Centre for International
Economic Studies

Discussion Paper
No. 0205

Impact of Exchange Rate Volatility on Indonesia's Trade Performance in the 1990s

Reza Siregar and Ramkishen S. Rajan

March 2002

Adelaide University
Adelaide 5005 Australia

CENTRE FOR INTERNATIONAL ECONOMIC STUDIES

The Centre was established in 1989 by the Economics Department of the Adelaide University to strengthen teaching and research in the field of international economics and closely related disciplines. Its specific objectives are:

- to promote individual and group research by scholars within and outside the Adelaide University
- to strengthen undergraduate and post-graduate education in this field
- to provide shorter training programs in Australia and elsewhere
- to conduct seminars, workshops and conferences for academics and for the wider community
- to publish and promote research results
- to provide specialised consulting services
- to improve public understanding of international economic issues, especially among policy makers and shapers

Both theoretical and empirical, policy-oriented studies are emphasised, with a particular focus on developments within, or of relevance to, the Asia-Pacific region. The Centre's Director is Professor Kym Anderson (kym.anderson@adelaide.edu.au) and Deputy Director is Dr Randy Stringer (randy.stringer@adelaide.edu.au)

Further details and a list of publications are available from:

Executive Assistant
CIES
School of Economics
Adelaide University
SA 5005 AUSTRALIA
Telephone: (+61 8) 8303 5672
Facsimile: (+61 8) 8223 1460
Email: cies@adelaide.edu.au

Most publications can be downloaded from our Home page: http://www.adelaide.edu.au/cies/

ISSN 1444-4534 series, electronic publication

CIES DISCUSSION PAPER 0205

Impact of Exchange Rate Volatility on Indonesia's Trade Performance in the 1990s

Reza Siregar and Ramkishen S. Rajan

Department of Economics, National University of Singapore
ecsrys@nus.edu.sg

and

School of Economics, University of Adelaide, Australia and Institute of Southeast Asian Studies, Singapore
ramkishen.rajan@adelaide.edu.au

March 2002

We thank Teuku Rahmatsyah and Damhuri Nasution for assistance with data and for insightful discussions.

ABSTRACT

Impact of Exchange Rate Volatility on Indonesia's Trade Performance in the 1990s

Reza Siregar and Ramkishen S. Rajan

Whether a real devaluation ultimately proves to be *expansionary* or *contractionary* depends on whether the boost given to the exportables sector offsets any possible output-depressing effects that may accompany the expenditure-switching policy. Failure of the exportables sector to adequately respond to the price incentives is a virtual guarantee that devaluation will be contractionary. This appears to have been the experience of Indonesia, the country worst hit by the crisis of 1997-98. This paper explores whether the increased exchange rate variability of the Indonesian rupiah post 1997 may have been a cause for the country's poor export performance.

Keywords: devaluation, exports, imports, trade, Indonesia, volatility

JEL codes: F30, F32, F41

Contact author:
Reza Siregar
Department of Economics,
National University of Singapore
ecsrys@nus.edu.sg

1. Introduction

The spate of financial crises in emerging economies over the last decade has often resulted in the collapse of US dollar pegs. While pegs have sometimes been "hard", more often than not they have been "soft" in the sense of not being backed by any institutional arrangements. This was the case in Southeast Asia in 1997-98. In principle, Thailand and the other regional countries were supposed to have adopted basket pegged regimes, with the US dollar, Japanese yen and other currencies receiving weights consistent with their respective significance in economic linkages with the Southeast Asian countries. However, in reality, the US dollar had the overwhelming weight *de facto*, leading McKinnon (2001) and others to make frequent reference to the region's "dollar standard" (Table 1; also see Ito, Ogawa and Sasaki, 1998 and Rajan, 2002).

A great deal of attention has been paid to the factors that have led to the crisis and eventual devaluation (i.e. are crises "self fulfilling" or "fundamentals-based"?)[1]. There is also growing recognition of the need to better comprehend the post devaluation output dynamics (Rajan, 2001). While the first and second genre of models may disagree about why a crisis occurs, both are agreed that the devaluation signals the end of the crisis; the nominal devaluation, if translated into a real one, will give a much needed boost to the exportables sector and thus aggregate output[2]. This was the case in Brazil, for instance, following the devaluation of the real in January 1999. On the other hand, the experiences of Mexico, East Asia and elsewhere have, by all indications, been quite painful, with severe output losses. These events have awakened us to the idea that there may be an intense recessionary threat associated with devaluation, at least in the short-term (Rajan and Shen, 2001). Thus, Dooley and Walsh (2000) have recently commented "(w)e are unsure why some crises are followed by…periods of economic recession while others are not" (p.3).

---

[1] Focus here is solely on currency crises leading to a devaluation, i.e. "successful speculative attacks".

[2] For instance, Rodrik (2000) has noted "there is every reason to think that..(the)..real depreciations were an important boost to economic activity, particularly in tradables, and not simply something that went alongside higher growth. They unleashed energies and focused them on world markets, boosted exports, and set the stage for economic transformation" (pp.8-9).

While there are a multitude of channels via which a devaluation could be contractionary (Bird and Rajan, 2001 and Rajan and Shen, 2001), whether a devaluation ultimately proves to be expansionary or contractionary depends on whether the boost given to the exportables sector offsets the output-depressing effects (Krugman, 1999). Any failure of the exportables sector to adequately respond to the price incentives is a virtual guarantee that devaluation will be contractionary. This appears to have been the experience of Indonesia, the country worst hit by the crisis of 1997-98 (Figure 1). Far from stimulating export growth, a severe depreciation of the rupiah against the US dollar in 1997-1998 resulted in an outright collapse of the country's exports (Figure 2 and 3). Despite the fact that the rupiah fell by an average of 0.8 percent *per day* in nominal terms (against the US dollar) between July 1997 and January 1998, Indonesia's total exports of merchandise goods (in US dollars) declined by 8.5 percent at the end of 1998 compared to 1997[3]. In volume terms, Indonesia's merchandise exports experienced an average annual drop of 14 percent between Q2: 1998 and Q1: 1999, with the worst annual decline occurring in the last quarter of 1998 (close to 20 percent).[4].

There is, of course, the open question as to whether Indonesian exports comply with the Marshall-Lerner conditions. Studies for emerging economies have generally found foreign trade price elasticities to be sufficient to ensure an improvement in the trade account (Wilson, 2001). To the best of our knowledge, no study has focused specifically on the trade performance of Indonesia during the recent crisis[5]. However, it is revealing to note that rupiah devaluations in the recent past have helped stimulate exports. For instance, despite a rupiah devaluation of around 28 percent against the US dollar in early 1983, the non-oil exports (in US dollar) grew by 27 percent that year and 17 percent in the next, compared to a decline of 13 percent in 1982. When the rupiah was again devalued by 31 percent in September 1986 to

---

[3] For Indonesia, merchandise trade contributed over 85 percent of the country's total exports of goods and services (in US dollar) annually in the 1990s.

[4] Exports in rupiah terms contracted by about 40 percent in 1998 and 1999.

[5] Duttagupta and Spilimbergo (2000) include exports data for Indonesia in their panel data of six East Asian countries' exports to examine the implications of exchange rate depreciations in the region on the countries' exports.

counter the export stagnation, non-oil exports (in US dollar) rose by 11 percent in that year and over 30 percent in each of the next two years (Rosner, 2000). So devaluations in Indonesia have historically provided the necessary export and growth impetus. There was no such export lift in 1997-98. Why? There are two reasons that have most commonly been offered.

First, Indonesia was not alone in devaluing its currency, other regional economies also simultaneously doing so. The rupiah devaluation may have failed to boost exports as no significant competitive price advantage may have accrued to Indonesia (i.e. phenomenon of "competitive devaluations"). Duttagupta and Spilimbergo (2000) find that competitive devaluation played a key role in exacerbating the real effects of the crisis in the East Asia through the trade channel. Second, given the recessionary conditions faced by the region, even if there was any positive price effect on exports, it may have been more than offset by negative income effects. However, these caveats ought to apply as much to the other crisis-hit Southeast Asian economies as they might to Indonesia. For comparison, merchandise exports of Malaysia, the Philippines and Thailand experienced sharp falls in 1997 by 27 percent, 9 percent and 30 percent, respectively. But in 1998, exports rebounded in all three economies, with impressive rates of 33 percent for Malaysia, 67 percent for the Philippines and 60 percent in the case of Thailand (all in US dollar terms) (Figure 3). Indeed, the US dollar value of Indonesia's merchandise exports in 1999 was still below its level in 1996, unlike the three neighboring economies. This suggests a need for an alternative rationalisation for Indonesia's abysmal export performance post-devaluation.

Two obvious explanations for this disappointing export performance appear to be favored by policy makers. First, that the collapse of the domestic financial sector which accompanied the currency collapse (due to the balance sheet effects as well as an outright bank panic) caused severe cuts in trade finance and prevented local producers taking advantage of the depreciated rupiah (Pardede, 1999). Second, there were adverse movements in the terms of trade of several of the country's key export commodities (Rosner, 2000).

While there may well be an element of truth in both these reasons, another plausible explanation that has hitherto remained unexplored is the role of real exchange rate volatility. To be sure, past devaluations in Indonesia were all controlled ones in the sense that they involved a re-pegging of the rupiah at a new rate to the US dollar. In contrast, the devaluation of 1997-98 was followed by a massive shift to one of relatively greater regime flexibility (Figure 2)[6]. There has concomitantly been an intensification in the country's real exchange rate volatility which in turn may have had a detrimental impact of Indonesia's trade. As will be discussed in more detail, estimates of conditional variance confirm that the volatility of the real effective exchange rate of rupiah between February 1998 to July 2001 increased by more than thirty five times from its average in January 1994 to June 1997.

The aim of this paper is to test these *price*, *income* and *volatility* channels by estimating a set of export and import functions for Indonesia. In particular, we are interested in understanding the implication of the volatility of rupiah's real exchange rate on both the country's exports and imports. This is the basic question we try to answer in this paper. An important caveat is in order. The economic crisis faced by Indonesia has been accompanied by an acute political crisis and instabilities which in turn further deepened the overall economic crisis (Rosner, 2000 and Siregar, 2001). The simultaneous economic and socio-political turmoil in 1998 invariably tends to contaminate the data and analysis, clearly making it extremely difficult to separate the role of exchange rate volatility and other crisis related factors in explaining the performance of exports and imports of Indonesia. Therefore, in order to address the important policy issue at hand, we choose to concentrate our analysis on the pre-crisis period between Q1: 1980 and Q2: 1997. We then extrapolate the conclusions reached for this period to the post-crisis period to answer the question as to whether the rise in currency volatility during the post-1997 crisis might be expected to adversely hamper the

---

[5] Officially, Indonesia is supposed to be pursuing a floating regime with monetary policy anchored by an inflation target (see the various Letters of Intent (LOIs) between Indonesia and the IMF are available on the latter's website: www.IMF.org). However, in terms of actual implementation of the monetary-cum-exchange rate policy, the country's central bank, Bank Indonesia, has often time expressed its commitment to do everything in its power to prevent rupiah from further sliding (against the US dollar) in late 2001 (Siregar, 2001).

performance of Indonesia's trade, especially in 1998 and 1999. The more stable and conducive political environment in the pre-1997 period ought to provide us with a more reliable set of results that will be useful in understanding the post-crisis on goings in Indonesia.

The remainder of the paper is organized as follows. The next section offers a brief overview of the main empirical literature on the impact of exchange rate volatility on trade. Section 3 is devoted to describing the data series and defining the various terms and variables to be used in the empirical analysis. We pay particular attention to defining and measuring exchange rate volatility. We construct two commonly used measurements of exchange rate volatility, viz. a Moving Average standard deviation introduced by Kenen and Rodrik (1986) and a GARCH model. Discussions on Johansen cointegration test results are provided in Section 4. The roles of the two volatility indices on Indonesia's total non-oil merchandise exports and imports are both considered. To further enhance our analysis on non-oil merchandise imports we decompose imports into capital and intermediate products. We also specifically test the impact of currency volatility on Indonesia's bilateral merchandise exports to Japan and imports from Japan (which is Indonesia's single largest trading partner). The final section offers a summary section and some concluding observations.

2. Literature Survey

Is currency volatility harmful to international trade? This seemingly straightforward question has in fact been among the most elusive to answer in international economics. Theory is highly ambiguous on the issue (Rahmatsyah, Rajaguru and Siregar, 2001). Accordingly, as with most other things, it is an empirical issue. In a comprehensive survey of the literature on the impact of exchange rate volatility on trade flows, McKenzie (1999) concludes that the recent empirical studies have had "greater success in deriving a statistically significant relationship between volatility and trade" (p.100). Calvo and Reinhart (2000a) review a more limited set of such studies and reach a similar conclusion[7]. While a large number of these empirical studies have shown negative impacts of exchange rate volatility on total trade, exports and imports, some have also reported positive and insignificant consequences.

Table 2 highlights a number of recent studies on the issue. Only Chowdhury (1993) and Caporale and Doroodian (1994) report consistently adverse consequences of exchange rate volatility on exports and imports. Other studies such as by Klein (1990), McKenzie (1998), Bailey, Tavlas and Ulan (1987), Koray and Lastrapes (1989), Aseery and Peel (1991), Kroner and Lastrapes (1993), McKenzie and Brooks (1997), McKenzie (1998), Daly (1998), Wei (1999) and Chou (2000) have found cases where a rise in exchange rate volatilities may have both positive and negative implications on exports and imports, depending on products' and countries' cases. However, these conclusions cannot be seen as definitive. There are also a few studies which conclude that exchange rate volatility plays no significant role in explaining exports and imports. This includes a recent study by Aristotelous (2001) that finds exchange rate volatility has not had any significant impact on the performance of the British exports to the United States during the period of 1889-1999. All in all, the empirical literature has reaffirmed the ambiguous nexus between currency volatility and trade as indicated by the theoretical literature on the subject.

3. Model, Data and Definitions

3.1 Export and Import Demand Functions

There are two primary determinants of export and import demand (Dornbusch, 1988 and Hooper and Marquez, 1993). First, is the foreign income variable which measures the economic activity and the purchasing power of the trading partner country ("income effect"). Second, is the relative price or the terms of trade variable ("price effect"). As noted, exchange

[7] Another recent set of empirics by Andrew Rose based on gravity models using both cross-sectional and time series data suggests institutionally fixed exchange regimes (i.e. common currency, currency boards or dollarization) stimulates trade, which in turn boosts income (see Frankel and Rose, 2001, Glick and Rose, 2001 and Rose, 2000).

rate volatility is an additional factor that needs to be explicitly taken into account ("volatility effect"). Incorporating all of the determinant factors, we can derive the following set of simple export and import-demand functions:

$$x_t = \alpha_{11} + \alpha_{21} y_t^{foreign} + \alpha_{31} p_t + \alpha_{41} V_t + \varepsilon_{1t} \quad (1)$$

$$m_t = \alpha_{12} + \alpha_{22} y_t^{local} + \alpha_{32} p_t + \alpha_{42} V_t + \varepsilon_{2t} \quad (2)$$

where:

x_t ⇒ the natural logarithm of export volume.
m_t ⇒ the natural logarithm of import volume.
$y_t^{foreign}$ ⇒ the natural logarithm of real foreign/world GDP.
y_t^{local} ⇒ the natural logarithm of domestic real GDP.
p_t ⇒ the terms of trade
V_t ⇒ volatility of the real exchange rate.

According to our theoretical priors, the volume of exports (imports) to a foreign country (domestic country) ought to increase as the real income of the trade partner (domestic economy) rises, and vice versa. So we expect $\alpha_{21} > 0$ and $\alpha_{22} > 0$. A rise (fall) in the terms of trade will cause the domestic goods to become less (more) competitive than foreign goods, therefore exports will fall (increase) and imports will rise (fall). So we expect $\alpha_{31} < 0$ and $\alpha_{32} > 0$. As discussed previously, the impact of exchange rate volatility on exports and imports is ambiguous, i.e. α_{41} and α_{42} could either be positive or negative.

3.2 Data

As briefly mentioned in the Introductory Section, we conduct three sets of tests on the working models (Equations 1 and 2), all with the aim of trying to decipher the impact of the role of exchange rate volatility on Indonesia's trade performance. The first test is applied on Indonesia's total imports and exports. The second test decomposes imports into its two main components, viz. intermediate imports and capital imports. The third set reports the regression results of Indonesia's bilateral exports and imports with its largest trading partner, Japan.

All raw data are of quarterly frequency and are taken from the *International Financial Statistics*-IMF CD ROM and the *OECD Statistical Compendium*-CD ROM, except for capital and intermediate imports which are sourced from the *Central Bureau of Statistics of Indonesia*. To recap, this study covers the period from the 1980s (depending on data availability) until the second quarter of 1997; the post-1997 crisis period is excluded to avoid any structural breaks in the data.

3.3 Definitions

a) Trade Volume

For total exports and imports we have adopted the series in quantity or volume terms[8]. While volume data for Indonesia's aggregate exports and imports are available, this is not the case for bilateral trade. Thus, in order to obtain the volume of Indonesia's trade with Japan (which, as noted, is needed for the third set of tests), we divide the available value series of bilateral trade by an appropriate price index (both are in US dollars).

$$X_t^{JP} = \frac{XVAL_t^{JP}}{XP_t} \qquad (3)$$

$$M_t^{JP} = \frac{MVAL_t^{JP}}{XP_t^{JP}} \qquad (4)$$

where: X_t^{JP} is the quantity of Indonesia's exports to Japan; M_t^{JP} is the quantity of Indonesia's imports from Japan; $XVAL_t^{JP}$ is the value of exports to Japan; XP_t is Indonesia's export price; $MVAL_t^{JP}$ is the value of Indonesia's imports from Japan; and XP_t^{JP} is the Japanese export price (proxy for Indonesia's import price from Japan).

[8] Previous studies, such as Learner and Stern (1970), suggest that trade *volume* is a more appropriate measure than *value*.

b) Income

Quarterly real GDP of Japan and Indonesia (y^{JPN} and y^{IND}) are used as proxies for their respective real incomes. As for the world real GDP or income, which is needed for the first two sets of tests, the series is the trade weighted sum of the GDP of Indonesia's six key trading partners.

c) Terms of Trade

The bilateral terms of trade with Japan (p^{JPN}) is constructed as the ratio of Indonesia's export price to the Japan export price (as a proxy for Indonesia's import price from Japan). As for the total terms of trade (p^{World}), the series is the total trade-weighted sum of terms of trade of Indonesia against the country's six key trading partners. The real exchange rate of rupiah against the Japanese yen is computed by multiplying the nominal exchange rate by the relative prices:

$$RER_t^{JP} = NER_t^{JPN} \times \frac{WPI_t}{WPI_t^{JP}} \quad (5)$$

where: WPI_t is the domestic wholesale price index of Indonesia and WPI_t^{JP} is the Japanese wholesale price index. An increase in RER_t^{JP} (real exchange rate) or NER_t^{JP} (nominal exchange rate) implies an appreciation in the Indonesian rupiah against the Japanese yen. As for the real effective exchange rate *(REER)*, the series is computed as the weighted sum of real exchange of rupiah against seven key trading partners' currencies, viz. the US dollar, Japanese yen, Singapore dollar, British pound sterling, France franc, German DM, and Netherlands. The assigned weights to each real exchange rate represent the trade share (imports and exports) of each of these economies in their total trade with Indonesia.

d) Volatility

The ambiguous results obtained in the empirical literature reviewed in Section 2 may also be partly due to the absence of a uniform definition or means of computing volatility. This is apparent from Table 3. While most studies only provide a single measure of exchange rate volatility, to ensure robustness, we actually construct two measures. We make use of *real* as opposed to *nominal* exchange rates in the computations[9].

The first index of real exchange rate volatility we construct is a Moving Average standard deviation (MASD) of the growth rate of the exchange rate (ER) initially employed by Kenen and Rodrik (1986).

$$V_t = \left[\left(\frac{1}{m} \right) \sum_{i=1}^{m} \left(\ln ER_{t+i-1} - \ln ER_{t+i-2} \right)^2 \right]^{\frac{1}{2}} \tag{6}$$

where: *m* is the order of the moving average and *ln* implies the log form of the series. Our estimations make use of *m* equal to 4 months for both the REER and bilateral real exchange rate against the yen[10]. Figure 4 and 5 show the MASD volatilities ($V^{REER\text{-}MASD}$) and ($V^{RERJP\text{-}MASD}$). This measurement has an advantage of being able to capture higher frequency movements in the exchange rate. Several authors have used a moving average transformation to smooth out the series[11].

The second measure of real exchange rate volatility we employ is a GARCH specification as follows:

$$\ln RER_t = a_0 + a_1 \ln RER_{t-1} + e_t, \text{ where } e_t \sim N(0, h_t) \tag{7}$$

$$h_t = \alpha + \beta e_{t-1}^2 + \gamma h_{t-1} + u_t. \tag{7b}$$

[9] After comparing results from nominal and real exchange rate volatility that are fitted by an ARCH model, McKenzie and Brooks (1997) conclude, "it would be irrelevant whether the volatility coefficients are estimated from real or nominal exchange rates as the volatility is sourced solely from the nominal exchange rate" (p.2).

[10] For our empirical tests, we also apply *m* = 6 months and *m* = 8 months. The results are largely consistent with *m* = 4 months.

[11] See, for instance, Koray and Lastrapes (1989), Lastrapes and Koray (1990), Chowdhury (1993), and Daly (1998).

The conditional variance equation (Equation 7b) described above is a function of three terms: (i) the mean, α; (ii) news about volatility from the previous period, measured as the lag of the squared residual from the mean equation, e_{t-1}^2 (the ARCH term); and (iii) the last period's forecast error variance, h_{t-1} (the GARCH term). We estimated a number of versions of ARCH models. The GARCH (1,1) model generated the best results (significant coefficients for Equation 7b) as far as the volatility of the rupiah's REER ($V^{REER\text{-}GARCH}$) is concerned, and the ARCH(1) did so for the real exchange rate of the rupiah against the Japanese yen ($V^{RERJPN\text{-}ARCH}$) (Table 4, Figures 4 and 5).[12]

For the single purpose of illustrating the magnitude of the rise in the volatility of rupiah during the post-1997 crisis period, we estimate another GARCH (1,1) conditional variance as stated in Equations 7 and 7b on monthly REER series for the period between January 1994 and July 2001. To further understand the degree of volatility of the rupiah we also test and contrast the rupiah's volatility with those of Singapore dollar, Korean won and Thai baht. The observation set is divided into the pre-1997 crisis period (January 1994 to June 1997) and the post-1997 crisis period (February 1998 to July 2001). We excluded observations from the most turbulent period of July 1997 to January 1998 so as to avoid overstating the volatility of the regional currencies (and therefore skewing the results).

Table 5 makes clear the severity of the rupiah's volatility compared to other crisis-affected currencies in East Asia. The post-crisis mean conditional variance of rupiah is about thirty five times larger than the pre-crisis average. The next worst case was Thailand, though the jump in its average conditional variance was only about one-third of the rupiah's. The pre-

[12] Results of other ARCH specifications are available from the authors upon request. Mckenzie (1998) highlights the potential problems involved in ARCH based measures of exchange rate volatility. He opines that the exchange rate volatility generated prior to the end of the sample period incorporates knowledge about the future, as ARCH models are estimated over the entire sample period. To overcome this problem, one would need to re-estimate the ARCH model beginning of each quarter using information that is known to the trader at the point in time. However, if the estimated ARCH/ GARCH coefficients are stable over time, one may not need to be concerned about the biasedness of the volatility estimates. We find the coefficients for the case of real exchange rate against the Japanese yen and the real effective exchange rate to be stable. It is worth noting that Rahmatsyah, Rajaguru and Siregar (2001) report a broadly similar finding for the case of real exchange rate of the baht against the Japanese yen.

and post-crisis ratio of conditional variances of Singapore dollar and Korean won were in fact less than one-tenth and one-third that of the Indonesian rupiah, respectively. In addition, the average of the conditional variance of the Indonesian rupiah was only 1.5 times of the Thailand's baht and Korean won during the pre-crisis period. However, between February 1998 and July 2001, the post-crisis volatility rate for rupiah was three and six times that of the Thailand's baht and Korean won, respectively. In summary, not only had the rupiah become significantly more volatile in recent years, the magnitude of the volatility rate was extremely high even in comparison to other regional currencies.

4. Test Results

Table 6 presents the results for the ADF-unit root tests. All variables are stationary at the first difference (I(1) variables) except the volatility indices which are all I(0)). Given the unit-root properties of the variables, we proceed to conduct three sets of Johansen cointegration test procedures on equation 1 and 2[13]. The test results for the total export and import cases are shown in Tables 7a to 8b. The main result can be summarized as the following set of equations.

Exports:

$$x_t^{total} = 134.76 - 8.542 y_t^{World} - 0.315 p_t^{World} - 0.003 V_t^{REER-MASD} \qquad (8)$$

$$x_t^{total} = 2.044 + 0.344 y_t^{World} - 0.488 p_t^{World} - 150.257 V_t^{REER-GARCH} \qquad (9)$$

Imports:

$$m_t^{total} = -11.293 + 1.218 y_t^{World} + 0.568 p_t^{World} - 0.0002 V_t^{REER-MASD} \qquad (10)$$

$$m_t^{total} = -11.742 + 1.275 y_t^{World} + 0.514 p_t^{World} + 4.283 V_t^{REER-GARCH} \qquad (11)$$

---

[13] Engle and Granger (2000, p.14) state that inclusion of stationary variable in the cointegrating relationship should *not* affect the remaining coefficients (assuming that it is not the dependent variable). It also ought not to affect the asymptotic critical values of the test statistics.

One cointegration relationship is found in all regressions at the 1 percent significance level, except for one of the export cases at the 5 percent significance level. With regard to the export functions, we find the world income variable has either played an altogether insignificant role or has a theoretically inconsistent sign (Tables 7a and 7b). Similarly, we find the terms of trade or price variable to be statistically insignificant[14]. However, the real effective exchange rate volatility indices are significant and negative at least 1 percent and 10 percent significance level for ($V^{REER\text{-}MASD}$) and ($V^{REER\text{-}GACRH}$), respectively.

With regard to the import functions, we find the income and price proxies are generally significant (at 1 percent level) with theoretically consistent signs. However, the exchange rate volatility indices turn out to be statistically insignificant. To further evaluate the role of exchange rate volatility on Indonesian imports, we sub-divide Indonesia's imports into its two main components, viz. *intermediate and capital imports*. The test results are detailed in Tables 9a to 10b. A summary of the results is offered using the following equations.

Capital Imports:

$$m_t^{Capt} = -32.735 + 3.337 y_t^{IND} + 0.927 p_t^{World} - 0.008 V_t^{REER-MASD} \quad (12)$$

$$m_t^{Capt} = -7.674 + 0.956 y_t^{IND} + 1.045 p_t^{World} - 113.95 V_t^{REER-GARCH} \quad (13)$$

Intermediate Imports:

$$m_t^{Int} = -16.449 + 1.758 y_t^{IND} + 1.262 p_t^{World} - 0.002 V_t^{REER-MASD} \quad (14)$$

$$m_t^{Int} = -16.038 + 1.739 y_t^{IND} + 1.169 p_t^{World} - 7.114 V_t^{REER-GARCH} \quad (15)$$

As for the cases of capital imports, one cointegration equation is found to exist at the 1 percent and 5 percent significance level. For both intermediate import equations, one

[14] The poor results for income and terms of trade variables may be due to the quality of proxies that we constructed. However with no official data available for these two series, we have no alternatives but to construct the proxies.

cointegration equation is found at 1 percent level. The coefficients for both the income and competitiveness proxies are significant at the 1 percent level and are theoretically consistent. The income variable has also contributed positively and significantly, except for the case of capital imports (Table 9b). We find relatively conclusive results for the real exchange rate volatility indices. Specifically, the coefficient estimates for both the real exchange rate volatility indices are statistically significant and negative in the case of capital imports at the 1 percent significance level for ($V^{REER\text{-}MASD}$) and at the 5 percent significance level for ($V^{REER\text{-}GACRH}$). The same can be said for intermediate capital imports when the Moving Average Standard Deviation volatility index is used but not when GARCH(1,1) is used.

4.1 Indonesia-Japan Bilateral Trade

We conduct a last battery of tests on the Indonesia's exports to and imports from Japan at a bilateral level. Japan has been Indonesia's largest market for Indonesian exports and its largest source of import since 1980. Out of Indonesia's total non-oil manufacturing trade (exports plus imports), the average share of the country's trade with Japan between 1980-1997 is in the range of 35 percent to 40 percent. Therefore, it is important to understand how exchange rate volatility may impact Indonesia's trade performance vis-à-vis the Japanese market. The test results may be described in the following set of equations and details are provided in Tables 11a to 12b.

Exports:

$$x_t^{JPN} = -2.106 + 0.654 y_t^{JPN} - 0.386 p_t^{JPN} - 0.0009 V_t^{RERJPN-MASD} \quad (16)$$

$$x_t^{JPN} = -0.369 + 0.534 y_t^{JPN} - 0.429 p_t^{JPN} - 29.62 V_t^{RERJPN-ARCH} \quad (17)$$

Imports:

$$m_t^{JPN} = -1.196 + 0.439 y_t^{IND} + 0.201 p_t^{JPN} - 0.0004 V_t^{RERJPN-MASD} \quad (18)$$

$$m_t^{JPN} = -1.080 + 0.428 y_t^{IND} + 0.211 p_t^{JPN} - 25.89 V_t^{RERJPN-ARCH} \quad (19)$$

One cointegration equation exists in both the export and import regressions at the 1 percent and 5 percent level of significance, respectively. The estimated coefficients for the price and income terms are significant at the 1 percent level with theoretically consistent signs. Results for the volatility indices indicate that the exchange rate volatility negatively impacts both Indonesia's trade flows to Japan (all significant at the 1 percent critical level).

5. Concluding Remarks

While there are a host of factors that could lead a crisis-induced devaluation (i.e. a devaluation following a currency crisis) to be contractionary, a necessary condition for economic recovery is that exports are boosted. Exports are supposed to be the engine of growth following such an expenditure switching policy. Nonetheless, despite the dramatic decline in the nominal value of the rupiah since mid 1997 (which has in turn been translated into a real devaluation), exports *did not* show a stable and strong pick up even four years after the break of the crisis; if anything, just the reverse happened. Indeed, the latest developments and outlook for Indonesia's external trade sector for 2002 continue to remain quite bleak (Siregar, 2001).

The question we have explored in this paper is whether exchange rate volatility has had any detrimental impact on trade flows in Indonesia during the pre-crisis period. Our observation period has spanned Q2: 1980 to Q2: 1997. We have intentionally excluded the crisis period itself in order to circumvent problems related to structural breaks in the trade series which may be associated with various non-economic factors, like political uncertainty[15].

[15] Indeed, the rupiah's post 1997 volatility may have been a reflection of the underlying social and political instability in the country which in turn could have caused foreign buyers to shift their orders to other countries (Rosner, 2000).

Table 13 summarizes our regression results. Out of twelve regressions undertaken in this paper, nine cases indicate that exchange rate volatility adversely affected exports and imports performance of Indonesia during the pre-crisis period. Extrapolating these results forward, the rise in exchange rate volatilities should have played a critical role in explaining the poor performance of the trade sector in recent years. The adverse impact of exchange rate volatility on trade and the real sector may in part be the reason for the supposed "fear of floating" that has seemed to characterize many emerging economies[16]. Recent financial crises involving emerging economies have called into question the wisdom of them adopting pegged exchange rates (be it "hard" or "soft") and has strengthened the appeal of allowing for greater exchange rate flexibility. However, it is easy to overlook that flexible exchange rates bring with them their own problems. This surely has implications for the perennial issue of appropriate choice of exchange rate regime.

[16] This term was popularized by Calvo and Reinhart (2001). Other reasons for this phenomenon could include concerns about liability dollarization as well as possible inflationary effects of exchange rate fluctuations. Also see Rajan (2002).

References

Aristotelous, K. (2001). "Exchange Rate Volatility, Exchange Rate Regime, and Trade Volume: Evidence from the UK-US Export Function (1889-1999)", Economic Letters, 72, pp.87-94.

Asseery, A. and D. Peel (1991). "The Effects of Exchange Rate Volatility on Exports", Economic Letters, 37, pp.173-77.

Bailey, M., G.. Tavlas, and M. Ulan (1987). "The Impact of Exchange Rate Volatility on Export Growth: Some Theoretical Considerations and Empirical Results", Journal of Policy Modelling, 9, pp.225-43.

Bird, G. and R. Rajan (2001). "Recovery or Recession? Post-Devaluation Output Performance: The Thai Experience", Working Paper No.43, CIES, University of Adelaide.

Boorman, J., T. Lane, M. Schultze-Ghattas, A. Bulir, A. Ghosh, J. Hamann, A. Mourmouras and S. Phillips (2000). "Managing Financial Crises: The Experience in East Asia", Working Paper No.00/107, IMF.

Calvo, G. and C. Reinhart (2000). "Fear of Floating", Working Paper No. 7993, NBER.

Caporale, T. and K. Doroodian (1994). "Exchange Rate Variability and the Flow of International Trade", Economic Letters, 46, pp.49-54.

Chou, W. (2000). "Exchange Rate Variability and China's Exports", Journal of Comparative Economics, 28, pp.61-79.

Chowdhury, A. (1993). "Does Exchange Rate Volatility Depress Trade Flows? Evidence from Error Correction Models", The Review of Economics and Statistics, 75, pp.700-6.

Cushman, D. (1988). "U.S. Bilateral Trade Flows and Exchange Risk During the Floating Periode", Journal of International Economics, 24, pp.317-30.

Daly, K. (1998). "Does Exchange Rate Volatility Impede the Volume of Japan's Bilateral Trade?", Japan and the World Economy, 10, pp.333-48.

Duttagupta, R. and A. Spilimbergo (2000). "What Happened to Asian Exports During the Crisis?", Working Paper No. 200, IMF.

DeGrauwe, P. (1988). "Exchange Rate Variability and the Slowdown in Growth of International Trade", International Monetary Fund Staff Papers, 35, pp.63-84.

Dooley, M. and C. Walsh (2000). "Capital Controls and Crises: Theory and Experience", mimeo (undated). Paper presented at AEA Meetings (June).

Dornbusch, R.(1988). Exchange Rates and Inflation. MIT Press: Cambridge.

Engle, R. and C. Granger (2000). Long-Run Economic Relationships. Oxford University Press: New York, USA.

Frankel, J. and A. Rose (2000). "Estimating the Effects of Currency Unions on Trade and Output", Working Paper No.7857, NBER.

Frankel, J. and S. Wei (1994). "Yen Bloc or Dollar Bloc?: Exchange Rate Policies of the East Asian Economies", in T. Ito and A. Krueger (eds.), Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows, Chicago: University of Chicago Press.

Giovannini, A. (1988). "Exchange Rates and Traded Goods Prices", Journal of International Economics, 24, pp.45-68.

Glick, R. and A. Rose (2001). "Does a Currency Union Affect Trade?: The Time Series Evidence", Working Paper No.8396, NBER.

Grenville, S. (2000). "Monetary Policy and the Exchange Rate During the Crisis", Bulletin of Indonesian Economic Studies, 36, pp.43-60.

Hooper, P. and J. Marquez (1993). "Exchange Rates, Prices, and External Adjustment in the United States and Japan", International Finance Discussion Paper, No.456. Board of Governors of the Federal Reserve System.

International Centre for the Study of East Asian Development (ICSEAD) (2000). East Asian Economic Perspective: Recent Trends and Prospects for Major Asian Economies. 11, Kitakyushu, Japan.

International Monetary Fund (IMF) (1984). Exchange Rate Volatility and World Trade. IMF: Washington, DC.

IMF (1999). International Capital Markets: Developments, Prospects, and Key Policy Issues, IMF: Washington, DC.

IMF (2000). International Financial Statistics CD-ROM, IMF: Washington, DC.

Ito, T., E. Ogawa and Y. Sasaki (1998). "How did the US Dollar Peg Fail?", Journal of Japanese and International Economics, 12, pp.256-304.

Kenen, P. and D. Rodrik (1986). "Measuring and Analyzing the Effect of Short-Term Volatility on Real Exchange Rates", The Review of Economics and Statistics, 68, pp.311-15.

Kim, T. and J. Ryou (2001). "The Optimal Currency Basket and the Currency Bloc in Asia", Bank of Korea Economic Papers, 4, pp.194-216.

Klein, M. (1990). "Sectoral Effects of Exchange Rate Volatility on United States Exports", Journal of International Money and Finance, 9, pp.299-308.

Koray, F. and W. Lastrapes (1989). "Real Exchange Rate Volatility and US Bilateral Trade: a VAR Approach", The Review of Economics and Statistics, 71, pp.708-12.

Kroner, K. and W. Lastrapes (1993). "The Impact of Exchange Rate Volatility on International Trade: Reduced Form Estimates Using the GARCH-in-Mean Model", Journal of International Money and Finance, 12, pp.298-318.

Krugman, P. (1999). "Balance Sheets, The Transfer Problem, and Financial Crisis", mimeo (January).

Kwan, C. (1995). Enken no Keizaigaku (The Economics of the Yen Bloc), Nihon Keiza Shinbunsha: Tokyo (in Japanese).

Lastrapes, W. and F. Koray (1990). "Exchange Rate Volatility and U.S. Multilateral Trade Flows", Journal of Macroeconomics, 12, pp.341-62.

Learner, E. and R. Stern (1970). Quantitative International Economics. Allyn and Bacon: Boston.

Mckenzie, M. and R. Brooks (1997). "The Impact of Exchange Rate Volatility on Germany - US Trade Flows", Journal of International Financial Markets, Institutions and Money, 7, pp.73-87.

Mckenzie, M. (1998). "The Impact of Exchange Rate Volatility on Australian Trade Flows", Journal of International Financial Markets, Institutions and Money, 8, pp.21-38.

Mckenzie, M. (1999). "The Impact of Exchange Rate Volatility on International Trade Flows", Journal of Economic Surveys, 13, pp.71-106.

McKinnon, R. (2001). "The East Asian Dollar Standard, Life After Death", Economic Notes, 29, pp.31-82.

Pardede, R (1999). "Survey of Recent Developments", Bulletin of Indonesian Economic Studies, 35, pp.3-39.

Rahmatsyah, T, G. Rajaguru and R. Siregar (2001). "Exchange Rate Volatility, Trade and "Fixing for Life" in Thailand", mimeo (October).

Rajan, R. (1999). "Economic Collapse in Southeast Asia", Policy Study, The Lowe Institute of Political Economy: Claremont, CA.

Rajan, R. (2001). "(Ir)relevance of Currency Crises Theory to the Devaluation and Collapse of the Thai Baht", Princeton Study in International Economics No.88, International Economics Section, Princeton University.

Rajan, R. (2002). "Exchange Rate Policy Options for Post-Crisis Southeast Asia: Is There a Case for Currency Baskets?", The World Economy, 25, pp.137-63.

Rajan, R. and C.H. Shen (2001). "Are Crisis-Induced Devaluations Contractionary?", Discussion Paper No.0135, CIES, University of Adelaide.

Rana, P. (1981). ASEAN Exchange Rates: Policies and Trade Effects, Institute of South Asian Studies: Singapore.

Rodrik, D. (2000). "Exchange Rate Regimes and Institutional Arrangements in the Shadow of Capital Flows", mimeo (September).

Rose, A. (2000). "One Money, One Market: Estimating the Effect of Common Currencies on Trade", Economic Policy, 15, pp.7-46.

Rosner, L. (2000). "Indonesia's Non-Oil Export Performance during the Economic Crisis: Distinguishing Price Trends from Quality Trends", Bulletin of Indonesian Economic Studies", 36, pp.61-96.

Siregar, R. (2001). "Survey of Recent Developments", Bulletin of Indonesian Economic Studies, 37, pp.277-304.

Thursby, M. and J. Thursby (1987). “Bilateral Trade Flows, the Linder Hypothesis, and Exchange Risk”, The Review of Economics and Statistics, 69, pp.488-95.

Wei, S. (1999). “Currency Hedging and Goods Trade”, European Economic Review, 43, pp.1371-94.

Wilson, P. (2001). “Exchange Rates and the Trade Balance for Dynamic Asian Economies ---Does the J-Curve Exist for Singapore, Malaysia and Korea?”. Open Economies Review, 12, pp.389-413.

Table 1: The Southeast Asian Dollar Standard (daily nominal exchange rate)

Regression Model[a]:

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

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; DM = German DM and SF: Swiss Franc
Source: McKinnon (2001)

Table 3: Empirical Studies of Exchange Rate Volatility and Trade Flow

Author	Country / Sample Period	The effect of ER volatility to trade
Hooper and Kohlhagen (1978)	Germany, Japan, United Kingdom, United States, Canada, France (bilateral trade). 1965.1 – 1975.4	*X:* Significant negative relationship in 2 equation, significant positive relationship in 4 equation and insignificant in 26 equation.
Rana (1981)	South Korea, Philippines, Thailand, and Taiwan (multilateral trade). 1960.1 - 1976.4	*M:* Significant negative relationship in 4 equation and insignificant for 1 equation for the pegged period in Taiwan equation.
IMF (1984)	United States, United Kingdom, France, Germany, Italy, Canada, and Japan (bilateral trade) 1965.1 – 1982.4	*X:* Significant negative relationship in 3 equation, significant positive relationship in 11 equation and insignificant in 28 equation.
Kenen and Rodrik (1986)	US, Canada, Japan, Belgium, France, Germany, Italy, Netherlands, Sweden, Switzerland, UK (multilateral trade) 1975.1 - 1984.2	*M:* Significant negative relationship in 4 equation and insignificant in 7 equation.
Bailey, Tavlas, and Ulan (1987)	Canada, France, Germany, Italy, Japan, UK, US, Australia, New Zealand, Netherlands, Switzerland (multilateral trade) 1962.2 - 1974.4 and 1975.1 - 1985.3	*X:* Significant negative relationship in 3 equation, significant positive relationship in 5 equation and insignificant in 34 equation.
Thursby and Thursby (1987)	Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, Netherlands, Norway, South Africa, Sweden, Switzerland, United Kingdom, and United States. (bilateral trade); 1974 – 1982 (annually)	*X:* Significant negative relationship in 10 equation.

Cushman (1988)	US (bilateral trade) 1974 – 1983 (annually).	*X:* 2 of 6 equations have a significant negative effect and 1 has a significant positive effect. *M:* 5 of 6 equations have a significant negative effect.
Koray and Lastrapes (1989)	US with UK, France, Germany, Japan, & Canada (bilateral trade) 1959.01 - 1985.12	*M:* Significant negative relationship in 41 equation, significant positive relationship in 16 equation and insignificant in 39 equation.
Lastrapes and Koray (1990)	US (multilateral trade) 1973.03 - 1987.12	*X & M:* Significant negative relationship in 6 equation and insignificant in 42 equation.
Klein (1990)	US with Netherland, Canada, Japan, France, Italy, Germany. (sectoral analysis in bilateral trade) 1978.01 - 1986.12	*X:* Significant negative relationship in 4 equation, significant positive relationship in 7 equation and insignificant in 43 equation.
Asseery and Peel (1991)	Australia, Japan, UK, US, West Germany (multilateral trade) 1972.1 - 1987.4	*X:* Significant negative relationship in 1 equation, significant positive relationship in 2 equation and insignificant in 3 equation.
Bini-Smaghi (1991)	Italy, France, Germany (multilateral trade of the manufacturing sector) 1976.1 – 1984.4	*X:*: Significant negative relationship in 13 equation and insignificant in 11 equation.
Chowdhury (1993)	Canada, France, Germany, Italy, Japan, UK, US (multilateral trade) 1973.1 - 1990.4	*X:* Significant negative relationship in all 7 equation.
Kroner and Lastrapes (1993)	US, UK, France, Germany, Japan (multilateral trade) 1973.05 – 1990.11	*X:* Significant negative relationship in 3 equation, significant positive relationship in 1 equation and insignificant in 1 equation.

Caporale and Doroodian (1994)	US to Canada (bilateral trade) 1974.01 – 1992.10	*M:* Significant negative relationship.
Mckenzie and Brooks (1997)	German to US (bilateral trade) 1973.04 - 1992.09	*X:* 4 equation have a positive effect (but insignificant). *M:* 4 equation have a significant positive effect.
Mckenzie (1998)	Australia (multilateral, bilateral and sectoral trade) 1969.3 – 1995.4	*X:* Generally have a positive effect. *M:* 5 of 6 Generally have a negative effect.
Daly (1998)	Japan (bilateral trade) 1978.1 – 1992.2	*X:* 4 equation have a positive effect and 3 equation have a negative effect. *M:* 5 equation have a positive effect and 2 equation have a negative effect. (overall likely to have a positive correlation)
Wei (1998)	63 countries in the world (bilateral trade) 1975, 1980, 1985, & 1990	*X & M:* *Pooled equation* in 1975 & 1980 has significant negative effect. in 1985 has insignificant positive effect. in 1990 has significant positive effect. *Panel equation* significant positive effect.
Chou (2000)	China (multilateral and sectoral trade) 1981.1 – 1996.4	*X:* Negative effect on total export, export of manufacture goods & mineral fuels. Positive effect on export of industrial materials.
Aristotelous (2001)	UK to US (bilateral trade) 1889 – 1999	*X:* Neither exchange-rate volatility nor the different exchange rate regimes had an effect on export volume.

Notes: *X* refers to export model; and *M* refers to import model.
Source: Compiled by authors

Table 4: Exchange Rate Volatility Measures

Measures of Exchange Rate Volatility	*Author*
The average (over thirteen weeks) absolute difference between the previous forward and the current spot rate.	Hooper Kohlhagen (1978)
Gini's mean difference (a non-parametric measure)	Rana (1981)
Standard deviation of the growth rate of the exchange rate (ER_t) with a moving average transformation (by several authors) : $V_t = \left[\left(1/m \right) \sum_{i=1}^{m} \left(\ln ER_{t+i-1} - \ln ER_{t+i-2} \right)^2 \right]^{1/2}$ where m is the order of the moving average.	IMF (1984) Kenen and Rodrik (1986), Bailey, Tavlas and Ulan (1987), Cushman (1988), Koray and Lastrapes (1989), Lastrapes and Koray (1990), Klein (1990), Bini-Smaghi (1991), Chowdhury (1993), Daly (1998), Wei (1998), Aristotelous (2001)
The variance of the spot exchange rate (ER_t) around its predicted trend that is estimated from: $\ln ER_t = \phi_0 + \phi_1 t + \phi_2 t^2 + \varepsilon_t$	Thursby and Thursby (1987)
Autoregressive Integrated Moving Average (ARIMA) model	Asseery and Peel (1991),
Autoregressive Conditional Heteroscedasticity (ARCH) models	Kroner and Lastrapes (1993), Caporale and Doroodian (1994), Mckenzie and Brooks (1997), Mckenzie (1998), Chou (2000)

Source: Compiled by authors

Table 5: GARCH model summary: $h_t = \alpha + \beta e_{t-1}^2 + \gamma h_{t-1} + u_t$

	REER		RERJPN	
	β_1	γ	β_1	γ
GARCH(1)[a]	0.9495 (0.2655)	0.2547 (0.1318)		
ARCH(1)[b]			0.5347 (0.2669)	

Note: The values in the parentheses are standard errors. All coefficients are found to be significant at least at 5% significant level.

[a]/ GARCH (1,1) is the best model for the real effective exchange rate of rupiah.

[b]/ ARCH(1) is the best model for the real exchange rate of rupiah against the yen.

Table 6: Pre-and Post-Crisis Conditional Variance (h_t)

	Pre-Crisis		Post-Crisis		
Country	Mean (1)	Standard Deviation	Mean (2)	Standard Deviation	Ratio of (2) / (1)
Indonesia	0.000196	0.00011	0.00704	0.00796	35.9
Singapore	0.000062	0.000012	0.000190	0.00019	3.06
Thailand	0.000128	0.000013	0.001736	0.002725	13.56
South Korea	0.000130	0.000083	0.00137	0.00141	10.5

Observation sets:

Indonesia, South Korea and Singapore:
Pre-Crisis: January 1995 – June 1997; Post-Crisis: February 1998 – July 2001

Thailand:
Pre-Crisis: January 1994 – June 1997; Post-Crisis: February 1998 – July 2001

Table 7: Augmented Dickey-Fuller Test Results
(All variables are in log-forms, except volatility index)

Country	Series		ADF statistics*	Test type	Lag	Order of integration
Indonesia	x^{Total}	Level	-1.381	t and c	4	I(1)
		1st difference	-6.229	---	3	
	m^{Total}	Level	-2.756	t and c	4	I(1)
		1st difference	-7.784	c	1	
	m^{Capt}	Level	-2.113	t and c	3	I(1)
		1st difference	-6.561	---	2	
	m^{Int}	Level	2.160	---	2	I(1)
		1st difference	-8.908	c	1	
	x^{JP}	Level	-2.018	c	2	I(1)
		1st difference	-7.551	c	2	
	m^{JP}	Level	-2.377	t and c	4	I(1)
		1st difference	-5.204	---	3	
	tot^{World}	Level	-1.833	c	6	I(1)
		1st difference	-7.868	---	1	
	tot^{JP}	Level	-1.146	---	1	I(1)
		1st difference	-6.814	---	1	
	y^{IND}	Level	-1.293	t and c	5	I(1)
		1st difference	-4.604	t and c	4	
	$V^{REER\text{-}MASD}$	Level	-4.171	t and c	2	I(0)
	$V^{REER\text{-}GARCH}$	Level	-4.436	t and c	2	I(0)
	$V^{JP\text{-}MASD}$	Level	-3.874	c	1	I(0)
	$V^{JP\text{-}ARCH}$	Level	-4.231	c	1	I(0)
World	y^{World}	Level	-2.043	c	4	I(1)
		1st difference	-3.246	---	3	
Japan	y^{JP}	Level	-2.077	c	1	I(1)
		1st difference	-3.789	c	1	

Note: * Significant at the 5 % level; and ** t = trend and c = constant

Table 8a: Cointegration Test Results for Total Exports

Period: 1984:1 – 1997:2
(lags = 1)

Eigenvalue	Likelihood Ratio (LR)	5 Percent Critical Value	No of Cointegrating Equation(s)
0.366	52.96	47.21	None*
0.274	28.81	29.68	At most 1
0.181	11.86	15.41	At most 2
0.024	1.262	3.76	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

$x^{Total} = 134.76 - 8.542\ y^{World} - 0.315\ tot^{World} - 0.003\ V^{REER\text{-}MASD}$

Standard error (2.946) (0.323) (0.0009)

Chi-Sguare: (8.406) (0.951) (11.099)

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

Table 8b: Cointegration Test Results for Total Exports

Period: 1984:1 – 1997:2
(lags = 1)

Eigenvalue	Likelihood Ratio (LR)	1 Percent Critical Value	No of Cointegrating Equation(s)
0.452	59.620	54.46	None*
0.265	27.728	35.65	At most 1
0.178	11.441	20.04	At most 2
0.019	1.042	6.65	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

$x^{Total} = 2.044 + 0.344\ y^{World} - 0.488\ tot^{World} - 150.257\ V^{REER\text{-}GARCH}$

Standard error (5.423) (0.674) (89.30)

Chi-Sguare: (0.004) (0.519) (2.832)

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

Table 9a: Cointegration Test Results for Total Imports

Period: 1980:1 – 1997:2
(lags = 6)

Eigenvalue	Likelihood Ratio (LR)	1 Percent Critical Value	No of Cointegrating Equation(s)
0.500	72.859	54.46	None*
0.283	29.839	35.65	At most 1
0.125	9.218	20.04	At most 2
0.015	0.906	6.65	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

$m^{Total} = -11.293 + 1.218\, y^{IND} + 0.568\; tot^{World} - 0.0002\; V^{REER\text{-}MASD}$

Standard error (0.147) (0.093) (0.0004)

Chi-Sguare: (68.65) (37.29) (0.25)

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

Table 9b: Cointegration Test Results for Total Imports

Period: 1980:1 – 1997:2
(lags = 6)

Eigenvalue	Likelihood Ratio (LR)	1 Percent Critical Value	No of Cointegrating Equation(s)
0.490	72.273	54.46	None*
0.252	30.495	35.65	At most 1
0.164	12.457	20.04	At most 2
0.022	1.361	6.65	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

$m^{Total} = -11.742 + 1.275\, y^{IND} + 0.514\; tot^{World} + 4.283\; V^{REER\text{-}GARCH}$

Standard error (0.124) (0.086) (5.714)

Chi-Sguare: (105.7) (35.72) (0.562)

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

Table 10a: Cointegration Test Results for Total Capital Imports

Period: 1980:1 – 1997:2
(lags = 8)

Eigenvalue	Likelihood Ratio (LR)	1 Percent Critical Value	No of Cointegrating Equation(s)
0.697	109.08	54.46	None*
0.227	30.37	35.65	At most 1
0.195	15.34	20.04	At most 2
0.038	2.34	6.65	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

$m^{Capt} = -32.735 + 3.337\ y^{IND} + 0.927\ tot^{World} - 0.008\ V^{REER\text{-}MASD}$

Standard error (0.465) (0.322) (0.002)

Chi-Sguare: (51.49) (8.29) (16.00)

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

Table 10b: Cointegration Test Results for Total Capital Imports

Period: 1980:1 – 1997:2
(lags = 4)

Eigenvalue	Likelihood Ratio (LR)	5 Percent Critical Value	No of Cointegrating Equation(s)
0.333	49.84	47.21	None*
0.180	22.74	29.68	At most 1
0.135	10.04	15.41	At most 2
0.012	0.78	3.76	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

$m^{Capt} = -7.674 + 0.956\ y^{IND} + 1.045\ tot^{World} - 113.95\ V^{REER\text{-}GARCH}$

Standard error (0.997) (0.548) (53.96)

Chi-Sguare: (0.927) (3.636) (4.46)

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

Table 11a: Cointegration Test Results for Total Intermediate Imports

Period: 1980:1 – 1997:2
(lags = 6)

Eigenvalue	Likelihood Ratio (LR)	1 Percent Critical Value	No of Cointegrating Equation(s)
0.458	77.28	54.46	None*
0.289	35.34	35.65	At most 1
0.176	14.19	20.04	At most 2
0.035	2.22	6.65	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

m^{Int} = -16.449 + 1.758 y^{IND} + 1.262 tot^{World} – 0.002 $V^{REER\text{-}MASD}$

Standard error: (0.218) (0.175) (0.0007)

Chi-Sguare: (65.04) (52.02) (8.16)

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

Table 11b: Cointegration Test Results for Total Intermediate Imports

Period: 1980:1 – 1997:2
(lags = 6)

Eigenvalue	Likelihood Ratio (LR)	1 Percent Critical Value	No of Cointegrating Equation(s)
0.437	66.96	54.46	None*
0.272	31.38	35.65	At most 1
0.147	11.72	20.04	At most 2
0.029	1.85	6.65	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

m^{Int} = -16.0.38 + 1.739 y^{IND} + 1.169 tot^{World} – 7.114 $V^{REER\text{-}GARCH}$

Standard error: (0.215) (0.151) (8.453)

Chi-Sguare: (65.42) (59.94) (0.71)

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

Table 12a: Cointegration Test Results for Total Exports to Japan

Period: 1984:1 – 1997:2
(lags = 1)

Eigenvalue	Likelihood Ratio (LR)	1 Percent Critical Value	No of Cointegrating Equation(s)
0.499	63.85	54.46	None*
0.251	27.86	35.65	At most 1
0.131	12.81	20.04	At most 2
0.101	5.53	6.65	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

$x^{JP} = -2.106 + 0.654\, y^{JP} - 0.386\, tot^{JP} - 0.0009\, V^{JP\text{-}MASD}$

Standard error: (0.118) (0.046) (0.0001)

Chi-Sguare: (30.70) (70.40) (81.00)

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

Table 12b: Cointegration Test Results for Total Exports to Japan

Period: 1984:1 – 1997:2
(lags = 1)

Eigenvalue	Likelihood Ratio (LR)	1 Percent Critical Value	No of Cointegrating Equation(s)
0.558	70.97	54.46	None*
0.252	28.48	35.65	At most 1
0.136	13.41	20.04	At most 2
0.106	5.83	6.65	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

$x^{JP} = -0.369 + 0.534\, y^{JP} - 0.429\, tot^{JP} - 29.62\, V^{JP\text{-}ARCH}$

Standard error: (0.113) (0.044) (4.374)

Chi-Sguare: (22.35) (95.06) (45.85)

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

Table 13a: Cointegration Test Results for Total Imports from Japan

Period: 1979:1 – 1997:2
(lags = 1)

Eigenvalue	Likelihood Ratio (LR)	5 Percent Critical Value	No of Cointegrating Equation(s)
0.283	48.53	47.21	None*
0.208	24.21	29.68	At most 1
0.093	7.17	15.41	At most 2
0.0004	0.03	3.76	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

m^{JP} = -1.196 + 0.439 y^{IND} + 0.201 tot^{JP} – 0.0004 $V^{JP\text{-}MASD}$

Standard error: (0.065) (0.045) (0.0001)

Chi-Sguare: (45.59) (19.95) (9.00)

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

Table 13b: Cointegration Test Results for Total Imports from Japan

Period: 1979:1 – 1997:2
(lags = 1)

Eigenvalue	Likelihood Ratio (LR)	5 Percent Critical Value	No of Cointegrating Equation(s)
0.339	52.54	47.21	None*
0.185	22.27	29.68	At most 1
0.095	7.36	15.41	At most 2
0.0008	0.06	3.76	At most 3

* LR indicates 1 cointegrating equation at 1% significance level

m^{JP} = -1.080 + 0.428 y^{IND} + 0.211 tot^{JP} – 25.899 $V^{JP\text{-}ARCH}$

Standard error: (0.066) (0.045) (6.223)

Chi-Sguare: (42.09) (21.99) (17.32)
Chi- square critical values:
at 1 percent = 6.6349; at 5 percent = 3.8415; and at 10 percent = 2.7055

Table 14: Summary of Regression Results

Cases:	**VMASD**	**VGARCH(1,1)**
A. With the World Markets		
Total Exports	-Negative -Significant at 1%	-Negative -Significant at 10%
Total Imports	-Negative -Not significant	-Positive -Not significant
Capital Imports	-Negative -Significant at 1%	-Negative -Significant at 5%
Intermediate Imports	-Negative -Significant at 1%	-Negative -Not significant
B. With the Japanese Market		
Exports to Japan	-Negative -Significant at 1%	-Negative -Significant at 1%
Imports from Japan	-Negative -Significant at 1%	-Negative -Significant at 1%

Figure 1: GDP Growth Rate of Selected 1997-Crisis Effected Asian Economies (1980 – 2000)

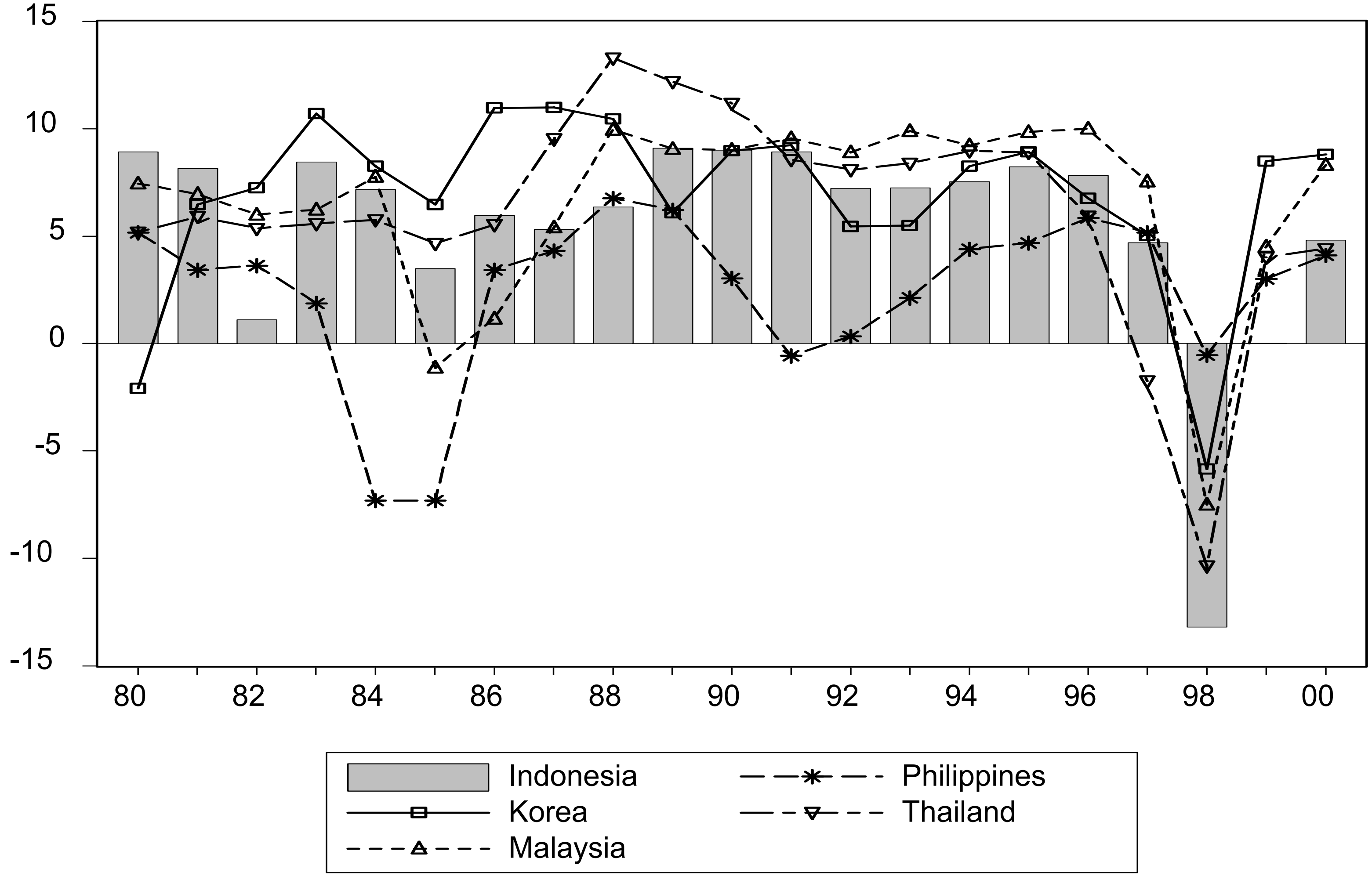


Figure 2: REER of Selected 1997- East Asian Crisis Affected Economies

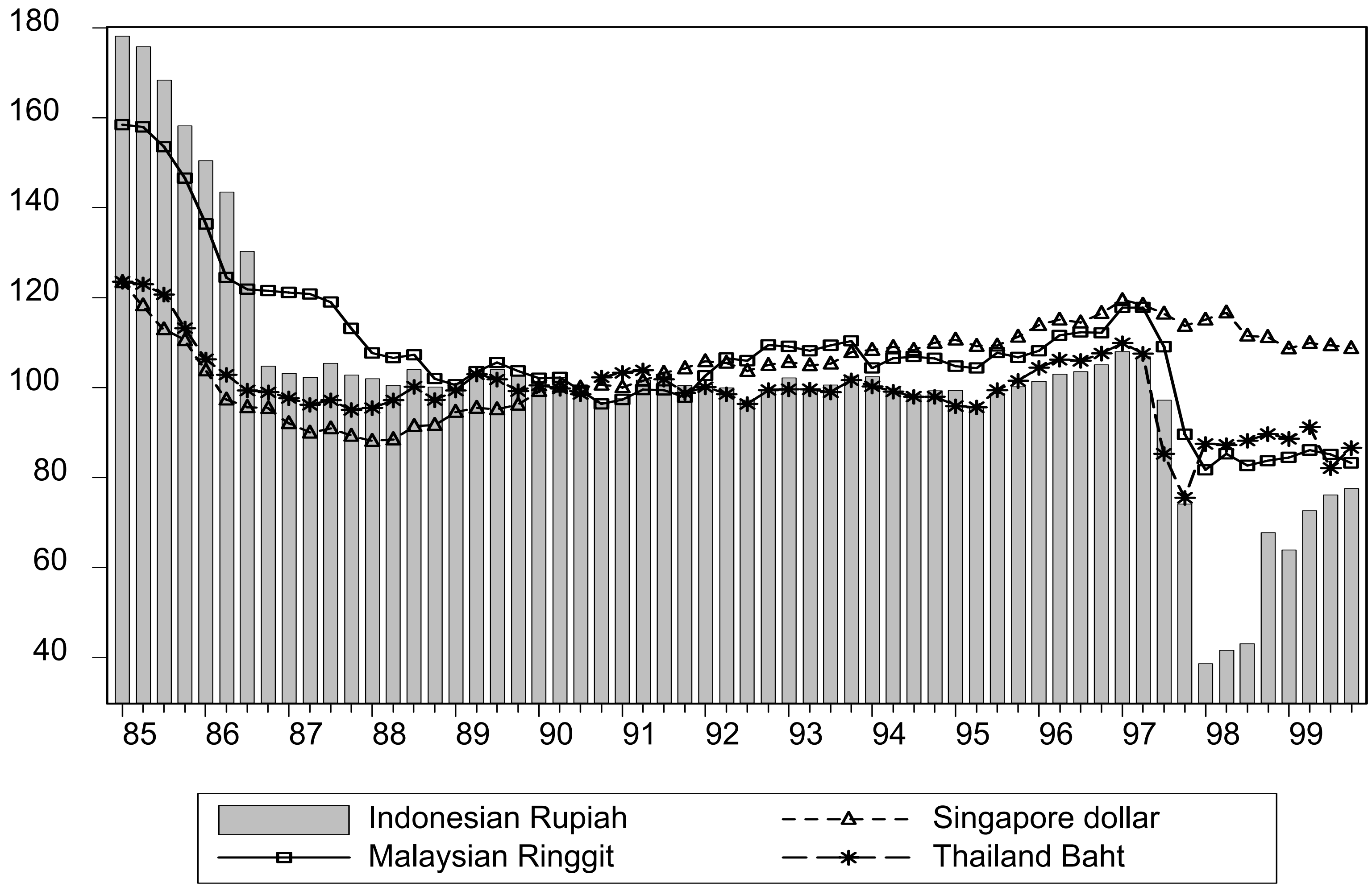


Figure 3: Growth Rates of Exports of Selected East Asian Economies (1991-1999)

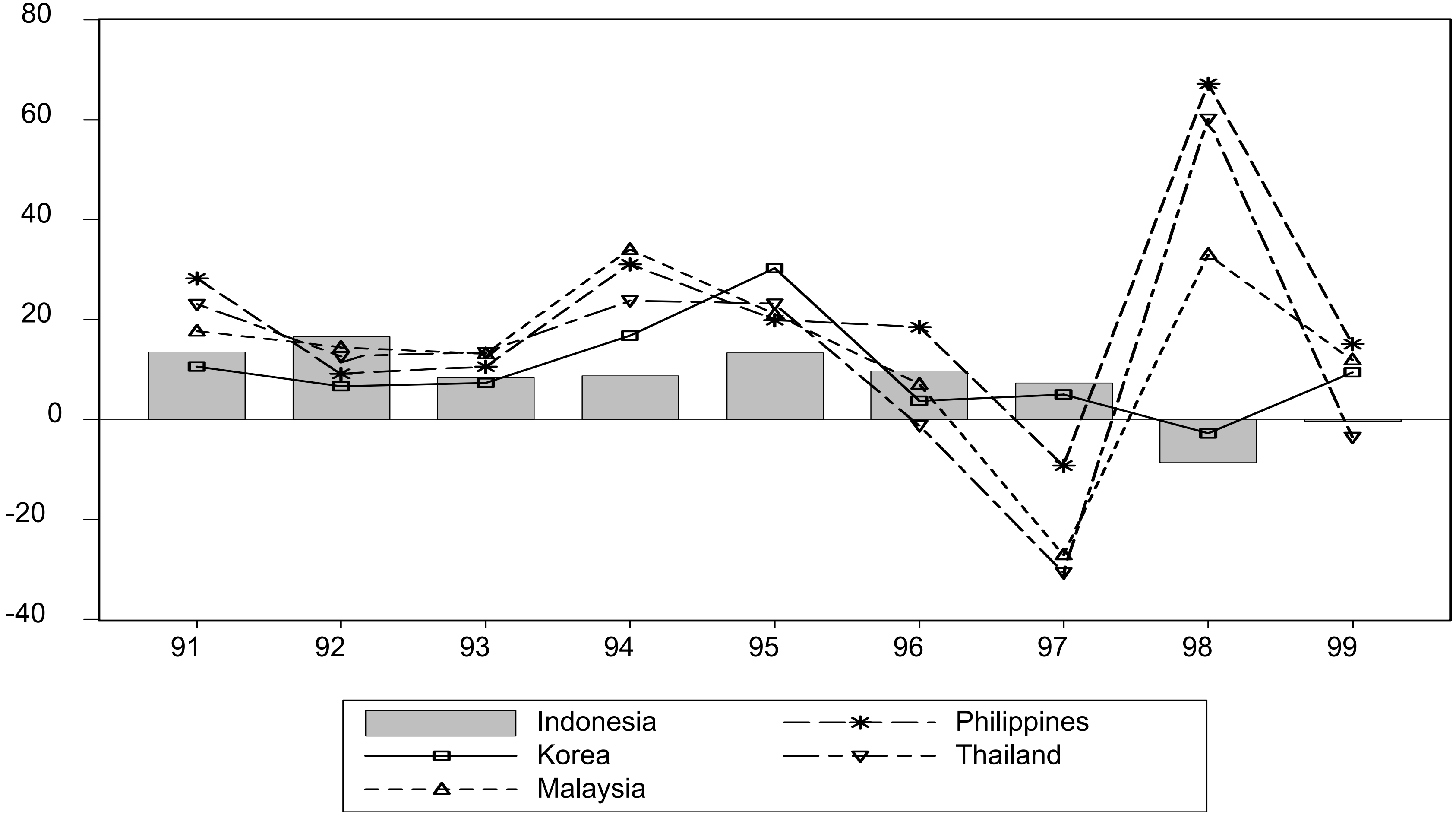


Figure 4: GARCH(1,1) and MASD Volatility of the Real Effective Exchange Rate of the rupiah

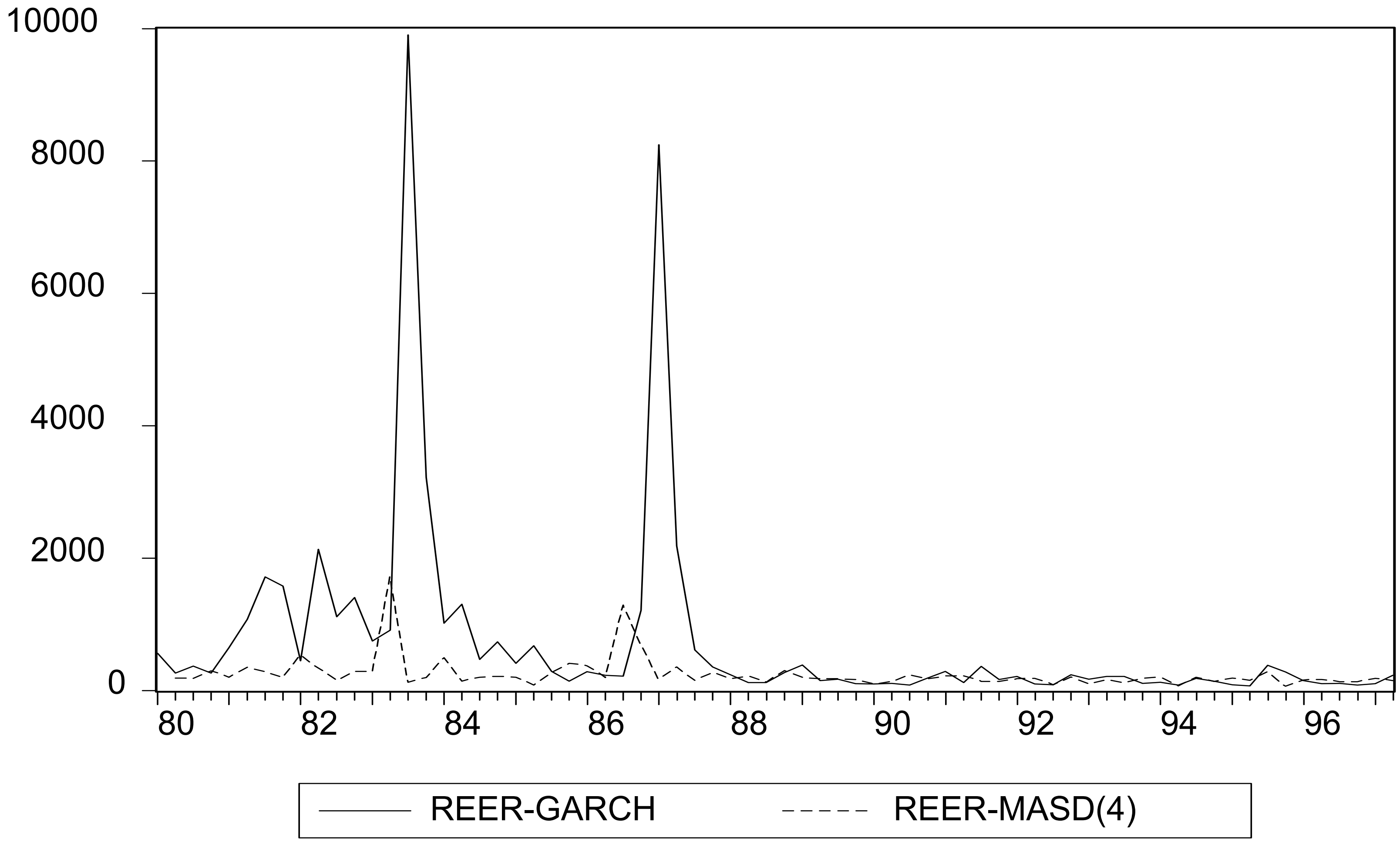
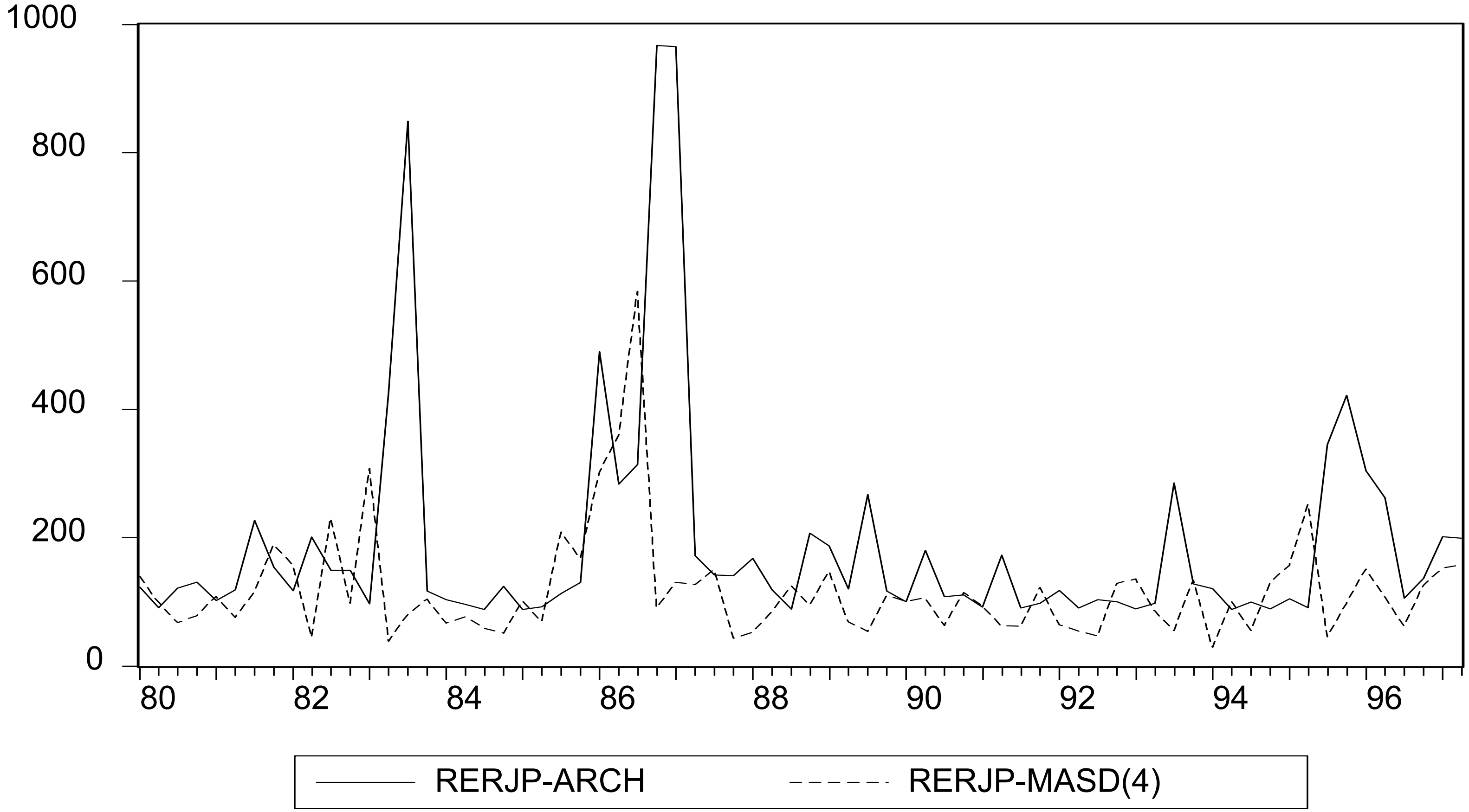


Figure 5: ARCH(1) and MASD Volatility of the Real Exchange Rate of the rupiah against the Japanese yen



CIES DISCUSSION PAPER SERIES

The CIES Discussion Paper series provides a means of circulating promptly papers of interest to the research and policy communities and written by staff and visitors associated with the Centre for International Economic Studies (CIES) at the Adelaide University. Its purpose is to stimulate discussion of issues of contemporary policy relevance among non-economists as well as economists. To that end the papers are non-technical in nature and more widely accessible than papers published in specialist academic journals and books. (Prior to April 1999 this was called the CIES Policy Discussion Paper series. Since then the former CIES Seminar Paper series has been merged with this series.)

Copies of CIES Policy Discussion Papers may be downloaded from our Web site at http://www.adelaide.edu.au/cies/ or are available by contacting the Executive Assistant, CIES, School of Economics, Adelaide University, SA 5005 AUSTRALIA. Tel: (+61 8) 8303 5672, Fax: (+61 8) 8223 1460, Email: cies@adelaide.edu.au. Single copies are free on request; the cost to institutions is US$5.00 overseas or A$5.50 (incl. GST) in Australia each including postage and handling.

For a full list of CIES publications, visit our Web site at http://www.adelaide.edu.au/cies/ or write, email or fax to the above address for our *List of Publications by CIES Researchers, 1989 to 1999* plus updates.

0205 Siregar,Reza and Ramkishen S. Rajan, “Impact of Exchange Rate Volatility on Indonesia’s Trade Performance in the 1990s”, March 2002.

0204 Xueyan Zhao, Kym Anderson and Glyn Wittwer, “Who Gains form Australian Generic Wine R & D and Promotion?”, February 2002.

0203 Bird, Graham and Ramkishen Rajan, “The Evolving Asian Financial Architecture”, January 2002.

0202 Rajan, Ramkishen and Rahul Sen, “Singapore’s New Commercial Trade Strategy: the Pros and Cons of Bilateralism”, January 2002.

0201 Rajan, Ramkishen, "Safeguarding Against Capital Account Crises: Unilateral, Regional and Multilateral Options for East Asia", January 2002. (Revised version forthcoming in G. de Brouwer (ed.), Financial Arrangements in East Asia, London: Routledge, 2002.)

0150 Rajan, Ramkishen, “Economic Globalization and Asia: Trade, Finance and Taxation”, December 2001. (Published in ASEAN Economic Bulletin, 18(1): 1-11, 2001.)

December 2001. (Published in ASEAN Economic Bulletin, 18(1): 1-11, 2001.)

0149 Rajan, Ramkishen and Iman Sugema, "The Devaluation of the Thai Baht and a Simple Second Generation Currency Crisis Model", December 2001. (Revised version forthcoming in Economia Internazionale, 2002.)

0148 Rajan, Ramkishen, "International Financial Flows and Regional Financial Safeguards in East Asia", December 2001.

0147 Rajan, Ramkishen S. and Rahul Sen, "Trade Reforms in India Ten Years on: How has it Fared Compared to its East Asian Neighbours?", December 2001.

0146 Evenett, Simon J., "Do all Networks Facilitate International Commerce. The case of US law firms and the mergers and acquisitions wave of the late 1990s", December 2001.

0145 Anderson, Kym and Shunli Yao, "How Can South Asia and Sub-Saharan Africa Gain from the Next WTO Round?", November 2001.

0144 Bernauer, Thomas and Erika Meins, "Scientific Revolution Meets Policy and the Market: Explaining Cross-National Differences in Agricultural Biotechnology Regulation", November 2001.

0143 Anderson, Kym, David Norman and Glyn Wittwer, "Globalization and the World's Wine Markets: Overview", November 2001

0142 Busse, Matthias, "Do Labour Standards Affect Comparative Advantage? Evidence for Labour-Intensive Goods", November 2001.

0141 Stringer, Randy and Glyn Wittwer, "Grapes, Wine and Water: Modelling Water Policy Reforms in Australia", November 2001.

0140 Damania, Richard, Randy Stringer, K. Ullas Karanth, and Brad Stith, "The Economics of Protecting Tiger Populations: Linking Household Behaviour to Poaching and Prey Depletion", November 2001.

0139 Damania, Richard and Erwin H. Bulte, "The Economics of Captive Breeding and Endangered Species Conservation", October 2001.

0138 James, Jennifer S and Julian M Alston, "Taxes and Quality: A Market-Level Analysis", October 2001.

0137 Rajan, Ramkishen, “Choosing an appropriate exchange rate regime for small and open economies” October 2001. (Paper prepared for *Malaysian Economic Outlook* 2001, organized by the Malaysian Institute for Economic Research, Kuala Lumpur, Malaysia).

0136 Anderson, Kym, Betina Dimaranan, Joseph Francois, Tom Hertel, Bernard Hoekman, and Will Martin, “The Burden of Rich and Poor Country Protectionism on Developing Countries”, September 2001. (Since published in *Journal of African Economies* 10(3): 227-257, 2001).

0135 Rajan, Ramkishen and Chung-Hua Shen, “Are Crisis-Devaluations Contractionary?”, September 2001.

0134 Shapiro, Perry and Petchey, Jeffrey “Internationally Mobile Factors of Production and Economic Policy in an Integrated Regional Union of States”, August 2001.

0133 Rajan, Ramkishen and Graham Bird, Still the Weakest Link: the Domestic Financial System and Post-Crisis Recovery in East Asia”, July 2001. (Since published in *Development Policy Review* 19 (3): 355-66, 2001

0132 Rajan, Ramkishen and Bird, Graham, “Banks, Maturity Mismatches and Liquidity Crises: a Simple Model”, July 2001. (Forthcoming in *Economia Internazionale*, 2002.)

0131 Montreevat, Sakulrat and Rajan, Ramkishen, “Banking Crisis, Restructuring and Liberalization in Emerging Economies: an Analytic Case Study of Thailand”, June 2001.

0130 Francois, Joseph F. “Factor Mobility, Economic Integration and the Location of Industry”, June 2001.

0129 Francois, Joseph F. “Flexible Estimation and Inference Within General Equilibrium Systems”, June 2001.

0128 Rajan, Ramkishen S., "Revisiting the Case for a Tobin Tax Post Asian Crisis: a Financial Safeguard or Financial Bonanza?" June 2001. (Paper prepared for presentation at a United Nations Meeting on Resource Mobilisation for Development, New York, June 25-26, 2001. Forthcoming in *Pacific Economic Review*, 2002.)