint, while another class focuses on the debtor's willingness to pay.[11]

More recently, Arellano and Mendoza (2003) have embedded the basic ideas of these models into an equilibrium business cycle framework with financial frictions. Although the aim of these papers are to explain the conditions that generate sudden stops, work within this vein provide an early, if not crude, understanding of the macroeconomic consequences faced by countries that are subject to and are undergoing recovery from a financial crisis.

III. Capital Flows and Macroeconomic Consequences in Thailand: A Quick Review

The data on capital flows in Thailand provide some insight surrounding the events immediately prior to and following the crisis. Table 3 captures the private capital flows data between 1997 and 1999, based on data reported by the BOT. Immediately obvious is the fact that, just prior to devaluation in the first quarter of 1997, both the bank and non-bank sectors experienced capital outflows.[12] This is a reflection of the general loss of confidence that precipitated in the severe pressure faced by the baht in February, although this did not lead to formal devaluation.

Some explanatory notes will better capture the flow dynamics of the period. First, funds continued to flow into the country during the first half of 1997, right up to devaluation in July. Indeed, it was only *after* the devaluation that there was a massive exodus of these banking sector flows. Furthermore, foreign direct investment (FDI) actually *rose* in 1998, somewhat offsetting the drastic declines in portfolio capital and non-resident baht accounts (NRBAs), and leading to a relatively small deterioration in the non-bank capital account.

Second, portfolio flows experienced a directional

TABLE 3
Thailand: Composition of Net Private Capital Flows, 1996–2002
(In US$ billion)

	1996	*1997*	*1998*	*1999*	*2000*	*2001*	*2002p*
Bank	5,003	–5,717	–12,723	–10,617	–6,606	–2,052	1,912
Commercial bank	419	–5,212	–3,272	–1,265	–2,596	–756	3,401
of which Recapitalization	0	0	2,291	2,588	467	22	184
BIBFs	4,584	–505	–9,451	–9,352	–4,010	–1,296	–1,489
Non-bank	13,198	–1,906	–2,760	–2,924	–3,164	–2,076	–7,421
Direct investment	1,455	3,180	5,019	3,218	2,761	3,588	829
Foreign direct investment	2,271	3,627	5,143	3,562	2,813	3,759	970
Thai direct investment abroad	–816	–447	–124	–344	–52	–171	–141
Others loans	5,451	–3,688	–3,713	–4,359	–4,509	–2,787	–2,200
Portfolio investment	3,488	4,550	422	391	106	–643	–1,109
Equity securities	1,123	3,987	265	946	897	17	209
Debt securities	2,365	563	157	–555	–791	–660	–1,318
Non-resident baht account	2,924	–5,812	–4,300	–2,909	–413	–1,371	–4,930
Trade credits	–145	–382	–411	619	–821	–470	234
Others	25	246	223	116	–288	–393	–245
Total	18,201	–7,623	–15,483	–13,541	–9,770	–4,128	–5,509

NOTE: p = projection
SOURCE: Bank of Thailand.

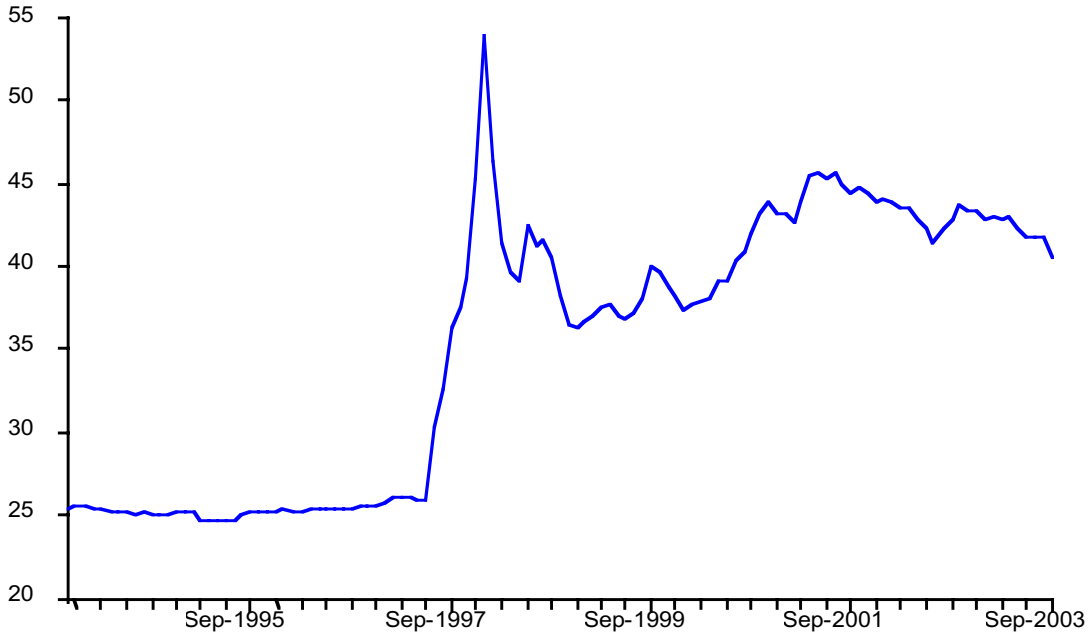
change in November and December 1997, leading to a sharp decrease in portfolio investment in 1998. Furthermore, private bank capital flows displayed a major turnover in the excess of $10 billion between the first and second halves of 1997. This reversal intensified in the following year, with outflows touching $14 billion that year.

Third, capital outflows from NRBAs were $3.5 billion in the first half of 1997, fell to just over $2 billion in the second half, before slowing to about $2.7 billion for 1998 as a whole. This acute decline almost resulted in national bankruptcy; an event that was only averted because creditors agreed to roll over their foreign loans to local firms, with over 80 per cent of the total amount of foreign loans being rolled over (*Bangkok Post*, 22 December 1997).

For the case of Thailand, it would appear that the rise in the baht value of external debts following the initial devaluation substantially worsened the balance sheet positions of domestic corporates and banks. This, in turn, led to a deterioration in domestic economic conditions and intensified capital outflows. The flotation of the Thai baht meant its continual depreciation, culminating in a nadir in January 1998, where the baht traded at about 55 to the dollar (Figure 3). Meanwhile, interbank rate differential over LIBOR continued to rise well after the successful speculative attack of July 1997, reflecting an expected further depreciation of the baht.

Furthermore, as shown in Table 4, even though exports grew by an average of 8 per cent in 1997 and 1998, domestic demand declined in 1997 and 1998 (by 9.5 per cent and 24.2 per cent in 1997 and 1998, respectively). Consumption and investment demand also experienced precipitous falls, with consumer durables and construction being the worst hit sectors in each. Consequently, real GDP, which enjoyed an impressive 8.5 per cent growth

FIGURE 3
Baht/US$ Exchange Rate, November 1993–September 2003



SOURCE: Bank of Thailand.

TABLE 4
Thailand: Components of GDP Growth, 1991–2001

	1991–94 (Average)	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
GDP Growth (%)	8.5	5.9	–1.8	–10.5	4.4	4.6	1.8
Domestic demand							
Private consumption expenditure growth (%)	7.6	6.8	–0.8	–11.5	4.3	4.9	3.4
Public consumption expenditure growth (%)	6.5	11.9	–3.6	3.9	3.2	2.6	1.6
Gross domestic investment growth (%)	9.5	6.8	–21.7	–50.9	8.7	10.9	0.6
Gross fixed investment growth (%)	10.0	7.4	–20.3	–44.3	–3.2	5.5	–22.8
Exports of goods and services growth (%)	14.0	–5.5	8.3	8.2	9.0	17.6	–4.2
Imports of goods and services growth (%)	12.4	–0.5	–11.7	–21.6	10.5	27.3	–8.3

SOURCE: Bank of Thailand and ARIC Indicators.

between 1991 and 1994, more or less stagnated in 1997 before collapsing to –10 per cent in 1998.

This episode naturally begs an empirical investigation that will formally examine exactly how (or whether) devaluations might (or did) lead to a real economic contraction. Since Thailand was the "trigger" country for the Asian financial crisis, it seems a natural starting point to flesh out the informal arguments made above with careful empirical testing.

IV. Empirical Analysis

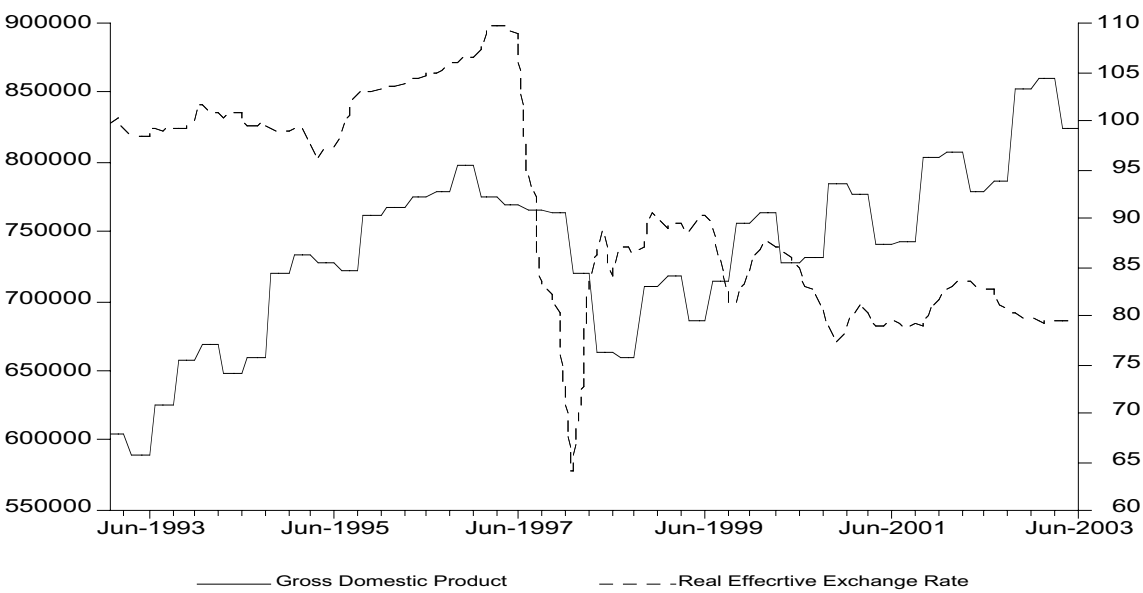
The broad story of original "crisis" leading to devaluation and resulting financial and economic "collapse" is shared by Mexico in 1994 and 1995. Thus Montiel (1999) rightly concludes that "(t)he upshot is that the similarities between Mexico and Thailand mattered much more than the differences, and the policy message from the two experiences is the same" (p. 41). Kamin and Rogers (2000) investigate the impact of Mexico's real exchange rate on domestic output using a VAR (vector autoregression) model. Motivated by their paper, in this section we attempt to uncover the reasons for the underlying post-devaluation economic collapse, and more specifically, the output effects (if any) of real exchange rate depreciations in Thailand.[13]

IV.1. Data Preliminaries

Figure 4 plots Thailand's real effective exchange rate (REER) against the seasonally adjusted real GDP. Two important observations bear noting.

First, the REER and output variables appear to have little if any co-movement prior to the crisis period (before mid-1996). To be specific, output was on a rapidly rising trend, peaking in mid-1996.[14] Before the crisis and devaluation, Thailand, as with most other Southeast Asian economies, maintained a *de facto* U.S. dollar peg despite the importance of trade and investment linkages with Japan (Frankel and Wei 1994; McKinnon 2000). As

FIGURE 4
Real Effective Exchange Rate and Real GDP, June 1993–June 2003



SOURCE: CEIC Database.

such, the pre-crisis variation of the REER was primarily due to the fluctuation of the baht *vis-à-vis* the yen. For instance, 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 heavily against the U.S. dollar reaching 80 yen per U.S. dollar). This trend was reversed sharply following the nearly 50 per cent nominal appreciation of the U.S. dollar relative to the yen between June 1995 and April 1997, leading to a marked appreciation of Thailand's REER (Rajan, Siregar, and Sugema 2003).

Second, the REER and real output variables have tended to move closely together around the time of the devaluation in early 1997 and early 1998. During the crisis period, the REER declined *prior to* the decline in output during the devaluation around July 1997, providing an early clue that devaluation might be contractionary. The deviation of the two variables from 1999 onwards is consistent with the recent findings that Thailand and other regional economies have chosen to revert to U.S. dollar pegs (McKinnon 2000; Calvo and Reinhart 2001).

Additional insight may be derived by more formal empirical analyses. The questions that we focus on are: (a) whether devaluation does cause a fall in output (i.e. is it contractionary); and if so, (b) whether this impact is reversed in the longer term.

We make use of data from the CEIC database over the period of November 1993 to May 2003. All the variables are transformed into logarithmic form. The Appendix provides information on the data set.

IV.2. Methodology

The empirics in this section involve three specific tests. We begin with a simple correlation test which provides an indication of the degree of correlation between the REER and real output (real seasonally adjusted GDP) in the short term. Of course, even if causation exists, correlation could run both ways. We therefore conduct a pair-wise Granger-causality test to determine the temporal ordering of the two variables. However, both these tests are bivariate ones, with well-known limitations. Therefore, as a third step, we estimate a vector error correction (VEC) model to establish medium to long-term interdependence between real exchange rate and output in Thailand.[15] Additionally, in a VAR framework, external shocks and the degree of interactions between variables can be detected through both impulse reaction functions (IRFs) and variance decomposition techniques.

IV.3. Bivariate Tests

Tables 5 and 6 report the results of the two bivariate tests at their first difference. We see that there is a positive nexus between the REER and real output variables in Thailand over the whole sample period as well as the second sub-period (Table 5), while a negative relationship is seen for the first sub-period. However, the degree of these correlations is not very strong: about 0.1 for the whole period and the second sub-period, and –0.1

TABLE 5
Correlations between REER and Real GDP

	Real Effective Exchange Rate		
	Whole sample (1993:11–2003:05)	*First sub-period (1993:11–1997:06)*	*Second sub-period (1997:07–2003:05)*
Real GDP	0.089418	–0.080097	0.093137

TABLE 6
Pair-wise Granger Causality Tests

Null Hypothesis	*obs*	*F-Statistic*	*Probability*	
Whole Sample: 1993:11 2003:05 Lags: 12				
Real GDP does not Granger Cause Real Effective Exchange Rate	102	0.31980	0.98373	X
Real Effective Exchange Rate does not Granger Cause Real GDP		**2.29683**	**0.01469**	**Y**
Subsample 1: 1993:11 1997:06 Lags: 12				
Real GDP does not Granger Cause Real Effective Exchange Rate	31	1.92799	0.21628	X
Real Effective Exchange Rate does not Granger Cause Real GDP		0.60422	0.78465	X
Subsample 2: 1997:07 2000:06 Lags: 2				
Real GDP does not Granger Cause Real Effective Exchange Rate	71	0.18278	0.99859	X
Real Effective Exchange Rate does not Granger Cause Real GDP		**1.92865**	**0.05544**	**Y**

for the first sub-period. To a very limited extent, though, the positive correlation in the second sub-period is again suggestive that a real devaluation (fall in REER) is accompanied by a drop in output. The pair-wise Granger causality on the entire sample period reveals that variations in the REER preceded output fluctuations, not vice versa, and that this relationship is significant (Table 6). Moreover, while no Granger causality exists in the first sub-period, the precedence of the REER to GDP is weakly significant in the second sub-period. This again supports the notion that a real exchange rate devaluation is a significant contributing factor to an output contraction.

IV.4. VAR Model

A virtue of the VAR model is its simplicity of method — it is not necessary to specify certain variables as endogenous or exogenous, and each equation can be estimated by OLS (ordinary least squares) separately.[16] However in a VAR analysis, there is the outstanding issue of whether the variables need to be stationary. In general, three cases are possible. One, if all variables are trend stationary, then the application of an unrestricted VAR in "levels" is appropriate. Two, if no cointegrating relationship exists, then the application of an unrestricted VAR in "first differences" is appropriate.[17] Both these are referred to as the conventional VAR model. Three, if at least one integrated variable and one cointegrating relation exists, then the data can be described by a Vector Error Correction (VEC) model.

As starting point, we first test the stationarity of the data series to determine the number of co-integrating equations.

Unit root tests and cointegration tests. The unit root tests are performed using the Augmented Dickey-Fuller (ADF) method. The null hypothesis in the ADF test is the existence of a unit root (Table 7). All the variables are integrated of order one or I(1). Thus the cointegration regressions can be run for the variables under consideration. The results of the Johansen cointegration test are presented in Table 8. It shows that cointegration exists among all the I(1) series in this study over three sample periods. This indicates that a long-term relationship does exist between the variables.

TABLE 7
Augmented Dickey-Fuller Unit Root Test

Variable	*Level [I(0)] Test Statistic*	*First-Difference [I(1)] Test Statistic*	
Exchange Rate	–1.823541	–4.194887	I(1)
Government Size	–2.707314	–9.879049	I(1)
Money Supply	–2.520427	–3.889387	I(1)
Inflation	–1.543142	–4.672964	I(1)
Output	–2.075311	–4.241163	I(1)
1 per cent Critical Value	–3.4906	–3.4911	
5 per cent Critical Value	–2.8877	–2.8879	

NOTE: MacKinnon (1990) critical values for rejection of hypothesis of a unit root.

Since most of the series in this study are found to be I(1) and co-integrating relationships do exist, the application of the VEC model is appropriate.[18] We find that there exists more than one integrating vector in the whole sample period and the second sub-period, while only one integrating vector can be found under the first sub-period.

VEC model. The VEC model is a restricted VAR designed for use with non-stationary series that are known to be cointegrated. A virtue of the VEC model is its specification, which restricts the long-run behaviour of the endogenous variables from converging to their cointegration relationships, yet allowing for a wide range of short-run dynamics.[19] As illustrated by Kamin and Rogers (2000, p. 107), it is possible to reduce a full system of all prominent channels of causality linking output to the real exchange rate to a relatively tractable system of four key equations.

The analysis here draws on the benchmark theoretical model of Kamin and Rogers (2000) and adapts it to the case of Thailand. The ordering of variables in the VEC model is reflective of decreasing exogeneity. Exogenous shocks to the capital account induce adjustments in the real exchange rate; then — conditional on government size (which determines the extent of the response) — the money supply is adjusted to effect stabilization policy that might offset the shock. This naturally leads to price changes, which then impact output. The model was estimated with lags for four periods, in order to capture non-contemporaneous influences of the exogenous variables.[20]

Model: Real effective exchange rate, government size, money supply, inflation rate, and output.[21] The equation used in the VEC model is:

$$\pi x_t = \Delta x_{t-1} - \pi_0 - \Sigma \pi_i \Delta x_{t-1} - \epsilon_t \qquad (4)$$

where:

x_t 5x1 vector of endogenous variables (REER, government size, money supply, inflation rate, and real GDP)

π_0 a 5x1 vector of intercept terms with elements π_{i0}

π_i a 5x5 coefficient matrices with elements $\pi_{jk(i)}$

ϵ_t a 5x1 vector with elements ϵ_{it}

The first difference of each endogenous variable is regressed on a one period lag of the cointegrating equation(s) and lagged first differences of all the endogenous variables in the system. Since each expression on the right-hand side of (4) is stationary, πx_{t-1} must also be stationary. Furthermore, as π contains only constants, each row of π is a cointegrating vector of x_t.[22]

TABLE 8
Johansen Cointegration Test

Sample: 1993:11 2003:05
Included observations: 110
Series: LEXR LGS LM LCPI LGDP
Lags interval: 1 to 4

Eigenvalue	*Likelihood Ratio*	*5 Per cent Critical Value*	*1 Per cent Critical Value*	*Hypothesized No. of CE(s)*
0.312586	105.5170	68.52	76.07	None **
0.217089	64.28685	47.21	54.46	At most 1 **
0.163188	37.36583	29.68	35.65	At most 2 **
0.105316	17.76863	15.41	20.04	At most 3 *
0.049007	5.527351	3.76	6.65	At most 4 *

* (**) denotes rejection of the hypothesis at 5 per cent (1 per cent) significance level
L.R. test indicates 5 cointegrating equation(s) at 5 per cent significance level

Sample: 1993:11 1997:06
Included observations: 42
Series: LEXR LGS LM LCPI LGDP
Lags interval: 1 to 1

Eigenvalue	*Likelihood Ratio*	*5 Per cent Critical Value*	*1 Per cent Critical Value*	*Hypothesized No. of CE(s)*
0.756745	88.94416	68.52	76.07	None **
0.327236	29.57102	47.21	54.46	At most 1
0.194500	12.92388	29.68	35.65	At most 2
0.087107	3.839640	15.41	20.04	At most 3
0.000283	0.011902	3.76	6.65	At most 4

* (**) denotes rejection of the hypothesis at 5 per cent (1 per cent) significance level
L.R. test indicates 1 cointegrating equation(s) at 5 per cent significance level

Sample: 1997:07 2003:05
Included observations: 72
Series: LEXR LGS LM LCPI LGDP
Lags interval: 1 to 2

Eigenvalue	*Likelihood Ratio*	*5 Per cent Critical Value*	*1 Per cent Critical Value*	*Hypothesized No. of CE(s)*
0.426978	105.9354	68.52	76.07	None **
0.347003	65.84349	47.21	54.46	At most 1 **
0.234677	35.15832	29.68	35.65	At most 2 *
0.183667	15.90137	15.41	20.04	At most 3 *
0.017760	1.290233	3.76	6.65	At most 4

* (**) denotes rejection of the hypothesis at 5 per cent (1 per cent) significance level
L.R. test indicates 4 cointegrating equation(s) at 5 per cent significance level

TABLE 9
Variance Decompositions

Periods	*Exchange Rate*	*Government Size*	*Money Supply*	*Inflation*	*Output*
Whole sample period (1993:11–2003:05)					
Variance Decomposition of Exchange Rate					
2	97.54406	0.600647	0.305468	0.191415	1.358405
5	90.30496	6.275193	0.620979	1.798986	0.999883
10	81.74220	14.09358	0.964584	1.493841	1.705797
Variance Decomposition of Output					
2	4.536617	0.691314	3.968941	0.006051	90.79708
5	8.744795	0.446265	2.349466	0.148588	88.31089
10	20.25396	1.015434	2.343956	0.844490	75.54216
First sub-period (1993:11–1997:06)					
Variance Decomposition of Exchange Rate					
2	92.05783	0.960525	3.452104	0.783449	2.746096
5	85.09581	1.861593	6.192009	3.466261	3.384325
10	83.88643	2.412057	5.945742	4.737489	3.018284
Variance Decomposition of Output					
2	35.93007	0.398556	0.034618	0.000521	63.63623
5	21.32703	0.980246	4.168056	0.432642	73.09202
10	11.61025	1.141843	11.25102	0.496662	75.50023
Second sub-period (1997:07–2003:05)					
Variance Decomposition of Exchange Rate					
2	99.06868	0.277355	0.177571	0.247055	0.229341
5	87.30034	1.014359	10.24944	0.496000	0.939867
10	77.80674	0.985883	18.66374	0.883631	1.660010
Variance Decomposition of Output					
2	2.955178	1.191337	11.64654	0.185070	84.02187
5	1.859303	5.961517	15.22862	2.975618	73.97495
10	1.246210	6.566104	16.97800	3.108258	72.10142

As with a VAR model, it is difficult to interpret the coefficients intuitively in the VEC model as the estimated coefficients of the regression equations contain complicated cross-equation feedbacks. Therefore, in order to draw conclusions, it is preferable to analyse the system's reaction to typical random shocks using the techniques of impulse response functions (IRFs) and variance decompositions (VDCs). VDCs determine the proportion of each variable's shock that is attributable to each of the innovations in the model, while the IRFs trace out the dynamic responses of each variable to an innovation in a particular variable.

Variance Decomposition and Impulse Response Functions. Table 9 and Figures 5 to 7 present the variance decompositions of the REER and the real GDP variables for the whole sample period and the two sub-periods, respectively. Table 9 reports the percentage of the fraction of the forecast error variance attributable to innovations in the associated column variable for the following horizons: two, five, and ten months. The salient results from the variance decompositions are as follows.

First, the predominant source of variation in REER forecast errors are "own shocks" to REER — these generally account for 90 per cent for lags of two periods, and not less than 70 per cent on the lags of five and ten periods, for all sample periods. Most other variables account for about only 1 per cent of the forecast errors in the REER on the lagged two period in all sample periods.

Second, and in some contrast to the first result, accounting for the effects of "own shocks" to the real GDP renders the REER as the second most important source of variation in GDP, for both the whole and first sub-period. However, the REER effects on output are not valid for the second sub-period.

Third, an additional interesting point for the first sub-period (Table 9 and Figure 5) is that the output variance due to an REER shock declines as the period increases, suggesting that the REER has a short-term lagged effect on output. On the other hand, output variance due to the own shock effect increases.

To sum up, the preceding results indicate that shocks on REER due to the variation of real GDP occur in all sample periods, but not vice versa. The impact of the REER variations on output tends to decrease over time. This may imply that the REER has only a short-term lagged effect on output. However, it is unclear as to whether REER shocks affect output positively or negatively. This question will be explored further by examinations of the IRFs.

Figures 8 to 10 respectively report the IRFs in the whole sample period as well as the two sub-periods. The results are consistent with the VDCs, that is, output variance is impacted by a REER shock and the impact declines over time. Two additional points of interest emerge from examination of the IRFs. One, the REER was positively related to output for the whole sample period and in the second sub-period. Thus a negative shock to the REER (devaluation) can cause the output to decline, confirming the simple bivariate correlation test results. Two, the first sub-period, which represents the pre-devaluation period, shows that REER and output variables are in turn negatively related to each other. This may be consistent with Krugman (2000), who has suggested that a crisis-induced or large devaluation could be contractionary (i.e., the REER and output variables both decline), but a "small" real devaluation is expansionary.

V. Conclusion

The conventional view is that devaluation is expansionary/inflationary and needs to be accompanied by demand deflationary monetary and fiscal policy. However, the devaluation of the Thai baht has been associated with a temporary but sharp recession. Analysis of the Thai example suggests that devaluation may have contributed to capital outflows and that it was the associated loss of liquidity that both directly and indirectly caused a recession. Detailed empirical analysis in this paper confirms the belief that a real devaluation in Thailand during the crisis period was contractionary. It also finds that long-term co-movement exists between the

FIGURE 5
Variance Decomposition of REER and Real GDP (1993:11–2003:05)

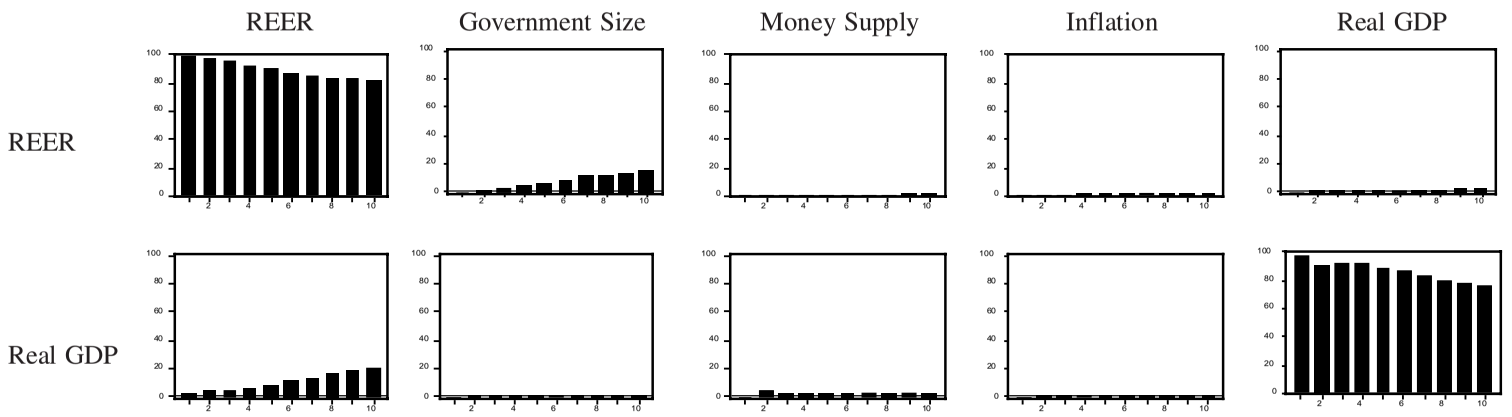


FIGURE 6
Variance Decomposition of REER and Real GDP (1993:11–1997:06)

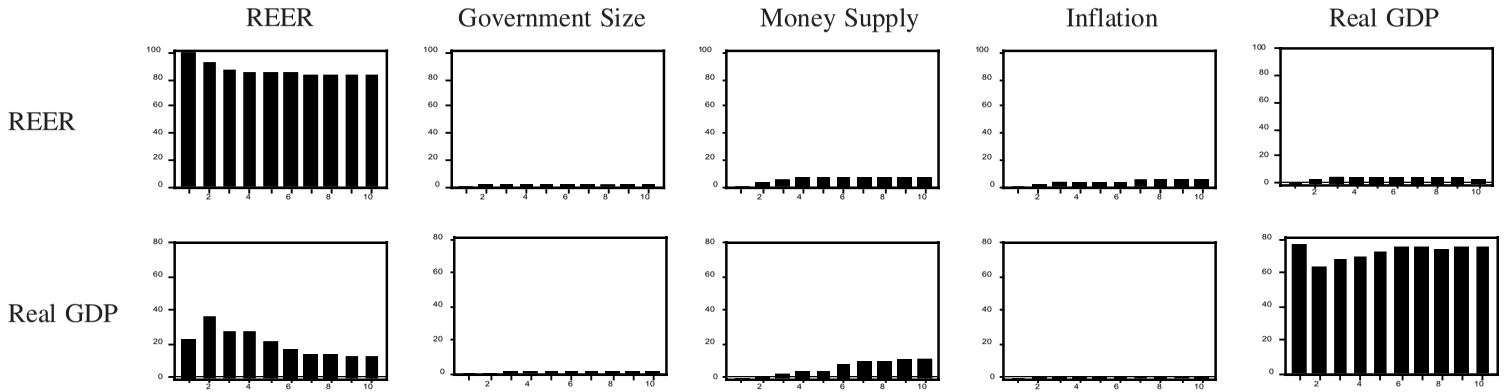


FIGURE 7
Variance Decomposition of REER and Real GDP (1997:07–2003:05)

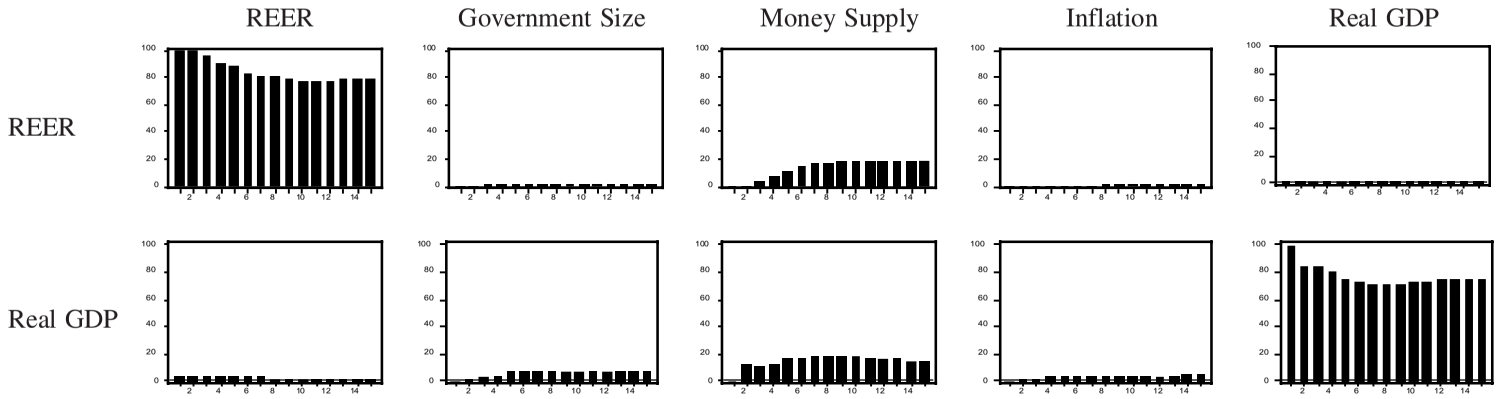


FIGURE 8
Impulse Responses of REER and Real GDP to One S.D. Innovations (1993:11–2003:05)

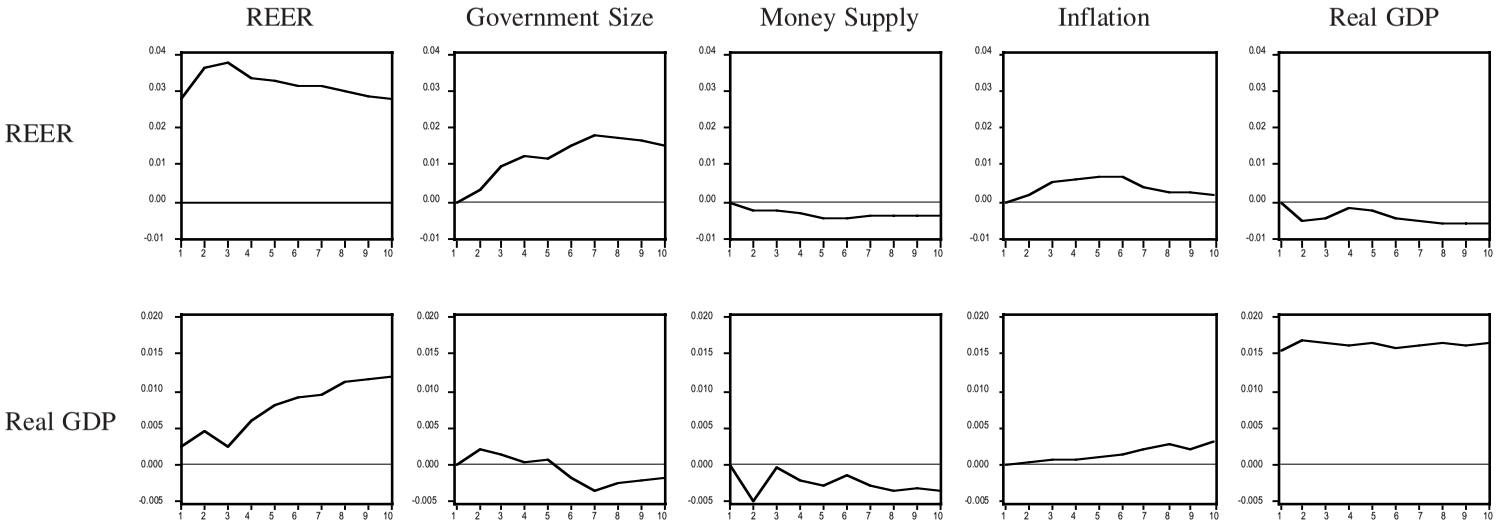


FIGURE 9
Impulse Responses of REER and Real GDP to One S.D. Innovations (1993:11–1997:06)

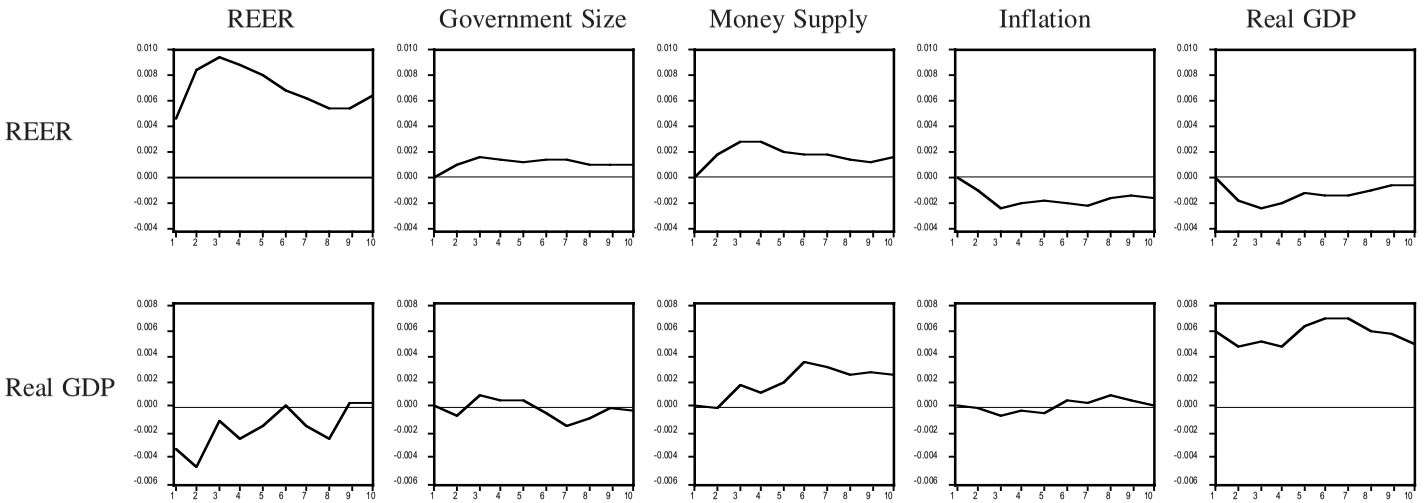
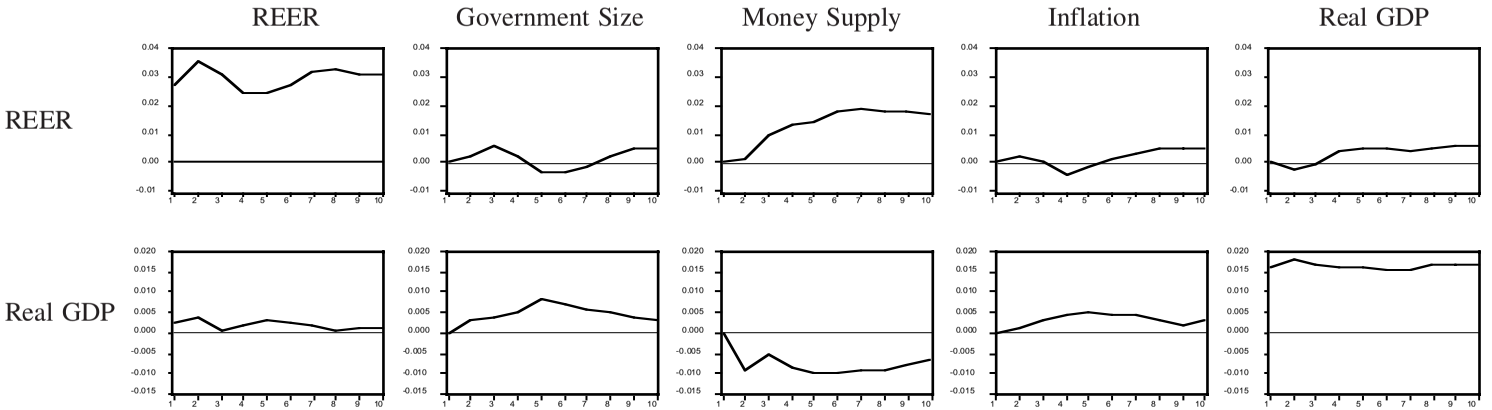


FIGURE 10
Impulse Responses of REER and Real GDP to One S.D. Innovations (1997:07–2003:05)



real exchange rate and output. The results further indicate the effects of a real devaluation shock on output declines as the lagged period increases, suggesting only a short-term lagged impact of real exchange rate variations on output.

While the empirical results are too tentative to draw firm policy lessons, the analysis does suggest the importance of considering the effects of devaluation on the response of capital markets when macroeconomic policies are designed during financial crises. After all, the restoration of "market confidence" has been among the stated goals of IMF conditionality during the crisis in East Asia in 1997–98.[23]

DATA APPENDIX

Indices	*Adjustment*	*Base yr*	*Timeframe*
TH: Government Expenditure: INDEX	s12	Jan–1993=100	M: Nov 1993: May 2003
TH: Real Effective Exchange Rate Index	TMIAB	1994=100	M: Nov 1993: May 2003
TH: Money Supply M2: INDEX	s13	Jan–1993=100	M: Nov 1993: May 2003
TH: Consumer Price Index	TIAA	1994=100	M: Nov 1993: May 2003
TH: Gross Domestic Product: 1988: sa: MONTHLY: INDEX	s10	Jan–1993=100	M: Nov 1993: May 2003

NOTES: All data are from the CEIC database. Data for government expenditure, money supply, and GDP were obtained in index form. GDP was adjusted for seasonal effects, and monthly GDP data were interpolations of quarterly data.

NOTES

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1. A broadly similar description seems to hold for Mexico. Calvo and Mendoza (1996) and Flood, Garber, and Kramer (1996) both develop extensions of the standard Krugman (1979) *ex ante* monetary disequilibrium model that rationalize particular aspects of the Mexican crisis. Rajan (2001) does the same for the case of Thailand, while Corsetti, Pesenti, and Roubini (1999) attempt to place the Asian case in the context of a model that considers the transmission mechanism. Clearly, an *ex post* monetary disequilibrium model, *à la* Obstfeld (1986), cannot be ruled out *a priori* either.
2. Note also how the data for other regional economies display similar patterns. This implies the distinct possibility that similar policy motivations exist for such a devaluation strategy in these other Asian crisis-struck countries.
3. In particular, arguments have been forwarded that this ambivalence in policy stance has led to a mitigation of the positive effects of IMF crisis lending and has further served to undermine the credibility of the fund-supported programme. However, one should note the experience of Indonesia, which *did* raise interest rates in response but subsequently fell into a deeper crisis than Thailand.
4. Boorman et al. (2000) ask the question, "did the tighter initial stance on fiscal policy have a negative effect on economic activity that persisted even though the initial tightening was unwound"? While they acknowledge that this is "difficult to answer with available data", they go on to note that, "(i) in the case of Thailand … the program was introduced in August 1997 and, at the first quarterly review in November, as early projections suggested underperformance with regard to the initial fiscal targets, additional measures were introduced with a view to achieving the original targets. The latter further tightening of policies — intended at the time to avoid shaking confidence by weakening fiscal targets at the time of accession of a new government — was, in hindsight, mistaken; it delayed the easing of fiscal policy until about six months into the program" (p. 51).
5. This section draws in part from the work of Rajan (2001) and Rajan and Bird (2002).

6. Possibly the earliest exposition of this view — albeit in a closed-economy context — is that of Bagehot (1873). A standard textbook exposition is that of Dornbusch (1988) or Mundell (1968, pp. 152–76).
7. In terms of practical policy-making, Taylor (1981) provides a critique of the standard IMF prescription, arguing that such programmes were in fact stagflationary. Edwards puts the data to the test and concludes that, for his analysis of twelve developing economies for the period 1965–80, that real devaluations have a small contractionary effect in the short-run but are neutral in the long-run. However, in a later survey, Kamin (1988) concludes that there existed insufficient empirical evidence to support the claim that devaluation, *per se*, was contractionary.
8. For the full derivation of these equations and those following, see the original paper by Aghion, Bacchetta and Banerjee (2000).
9. As Calvo (1996, p. 219) has noted, "if there is a 'bad' equilibrium lurking in the background, a devaluation — especially, an unscheduled devaluation — could coordinate expectations and help push the economy to the 'bad' equilibrium".
10. The term "sudden stops" was first coined by Calvo (1998). These empirical regularities include, *inter alia*, a major reversal of the current account deficit; sharp corrections in asset prices; a collapse of aggregate demand and production; and the loss of access to international financial markets (Arellano and Mendoza 2003).
11. Examples in each category are the papers by Edison, Luangaram, and Miller (2000), Kletzer and Wright (2000), and Wright (2001).
12. In particular, outflows were recorded in non-resident baht accounts (NRBAs) as well as the "other loans" component. NRBAs are essentially Nostro accounts, held in domestic banks, serving primarily the transactions of foreign parties. These include, for example, baht clearing for foreign currency-related transactions and stock market transactions by foreigners.
13. Rajan and Bird (2002) also explore the case of Thailand as the "trigger" country in the Asian financial crisis, although their analytical case study methodology differs from the approach presented in the present paper. Rajan and Shen (2002) have also attempted to explain the phenomenon of post-crisis economic contraction by deploying a two-step econometric model.
14. Indeed, Thailand was among the world's fastest growing economies before the crisis hit.
15. Kamin and Rogers (2000) briefly review the few available papers using VAR models to determine the nexus between real exchange rates and output.
16. See Sims (1980 and 1982); also see Cooley and LeRoy (1985) for an important critique.
17. The main argument against differencing is that it may not able to capture the information concerning the co-movements in the data. However Doan (1992) cautions against differencing even if the variables contain a unit root. He argues that the goal of VAR analysis is to determine the inter-relationship among the variables, not the parameter estimates.
18. Conventional VAR models with data in levels have also been estimated over all sample periods. The results of the models in level over different sample periods are qualitatively similar and are available from the authors on request.
19. See Enders (1995) for details on the VEC model.
20. Alternative models with different lag structures were also tested, and the results were qualitatively similar. In each case, the results remained robust to different lag length pairs. Overall, there appears to be little or no feedback from lags of more than four periods, hence the final specification.
21. We also examined models with exogenous variables (i.e. U.S. interest rate and capital account). The results are unaffected by the exogenous variables, and so we do not report them. For completeness, note that both variables were found to be I(0).
22. For example, the first row can be written as $(\pi_{11} x_{1t-1} + \pi_{12} x_{2t-1} + \ldots + \pi_{1n} x_{nt-1})$. Since each series x_{it-1} is I(1), $(\pi_{11}, \pi_{12}, \ldots, \pi_{1n})$ must be a cointegrating vector of x_t.
23. See for instance, Krugman (1998), Mussa (1999), and Rodrik (1999).

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