THE EFFECT OF EXCHANGE RATE VOLATILITY ON INDONESIAN EXPORTS

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ABSTRACT

Exchange rate volatility not only affects exchange rates, but also has important implications for export policies. This study investigates these issues as they relate to Indonesia's relations with its five main trading partners: the United States of America, Japan, Hong Kong, Singapore, and Malaysia. This is achieved by (i) measuring exchange rate volatility for each destination country; (ii) analysing whether exchange rate volatility has an effect on the export flows of Indonesia's five main trading partners; and (iii) exploring some of the policy implications. It uses three measures of exchange rate volatility: the standard deviation, the moving average standard deviation (MASD), and the autoregressive conditional heteroscedasticity (ARCH) model. Moreover, to analyse the effect of exchange rate volatility on exports, this study applies Johansen cointegration techniques and an error correction model to Indonesian quarterly data over the years from 1990 to 2008.

According to the Akaike Information Criterion (AIC), the results indicate that the ARCH model is the optimal measure of volatility of exchange rate. Furthermore, a long-run relationship does exist, which is showing that real exchange rate volatility has negative effects on real export demand for the USA, Hong Kong, and Malaysia in the long and short run. On the other hand, although real exchange rate volatility has negative effects for Japan and Singapore in the long run, its effects are insignificant in the short run. These findings suggest that policy makers should consider the degree of volatility of exchange rates and take notice of the likely effect of exchange rate volatility when implementing trade policies for each trading partner.

Keywords: *Cointegration, exchange rate volatility, exports, time series*
JEL classification: F310, F470

I. INTRODUCTION

Volatility of exchange rates has been related to speculative motives in international financial transactions. Therefore, they can introduce an element of uncertainty to the economy. Viaene and Vries (1992) show how changes in the first and second movements of an exchange rate theoretically affect trade flows. Since August 1997, Indonesia has changed its exchange rate system to free a floating exchange rate. In that year, Indonesia experienced a monetary crisis, causing high macroeconomic instability, and eventually this lead to a devaluation of rupiah.

It is apparent that rupiah exchange rate has become more volatile since then. This, in turn, resulted in growing uncertainty, affecting exporters' decisions via a risk effect.

Moreover, as an open economy, Indonesian exports constituted about 28.13 per cent of the Gross Domestic Product (GDP) in 2008. Furthermore, according to the Central Bureau of Statistics of Indonesia (2008), from the total export price, the biggest share of exports is in the non-oil and gas sector, which comprises almost 75 per cent of total exports. In addition, based on the five major destination countries, the total exports of non-oil and gas products were USD67,531.40 million in 2008. This amount is a crucial determinant of aggregate income and social welfare. Thus, with the move towards a free-floating exchange rate system, there have been concerns about the possible detrimental effects exchange rate volatility which could have on trade volumes, especially on Indonesian exports of non-oil and gas products.

The five major destination countries are the United States of America (USA), Japan, Singapore, Hong Kong, and Malaysia. The total value of exports to those countries increased considerably from 1990 to 2008. Yet in 1997, when the monetary crisis occurred and the exchange rate regime changed, the total value of exports dropped to less than USD10,000 million. Thus, if exchange rate movements are not fully anticipated, an increase in exchange rate volatility might lead risk-averse agents to reduce their international trading activities. Although economic theory states that devaluation would increase the competitiveness of domestic production, which would lead to increased exports; in the Indonesian case, that would not happen. This is because efficient transport systems, faster port handling, efficient customs clearance, and low interest on working capital loans, which seem to have been the strongest boosters of export competitiveness in many trading economies, do not present in Indonesian ports.

However, current theoretical models and empirical results show an ambiguous conclusion on the effect of exchange rate volatility on exports. The effect on trade could be either positive or negative, depending on the proxy for the exchange rate. Previous studies have shown that increasing risk, caused by the exchange rate volatility, has a negative effect on exports (Chowdhury, 1993; Arize, 1995; De Vita and Abbot, 2004). In contrast, Asseery and Peel (1991) found that higher risk because of exchange rate uncertainties could have a positive effect on trade, and a few studies have concluded that exchange rate volatility does not have significant effect on trade (Klein, 1990; Gagnon, 1993; McKenzie, 1998; Aristotelous, 2001).

There are some reasons for this inconsistent pattern of results on the

effect of exchange rate volatility on trade. The first relates to the specification of the exchange rate volatility measure adopted; for example, whether the nominal or real exchange rate is used. According to Bini-Smaghi (1991), the nominal exchange rate better captures the volatility-driven uncertainty faced by exporters. On the other hand, Gotur (1985) has stated that the real exchange rate is the most appropriate measure of movements in costs and prices.

The second reason relates to the statistical method used in estimating exchange rate volatility. There are three measures: standard deviation, moving average standard deviation (MASD), and the autoregressive conditional heteroscedasticity (ARCH) model (De Vita and Abbot, 2004). However, there is still no consensus on which technique should be used to construct the optimal measure of exchange rate volatility.

The third issue relates to differences between using aggregated and disaggregated trade data based on country destinations, commodities and time. Most empirical studies use aggregated trade data, which constrains the volatility estimates to be similar across countries and sectors of the economy (Bini-Smaghi, 1991). Thus, McKenzie (1999) recommended using disaggregated data in the context of export markets and using specific sector data.

Therefore, this study attempts to measure volatility and to analyse the effect of volatile exchange rates on Indonesian exports to its five major destination countries—Japan, the USA, Singapore, Hong Kong, and Malaysia—and whether the effect is positive or negative. There could be many possible explanations for these effects. Moreover, this paper would also recommend policies that the government should adopt to respond to the effect of exchange rate volatility on export volumes.

The remainder of the paper is structured as follows. We begin by presenting some theoretical and empirical arguments on how volatility of exchange rate can be measured and to highlight how the volatility of exchange rates might affect Indonesian exports. After that, the methods applied, together with a description of data and data sources are discussed. Then, an econometric analysis is undertaken to measure the volatility of exchange rates and to assess these effects. The findings and their implications are subsequently discussed in the final section.

II. LITERATURE REVIEW

2.1 Exchange Rate Measurement

There are several measures of volatility as a proxy for exchange rate risk. Many researches measure volatility based on the standard deviation from level, or the percentage change in the real exchange rate (Oskooee and Latifa, 1992; Chowdhury, 1993). However, Hooper and Kohlhagen (1978) measured exchange rate uncertainty by

using the average absolute difference between the previous forward rate and the current spot rate. Currently, most researches apply the ARCH and GARCH methods to measure exchange rate volatility, for instance, Qian and Varangis (1994) and Arize (1995). The ARCH and GARCH models are used to capture the time varying conditional variance as a parameter of exchange rate volatility. This technique allows consistent parameterisation of the conditional variance of the exchange rate.

Using standard deviation as a volatility measure gives the largest weight to extreme volatility (De Vita and Abbott, 2004). Thus, when volatility is small, exports might not be affected. Moreover, Klaassen (2004) has pointed out that using the MASD would capture more highly persistent real exchange rate movements compared with using standard deviation only. However, Caporale and Doroodian (1994) have criticised those two methods because they generate ad hoc, non-parametric estimates of exchange rate risk, which is avoided by the use of the ARCH and GARCH models. This is because these two both allow volatility clustering, such that large variances in the past generate large variances in the future, so that volatility can be predicted based on past values.

Furthermore, the measurement of exchange rate volatility is related to the classification of a country's exchange rate arrangements as either nominal or real. According to Clark *et al.* (2004), the choice between using nominal and real exchange rates depends, in part, on the time dimension which is relevant to the economic decision being taken. Usually the nominal exchange rate is used in the short term as a spot rate or current exchange rate. However, Hondroyiannis *et al.* (2005) point out that because nominal and real exchange rates tend to move closely together, and given the stickiness of domestic prices, especially in the short run, the choice of measure is not likely to affect volatility or econometric results significantly. The decision to engage in international transactions, however, stretches over a relatively long period, during which production costs and import prices in foreign currency terms are likely to vary. This latter consideration suggests that exchange rates measured in real terms are preferable. Therefore, in this study, real exchange rates are used.

2.2 The Effect of Exchange Rate Volatility on Exports

Traditionally, the effect of exchange rate volatility on exports is studied within the framework of producer theory under uncertainty conditions (Learner and Stern, 1970). Uncertainty emerges here because a firm's profits depend on the fluctuations of the exchange rate, which are difficult to predict. In this model, the effect of exchange rate volatility on trade is

based on simple models with restrictive assumptions; however, these are considered too rigid for an industrialised country. Recently, studies have examined the effect of exchange rate volatility by making the model assumptions more flexible. The following subsections will involve extensions to the basic trade uncertainty models, taking into account the relaxation of those assumptions and the degree of risk aversion.

Hedging Options

In the presence of a forward exchange market, forward contracts and options become possible (Broll, 1994). Broll analyses the economic behaviour of a risk-averse firm producing in a foreign country and facing random exchange rates, assuming its capital is usually raised by borrowing in the market before production begins.[1] In such cases, exchange rate volatility is found to affect the level of hedging only when the level of foreign production and capital allocation depends on the forward rate alone so that exchange rate volatility does not influence trade volumes.

On the other hand, Viaene and de Vries (1992) argue that it is possible for trade volumes to be indirectly affected by the spot exchange rate through its effect on the forward rate, even when there is a forward market. These authors postulate that exporters and importers are on opposing sides of the forward market, resulting in opposite effects on exports and imports. Hence, in this case, exports benefit and imports lose when the trade balance is negative, or the forward risk premium is negative, and vice versa.

However, firms may choose not to eliminate exchange rate risks through forward contracts, mainly because forward markets might not exist in developing countries, such as Indonesia. In addition, managing relevant future portfolios may be costly even though short-term exchange rate risks can be easily hedged. Moreover, it is argued that hedging the exchange rate over the medium to long term is more difficult, because forward contracts are typically for the short term (Cote, 1994). Specifically, it has been argued that hedging may be more difficult and costly for manufacturing firms entering longer-term sales contracts.

Degree of Risk Aversion

Earlier versions of the basic trade models proposed by Either (1973), Artus (1983), and Brodsky (1984) predict a negative relation between volatility and trade, based on the assumption of risk aversion. These authors assumed that exchange rate volatility would reduce output and trade volumes; they developed a perfectly competitive model that uses no imported inputs. The firm is paid in foreign currency so that

[1] A risk-averse person is one who is reluctant to accept a bargain with an uncertain payoff rather than another bargain with more certain, but possibly a lower, expected payoff (Copeland, 2008).

export revenues are converted at the current exchange rate. Moreover, the firm must make production decisions before observing any exchange rate movements because there would be costs involved in adjusting production volumes, and so the firm has to accept uncertainty in future exchange rates. The consequence is that the exporting firm is unable to alter its output in response to volatility in the real exchange rate. Under these conditions, uncertainty in the firm's export revenues is entirely dependent on the exchange rate risk. Hence, higher volatility in exchange rates results in uncertainty of expected profits from trading, inducing the firm to reduce its transactions.

In contrast, Baron (1976) proposes a model that shows that an increase in exchange rate volatility might not necessarily influence the level of trade; it relaxes the assumption of perfect competition and focuses on the role of invoicing in foreign currency. He states that exporters face price risks when invoicing in a foreign currency; because prices might change during the contract period, their revenue stream and profit becomes uncertain. As a result, risk-averse traders would increase the price to minimise risk. However, if the foreign currency is depreciating, the loss to the exporter is partly offset by the higher foreign currency export price. Furthermore, Clark (1973) also notes that production costs could be lowered if exporting firms were to obtain imports from a country whose currency is depreciating, which would then offset their declining export revenues.

The literature is, however, not unanimous in predicting a negative relation between exchange rate volatility and real export volumes. Several theoretical studies have shown that it is possible for trade volumes to increase even when there is an increase in risk. According to De Grauwe (1988), the degree of a firm's risk aversion influences the effect of exchange rate volatility on trade volumes. He used a model consisting of a perfectly competitive firm that is able to spread its allocation over domestic and foreign markets. The local currency price of exports is assumed to be the only source of risk. Thus, those producers who are risk-averse to a slight degree would produce less for export because the higher exchange rate risk reduces the expected marginal utility of export revenues. In contrast, extremely risk-averse producers would produce more to avoid a drastic decline in their revenue stream with increased risk. Similarly, Dellas and Zilberfarb (1993) assert, in line with De Grauwe (1988), that risk aversion does not necessarily imply a negative relation between exchange rate volatility and exports. They used a standard asset portfolio model to obtain nominal unhedged export contracts. Moreover, their results were robust in the presence of forward markets with non-zero transaction costs.

Furthermore, in a more recent paper, De Grauwe (1992) notes that, for greater exchange rate volatility, the higher price would encourage the firm to increase production to obtain higher revenues. He used a simple model consisting of a price-taking firm without adjustment costs. However, this depends on the firm's degree of risk aversion. The higher variance of profits has negative effect on the firm and, hence, discourages the firm from exporting. Nevertheless, if the firm is relatively less risk averse, the positive effect from the larger profits derived from greater exchange rate variability outweighs the negative effect from the higher variance of profits. Therefore, the firm will increase production and exports.

Furthermore, the effect of exchange rate volatility on prices could also be ambiguous. Giovannini (1988) demonstrates that exchange rate volatility could affect the export pricing decisions of even a risk-neutral firm. He notes that when export prices were set in a foreign currency, increasing the exchange rate risk did not affect domestic or export prices. However, when export prices were set in the domestic currency, the expected profit sometimes increased, leading to lower export prices.

Feenstra and Kendall (1991) have found that when prices are set in domestic currency, firms cannot cover their risk on the foreign exchange market because demand is uncertain. Consequently, setting prices in the domestic currency can reduce export prices, even in the presence of a forward market. However, when the market sets the price in a foreign currency, the firm's cover of exchange risk depends on the difference between the forward rate and the future spot rate (the risk premium). When there is no risk premium, the firm fully covers revenues, and exchange rate volatility does not affect the firm's profit maximising decision. Because the absence of a risk premium would result in negative responses for firms invoicing in domestic currency and positive responses for firms invoicing in foreign currency, they concluded that the effect of exchange rate volatility on export prices is ambiguous.

III. MODEL SPECIFICATION, VARIABLE DEFINITION, AND DATA SOURCE SPECIFICATION

3.1 Baseline Specification and Empirical Definitions

The approach followed in this study is in line with the traditional framework for analysing the demand for commodity exports, as set out by Chowdhury (1993), McKenzie (1998), and Vergil (2002). The export demand framework postulates a long-run relation between exports, foreign economic activity, terms of trade and exchange rate volatility. Therefore, the standard approach in the literature is to estimate the effect of exchange rate volatility on

exports by means of a single equation model of the following type:

$$lnx_t = \alpha_0 + \alpha_1 lnP_t + \alpha_2 lnY_t + \alpha_3 lnV_t + \varepsilon_t \quad (1)$$

Where:

lnX_t = export volume at time t
lnP_t = terms of trade at time t
lnY_t = real foreign GDP at time t
lnV_t = volatility of the real exchange rate at time t
ε_t = error term

Chowdhury (1993), McKenzie (1998), and Vergil (2002) show that specification (1) can be obtained from a standard export model. It would be expected that increases in the real GDP of trading partners would result in a greater volume of exports to those partners. This is because when foreign income is higher, it creates more demand for other countries' exports. On the other hand, a rise (fall) in the terms of trade will cause the domestic goods to become less (more) competitive than foreign goods. Therefore, exports will decrease (increase) because of lower (higher) demand for exports. The expected coefficient signs are, therefore, positive for foreign incomes and negative for terms of trade.

The relation between the exchange rate volatility and the volume of exports is ambiguous. Theoretically, exchange rate volatility is a source of risk and uncertainty, which tends to have a negative effect on risk-averse traders or exporters; thus, reducing exports. On the other hand, it has been argued that if traders anticipate the exchange rate movements better than the average foreign exchange market participant, then they would gain from their better knowledge and thus be able to offset the adverse effects of exchange rate uncertainty. There is then a possibility that exchange rate uncertainty could increase rather than decrease exports. Therefore, the sign on the exchange rate volatility is determined empirically rather than by theory.

Equation (1) is considered to be the long-run equilibrium relation based on the assumption that desired (unobserved) exports equal actual (observed) exports in the long run. The basic idea of using the cointegration method in this study is that, if there are economic time series that are integrated and of the same order, which means they are non-stationary, and related through a theoretical framework, then we could try to check whether there is a way to combine them into a single series, which, is itself, non-stationary. If it is possible, then the series that exhibits this property is called cointegrated. Engle and Granger (1987) postulated that a linear combination of two or more non-stationary time series can be stationary; under such circumstances, the non-stationary time series are said to be cointegrated. Such a stationary linear combination represented by a cointegrating equation can

be inferred as the long-run equilibrium relations between the variables in the model (Stock and Watson, 1988). Moreover, cointegration analysis is essential in this study to ensure that the export demand estimated is not 'spurious regressions'.

In this study, equation (1) is estimated on the quarterly figures of Indonesian exports to its five main export destination countries—the USA, Japan, Hong Kong, Singapore, and Malaysia—over the period from the first quarter of 1990 to the last quarter of 2008. The dependent variable, X_t is defined as the nominal exports to the destination countries deflated by the Indonesia's export price.[2] Data for these variables are taken from the IMF's Direction of Trade Statistics (DOTS). With respect to the explanatory variables, Y_t is proxied by the real GDP of the destination countries (expressed in US dollars), and P_t is constructed as the ratio of the Indonesian export price to the import price of its trading partners. Data for these two variables are from the IMF International Financial Statistics (IFS), Indonesian Financial Statistics (SEKI), Central Bureau of Statistics of Indonesia (BPS), Singapore Department of Statistics and the Department of Statistics Malaysia. All the data are expressed in real terms (year 2000 prices) by using the appropriate price indices.

The measurement of V_t (the degree of exchange rate volatility) is of particular importance in the context of this study and, therefore, deserves a detailed explanation.

3.2 Measuring the Volatility of the Exchange Rate

Three measures of exchange rate volatility will be used: the standard deviation of the log real exchange rate, the MASD of the quarterly log of bilateral real exchange rate, and the conditional volatilities of the exchange rates estimated using the ARCH model.

Standard Deviation

De Vita and Abbott (2004) have explained that a key characteristic of standard deviation is that it gives the largest weight to extreme volatility. Hence, exports might not be affected by relatively small volatility because the countries under consideration focus on export promotion and their domestic markets cannot absorb the entire pro-

[2] Following the same procedure as Siregar and Rajan (2004) for total exports, we preferred to adopt the series expressed in quantity or volume terms; the data for volume exports, however, are not available. Thus, in order to obtain the volume of Indonesia's trade with other countries (the USA, Japan, Singapore, Hong Kong, and Malaysia), the available value series of bilateral trade have been divided by an appropriate price index. Thus, trade volumes are constructed as follows:

$$X_t = \frac{XVAL_t}{XP_t}$$

Where:
X_t = the quantity of Indonesia's exports to destination countries
$XVAL_t$ = the value of exports to destination countries
XP_t = Indonesia's export price

duction. In addition, this measure will be zero when the exchange rate follows a constant trend, meaning it can be perfectly anticipated and, therefore, will not be a source of exchange rate risk.

However, the disadvantage of using standard deviation is that it cannot reflect exchange rate risk. The reason is that standard deviation measures the dispersion around a sample mean, indicating the extent to which these exchange rate movements are foreseen and reflected in the forward market.

Standard deviation, as a benchmark proxy for exchange rate volatility, is defined formally as:

$$V_t = \sqrt{\sum_{i=1}^{m} \frac{\left(\Delta e_{jt} - \Delta \bar{e}_{jt}\right)^2}{m} - 1} \qquad (2)$$

Where:

Δe_t = first difference of the log quarterly exchange rate
m = number of quarters

Moving Average Standard Deviation

The moving average standard deviation (MASD) captures the movement of exchange rate uncertainty over time. Several studies have used such a time-varying measure of exchange rate variability to account for periods of high and low exchange rate volatility (for example, Chowdhury, 1993), and define volatility as follows:

$$V_t = \left[\left(\frac{1}{m}\right)\sum_{i=1}^{m}(e_{t+i-1} - e_{t+i-2})^2\right]^{\frac{1}{2}}. \qquad (3)$$

Where:

e_t = the log of real exchange rate
m = order of the moving average

The main characteristic of this measure is its ability to capture the higher persistence of real exchange rate movements in the exchange rate (Klaassen, 2004). To avoid an arbitrary choice of the order of the moving average, the optimal lag structure is derived by estimating alternative dynamic specifications, with m set to 2, 4, 6, and 8. Then the highest value of the Akaike Information Criterion (AIC) from the test equation is used to select the order of moving average.

The ARCH Model

Caporale and Doroodian (1994) criticised the two previous methods because they are ad hoc, non-parametric estimates. Thus, they used general autoregressive conditional heteroscedasticity (GARCH) and autoregressive conditional heterosce-dasticity (ARCH) models to capture the time-varying conditional variance as a parameter of exchange rate. Both models use the conditional variance of the forecast error of the exchange rate directly, allowing for volatility clustering, such that large variances in the past generate large variances in the future; hence, volatility can be predicted based on past values. However, the GARCH model will not be used to measure exchange rate

volatility in this study and its use is left as an area for further research.

The ARCH model to be used in this study is:

$$\Delta lnR_t = \alpha_0 + \sigma^2 \quad (4)$$

$$\sigma_t^2 = \gamma 0 + \sum_{j=1}^{q} \gamma j u_{t-j}^2 + v_t \quad (5)$$

In equation 10, ΔlnR_t is the first difference of the real exchange rate expressed as a logarithm. The error term, σ^2, is normally distributed with zero mean. The ARCH model, illustrated in equation 11, represents the conditional variance of σ^2, given all its past values, where the white noise error term is $v_t v_t$. This model only makes sense if $\gamma 0 > 0$ and $\gamma j \geq 0$. If all the $\gamma j\,(s)$ are equivalent to zero, the model is left with the constant $\gamma 0$, implying there are no dynamics in the variance equation.

3.3 Comparing the Measures of VolAtility of Exchange Rate

To formally compare the performance of the various exchange rate volatility measures, each export equation is re-estimated as a single model using the different proxies (SD, MASD, and ARCH) and then the optimal one is selected, based on the following model selection criteria:

$$\text{AIC } (M_1{:}M_2) = LL_1 - LL_2 - (k_1 - k_2) \quad (6)$$

where AIC is the Akaike Information Criterion, M_1 and M_2 are models 1 and 2; LL_1 and LL_2 are the respective values of their maximised log-likelihood function; and k is the number of regressors. Ideally, the final model that minimises AIC is chosen, rather than others. For each estimated equation, the non-nested sequence followed a two-stage process. First, the export for SD volatility measure (M_1) was tested against the export for the MASD volatility measure (M_2). Then, to obtain an optimal measure of exchange rate volatility, the preferred model from the first stage was tested against the export model by using ARCH as a volatility measure.

3.4 Cointegration

Cointegration implies that variables Y and X share similar stochastic trends and, because their differences are stationary, they never diverge too far from each other. Checking whether the variables are cointegrated is done by checking whether the errors are stationary. Therefore, the test for cointegration is effectively a test of the stationarity of the residuals. If the residuals are stationary, then the variables are cointegrated; if the residuals are non-stationary, then the variables are not cointegrated and any apparent regression relation between them is spurious.

Test for Cointegration

This paper used Johansen cointegration to test for and to estimate cointegrated relations, which was extended by Johansen and Juselius (1992). This method tests explicitly for the number

of cointegrating relations in a system by using full information maximum likelihood (FIML) estimation in a vector autoregression (VAR) frame-work. Maximum likelihood procedures estimate unknown parameters in such a way that the probability of observing the estimated coefficient is as high as possible.

3.5 Error Correction Model

Engle and Granger (1987) showed that, if two variables are cointegrated, then some mechanism must exist to prevents the errors in the long-run relation to be progressively larger. This mechanism is an error correction model (ECM), and the result is known as the Granger representation theorem. This states that for any set of I (1) variables, error correction and cointegration are equivalent represenntations. In other words, cointegration requires that a model has an error correction representation, and the use of an error correction representation requires cointegration (Gruen, 2000).

Therefore, based on the theorem developed by Engle and Granger (1987), the following dynamic error correction representation of the data in this study is:

$$\Delta lnX_t = \alpha_0 + \alpha_1 ECT_{t-1} + \emptyset_i \sum^{k} \Delta lnX_{t-i} + \beta_i \sum_{i=0}^{k} \Delta lnY_{t-i} + \alpha_i \sum_{i=0}^{k} \Delta lnP_{t-i} + \gamma_i \sum_{i=0}^{k} \Delta lnV_{t-i} + \epsilon_t \quad (7)$$

Where:

Δ = variables that have been first differenced.

ECT_{t-1} = lagged error correction term (the residual from the cointegrating regression equation (1). The error correction erm, ECT ~ I (0) captures the adjustment toward the long-run equilibrium.

$\alpha_1 \alpha_1$ = the proportion of the disequilibrium in real exports in one period corrected in the next period.

This equation is estimated with a general specified lag structure for all the variables in the equation 1, a constant term, and one lagged error correction term. The lag length for the VAR models for each country is determined using the likelihood ratio test.

IV. RESULT AND ANALYSIS

4.1 Estimated volatility

After having established the ARCH effects, we can compute ARCH models. Table 1 shows the results of the ARCH model for each country. It reveals that all ARCH models for each country are significant at the 5 per cent level for Japan, Hong Kong, Singapore and Malaysia, and the ARCH model with a constant for the USA is significant at 10 per cent. Therefore, the ARCH model used in this study is ARCH (1). It means that, in this model, a 1-lag term is included. After estimating the ARCH models, the volatility of

Table 1. ARCH Model Results

Countries/ Estimated Variance	Coefficient (Standard Error)	Probability	ARCH Specification
USA			
Constant	0.69 (0.37)	0.0637	(1)
MA (1)	0.87 (0.43)	0.04	(1)
Japan			
Constant	0.54 (0.24)	0.02	(1)
MA (1)	0.54 (0.25)	0.03	(1)
Hong Kong			
Constant	1.07 (0.36)	0.00	(1)
MA (1)	0.97 (0.46)	0.03	(1)
Singapore			
Constant	0.92 (0.34)	0.00	(1)
MA (1)	0.99 (0.40)	0.01	(1)
Malaysia			
Constant	0.95 (0.31)	0.00	(1)
MA (1)	0.91 (0.32)	0.00	(1)

exchange rate for each country can be obtained.

Comparing the Measures of Volatility of Exchange Rate

Three measures of exchange rate volatility are used: the standard deviation of the first difference of the log real exchange rate, the moving MASD of the quarterly log of bilateral real exchange rate, and the conditional volatility of the exchange rates estimated using an ARCH model. We re-estimate each export equation as a single model using the different proxies (SD, MASD, ARCH). The Akaike Information Criterion (AIC) is used to select the optimal measure for volatility of exchange rate to be used in the export equation. Ideally, the final model that minimises the AIC is chosen, compared with an alternative one. Table 2 shows the AIC value for each of three measures of exchange rate volatility.

Table 2 shows that the ARCH model should be used as the volatility exchange rate measure because the AIC values in this model are lower than the AIC values for the SD and MASD models. Moreover, using the ARCH model as a volatility exchange rate measure may show that there is heteroscedasticity in the Indonesian exchange rate with its destination countries. Thus, there is also heteroscedasticity in its volatility which could show that the volatility is relatively non-stationary and has wide variance.

Table 2. AIC Value Based on Countries and Volatility Measures

Country	AIC values		
	SD	MASD	ARCH
USA	-2.947	-2.807	-3.856
Japan	-2.412	-2.457	-5.010
Singapore	-2.525	-2.581	-4.019
Hong Kong	-2.116	-2.110	-2.432
Malaysia	-2.818	-3.039	-4.166

4.2 Long-Run Export Model

Cointegration Test Result

In order to achieve stationarity, all variables used for the export models in the present study are integrated and they require first differencing. The Johansen and Juselius (1994) procedure and the Pantula (1989) principle are used to establish whether a long-run relation existed between the logarithmic levels of the variables included in the export equations for each destination country. Before implementing the Johansen and Juselius procedure, appropriate lag lengths had to be selected for each model based on six criteria: the sequential modified LR test statistic (LR); final prediction error (FPE); Akaike Information Criterion (AIC); Schwarz Information Criterion (SC); and Hannan-Quinn Information criterion (HQ). However, in this study, lag length is chosen based only on Akaike information criterion because according to Lutkepohl (1993), AIC is more often likely to choose the correct order than others; HQ and SC, for example.

Consequently, this study selects the following number of lags for the VAR (p) model: two lags for the US basic trade model; three lags for the Japan basic trade model; five lags for the Hong Kong basic trade model; and six lags for the Singapore and Malaysia basic trade models.

The next step tests for the existence of cointegration in the export demand equation for each country of destination. Recall that export demand is a function of foreign real income, terms of trade, and real exchange rate volatility. The Pantula (1989) principle suggests that, for Japan and Hong Kong, a specification is used that assumes the cointegration tests has deterministic trends and intercepts, including trends in the cointegration equation. However, it has suggested that Singapore, Malaysia, and USA use the specification that the cointegration tests have no assumed deterministic trends and that an intercept is included in the equation. Table 3 shows these results which summarise the results from the Johansen cointegration tests.

Table 3 reports the results from the Johansen's (1994) maximum likelihood ratio tests for the cointegration of export demand function. The two common likelihood ratio tests, the trace and the maximum eigenvalue ($\lambda_1 max$) tests, are used to determine the number of cointegrating relations in the non-stationary time series. For the $[(\lambda]_{max})$ and trace statistics, the null hypothesis is that there are r or fewer cointegration vectors, whereas the alternative hypotheses are that there are r+1 and at least r+1 cointegrating vectors for the $[(\lambda]_{max})$ and trace statistics, respectively.

Starting with the trace tests results for Japan, the null hypothesis of $r = 0$ (no cointegration) is rejected in favour of $r \geq 1$. Furthermore, the null hypothesis of $r \leq 1$ and $r \leq 2$ and $r \geq 3$ cannot be rejected in favour of alternative hypotheses of $r \geq 2$, $r \geq 3$, and $r \geq 4$, respectively. Hence, the trace test results indicate the presence of only one cointegrating relation for Japan. Moreover, the null hypotheses of $r = 0$ and $r \leq 1$ are rejected for Hong Kong, Singapore, Malaysia, and the USA. The trace test result indicates there are two cointegrating relations.

The λ_{max} results show similar results. The null hypothesis of $r = 0$ is rejected in favour of the alternative hypothesis $r = 1$ for Japan, Hong Kong, Singapore, Malaysia, and the USA. These results indicate the presence of only one cointegrating relation for each country. Overall, the results from both these tests have suggested that, at the 5 per cent significance level, there is at least a long-run equilibrium relation among real export

Table 3. Johansen Cointegration Test Result[1]

Country	Model (2), (3) or (4)	Trace Statistic				Maximum Eigenvalue Statistic $[(\lambda]_{max})$			
	H_0 = rank = r	r = 0	R ≤ 1	r ≤ 2	r ≤ 3	r = 0	r ≤ 1	r ≤ 2	r ≤ 3
Japan	Model 4	72.86*	37.89	17.43	7.48	34.97*	20.46	9.95	7.48
Hong Kong		82.60*	43.32*	21.13	4.35	39.27*	22.20	16.78	4.35
Critical Value (5%)		63.88	42.92	25.87	12.52	32.12	25.82	19.39	12.52
Singapore	Model 2	68.48*	41.55*	23.55	7.41	29.94*	17.99	16.14	7.41
Malaysia		73.52*	38.80*	17.83	3.96	34.71*	20.96	13.87	3.96
USA		68.94*	35.61*	16.38	5.96	33.33*	19.23	10.42	5.96
Critical Value (5%)		54.07	35.19	20.26	9.16	28.58	22.29	15.89	9.16

[1] Notes: r denotes the number of cointegrating vectors. Model 2 uses the assumption of no deterministic trends and an intercept included in the cointegration equation. Model 4 uses the assumption of deterministic trends and an intercept, including trend in cointegration equation. The lag length is selected based on the AIC. The critical values for the 5 per cent level of significance are automatically reported by eviews. The asterisks (*) indicate the rejection of the null hypothesis at the 5 per cent significance level.

volumes, foreign countries' income, terms of trade, and real exchange rate volatility for all countries.

Long-run Effect of Exchange Rate Volatility on Indonesian Exports

The cointegration vectors, which are normalised with respect to real exports, together with their respective t-values are reported in Table 4.

Table 4 shows the results of the normalisation estimates of the long-run elasticities on export equations, with the t-statistics in parentheses. It is interesting that the study finds that, at the 5 per cent level of significance, real exchange rate volatility has significant negative effect on real export volumes to the USA, Hong Kong, and Malaysia, but it has significant positive effect on real export volumes to Japan and Singapore. These results are consistent with the general empirical ambiguity observed in the current literature on the effect of exchange rate volatility on trade volumes. However, at the moment, the explanation why volatility has different effects with respect to different destination countries is not covered and thus, becomes a limitation of this study. Therefore, an analysis of intra-sectoral trade patterns is important in the future to understand why exporters respond differently to risk depending on the destination of their exports.

The coefficient of volatility in the US equation implies that the elasticity of real Indonesian export volumes to the USA with respect to IDR to USD real exchange rate volatility is about 5.94.[3] Hence, if the IDR to USD real exchange rate volatility goes up by 1 per cent on average, the real export volumes to the USA will decrease by about 5.94 per cent. Similar to the USA, the coefficient on LV

[3] The International Organization for Standardization (ISO) abbreviations for the pertinent national currencies are rupiah, IDR; ringgit, MYR; US dollar, USD; Singapore dollar, SGD; yen, JPY; and Hong Kong dollar, HKD

Table 4. Estimated Normalising Cointegrating Vectors in the Johansen Tests[1]

Country	Variable				
	Constant	Ln Y_t	Ln P_t	Ln V_t	@trend
Japan		-6.61* (-4.57)	-0.41* (-2.59)	0.34* (8.58)	-0.005 (-1.52)
Hong Kong		-7.83* (-4.25)	-0.3981 (-0.77)	-9.18* (-6.38)	0.027* (2.24)
Malaysia	3.42* (2.13)	0.22 (0.49)	-5.22* (-3.13)	-3.95* (-2.76)	
USA	-5.66* (2.01)	0.36 (0.45)	-0.44 (-0.71)	-5.94* (-3.85)	

[1] Notes: t-statistics are shown in parentheses. The appropriate critical value at 5 per cent level of significance is 1.666. The asterisks (*) indicate the rejection of the null hypothesis at the 5 per cent significance level.

in the Malaysia equation implies that the elasticity of real Indonesian export volumes to Malaysia with respect to the IDR to MYR real exchange rate volatility is about 3.95. Thus, if the IDR to MYR real exchange rate volatility goes up by 1 per cent on average, the real export volumes to Malaysia will fall by about 3.95 per cent. Furthermore, when the IDR to HKD real exchange rate volatility goes up by 1 per cent on average, the real export volumes to Hong Kong will reduce by 9.18 per cent. Thus, these negative volatility terms indicate that Indonesian exporters are mostly risk averse to volatility of exchange rate.

Hence, when variability in exchange rate increases, risk-averse producers favour domestic trade over international trade, so they would tend to reduce their export volume, meaning that the volatility in the exchange rate has negatively influenced export volume. These findings are consistent with the earlier versions of the basic trade model proposed by Either (1973), Artus (1983), and Brodsky (1984), which assumed that exchange rate volatility would reduce output and trade volumes. The first reason is that the firm is paid in foreign currency, so export revenues are converted at the current exchange rate. Moreover, firms also have to make production decisions before observing any exchange rate movements; therefore, they have to accept uncertainty in the future exchange rate. Consequently, firms' export revenues are entirely dependent on the uncertainty of the exchange rate. Hence, the higher the uncertainty of the exchange rate, the lower the transactions on trade made by firms.

In contrast, the positive sign of the exchange rate term for some other countries (Japan and Singapore) implies that exchange rate volatility imposes costs on risk-averse market participants who respond by favouring trading at the margin; hence, inducing exports. This positive relation is significant at the 5 per cent level. In addition, the elasticity of real Indonesian export volumes to Japan and Singapore with respect to the IDR to JPY and IDR to SGD real exchange rate volatility is about 0.34 and 1.90, respectively. So if IDR to JPY and IDR to SGD real exchange rate volatility go up by 1 per cent on average, the real export volumes to Japan and Singapore will increase by about 0.34 per cent and 1.90 per cent, respectively. These findings are consistent with the theoretical literature, which recognises that the combination of relative risk aversion, availability of hedging facilities, and profit opportunities from exchange rate risk may allow exchange rate volatility to positively affect export volume.

The signs of the foreign income terms are not entirely as expected. Importing country income for Japan, Hong Kong, and Singapore are statistically significant at the 5 per cent level, but neither the US nor Malaysian incomes

are statistically significant. One possible reason is that for manufactured goods, the US market is more significant for Indonesia than the Indonesian market which is for the USA. Eighteen per cent of Indonesian manufactured exports are destined for the USA, but only 1 per cent of US manufactured exports are bound for Indonesia (Hufbauer and Rahardja, 2007).

Furthermore, each of the importing countries' incomes for Japan, Hong Kong, and Singapore has negative relation to the Indonesian real export volumes. This is not consistent with the economic theory that suggests increases in the real incomes of trading partners' results in a greater volume of exports to those partners. One possible reason for this situation is that the type of goods exported to Japan, Hong Kong, and Singapore are relatively inferior. Indonesia exports mainly furniture and textile products to those countries, goods that are mostly sold in the low-price market. Thus, when the real income of those countries rises, they tend to buy from another country providing better quality products. However, inferior items are supposedly protected by the so-called 'Wal-Mart effect', which presumably suggests that a fall in income during recessions encourages people to switch to cheaper products, such that the demand for them rises (Rogoff, 2006). For example, because Indonesia primarily exports low-end textile products, if income is declining in industrial countries, for example Japan, this would cause them to buy more from Indonesia because of this 'Wal-Mart effect', which applies in markets for low-price textiles (Anoraga, 2004). We may presume that this condition also applies in other countries, such as Hong Kong and Singapore, which have shops that sell low-quality goods. Consequently, the export sector in Indonesia would go through difficult times when there global expansion because customers in destination countries would shift away from Indonesian products towards other, superior products. However, exporting inferior goods makes Indonesia relatively insulated from a global recession.

The terms of trade (Ln P_t) have negative signs as expected, except for Singapore. However, the t-stat values of Ln P_t for the USA and Hong Kong, smaller than 5 per cent critical value, do not reject the null hypothesis. In other words, LnP_t does not influence Indonesian exports to the USA and Hong Kong. Although, the Ln P_t for Singapore is significant at the 5 per cent level, the sign is not consistent with the theoretical predictions. Thus, Ln P_t does not affect exports to Singapore either. This means that the USA, Hong Kong, and Singapore do not have strong orientation for imported goods from Indonesia in the long run. A possible explanation for this finding might be that bilateral imports of those countries consist, largely, of non-competing imports of neces-

sity goods, such as raw materials and intermediate inputs that are price-insensitive. Hence, even though the price of goods in Indonesia is relatively inexpensive, this still would not increase export values significantly. On the other hand, terms of trade influence Indonesian exports to Japan and Malaysia at the 5 per cent level of significance. The estimated coefficient of Ln P_t implies that a 1 per cent increase in terms of trade means that the foreign price rises 1 per cent, causing Indonesian exports to decrease by 5.22 per cent and 0.41 per cent to Malaysia and Japan, respectively. This is because of the foreign price which is lower than the domestic price.

In summary, the results from this study indicate that the effect of exchange rate volatility on exports in the long run is not the same for all destination markets. It has a negative effect on the volume of total exports to the USA, Hong Kong, and Malaysia, but positively affects the volume of total exports to Japan and Singapore. However, the decisions of exporters may be influenced by a short-term factor, the short-run dynamic effects of exchange rate volatility on the volume of total exports.

4.3 Short-Run Export Error Correction Model

Short-Run Effect of Exchange Rate Volatility on Indonesian Exports

The previous finding, that there is one cointegrating vector for each export category, implies that is possible to formulate and estimate error correction models to capture the short-run dynamics of real export volumes. Hence, this section gives an account of the estimation of the error correction model (ECM) for all countries. The short-run structure reflects the relations between the selected variables. The results of the short-run models for the selected countries are given in Table 5.

Table 5 shows that the estimated coefficients of the error term (ECT) of all countries are negative and significant at the 5 per cent level of

Table 5. Regression Results for Error Correction Models*

Country	USA	Japan	Hong Kong	Singapore	Malaysia
ECT_{t-1}	-0.122* (-3.030)	-0.002* (-2.42)	-0.041* (-3.77)	-0.058* (-2.744)	-0.08* (-3.48)
$\Delta Ln\ X_{t-1}$	-0.475* (-3.971)	-0.558* (-4.661)	-0.145* (-2.13)	-0.279* (-2.430)	-0.419* (-3.27)
$\Delta Ln\ Y_t$	0.199 (0.205)	-0.469* (-1.717)	0.402 (0.904)	0.004 (0.016)	0.06 (0.16)
$\Delta Ln\ P_t$	-0.467* (-2.520)	-0.44** (-1.51)	-0.306* (-2.301)	-0.083 (-0.668)	-0.503* (-1.82)
$\Delta Ln\ V_t$	-0.503* (-2.57)	0.225 (0.194)	-0.302* (-2.391)	0.092 (0.737)	-0.29* (-2.23)

Table 5. Regression Results for Error Correction Models[1]—*lanjutan*

Summary Statistics					
Adjusted R^2	0.38	0.33	0.26	0.22	0.39
SC $X^2(1)$	8.84 (0.91)	1.10 (0.37)	1.14 (0.25)	5.32 (0.86)	0.68 (0.81)
ARCH $X^2(2)$	0.59 (0.91)	3.01 (0.22)	0.95 (0.53)	0.48 (0.89)	13.5 (0.72)
RESET (2.64)	18.53 (0.85)	19.63 (0.35)	25.65 (0.48)	17.44 (0.35)	21.18 (0.17)

[1] Notes: The numbers in parentheses are the t-statistics; those after the summary statistics are the p values. Δ is the first difference. The appropriate critical values at 5 and 10 per cent levels of significance are 1.666 and 1.2927, respectively. The asterisks (*) and (**) indicate the rejection of the null hypothesis at the 5 and 10 per cent significance levels. ARCH $[X^2(q)]$ is the chi-squared test for autoregressive conditional heteroscedasticity. SC$[X^2(q)]$ is the q^{th} order Breusch-Godfrey LM test statistic for serial correlation. RESET $[F(q, T-k)]$ is the q^{th} order Ramsey's RESET test statistic.

significance, implying that part of the changes in exports represents an adjustment to the last period deviations from the long-run, steady-state equilibrium, so the time paths of these variables do not diverge in the long run. The values of the estimated coefficients of the ECT range from -0.002 to -0.122. Among the countries studied, Japan has the lowest value, which indicates that any deviation in exports resulting from the selected variables takes a longer time to fine tune to return to the long-run equilibrium, but the speed of adjustment of the USA is the highest among the five countries. This implies that any deviation in the export demand function will be restored to its long-run equilibrium very quickly.

The point of primary interest in this section is that the estimated volatility measure is negative and significant at the 5 per cent level for the USA, Hong Kong, and Malaysia. Therefore, if real exchange rate volatility increases by 1 per cent, on average, the real export volumes to Hong Kong, the USA, and Malaysia would fall by about 0.50 per cent, 0.30 per cent, and 0.29 per cent, respectively. These outcomes are consistent with the results for the long-run effect of volatility on export volumes, which means that exporters are risk averse in the long and the short-run periods. In contrast, the estimated volatility measure is positive and insignificant for Japan and Singapore. The first possible reason that exchange rate volatility does not show up as a significant effect in the short run for Japan and Singapore might be that it is rather stable over time. Another reason could be that there is a contract between exporters and importers with a specific exchange rate for a short period to avoid short-term fluctuation.

However, when contracts are negotiable in the long run, then the volatility of exchange rate could affect the demand for exports. The exchange rate risk seems to be less of a factor in explaining export demand for those countries in the short run.

The estimated coefficients of income of all the chosen countries in general are positive, but not statistically significant, even at the 10 per cent level. However, Japan's income has a negatively significant effect on demand export. The estimated coefficient is 0.46, which means that an increase of 1 per cent in Japan's income would cause a decline in export demand of about 0.46 per cent on average. As expected, the terms of trade have a negative sign. However, the terms of trade provide a negative significant effect in affecting exports at the 5 per cent level of significance, only for the USA, Hong Kong, and Malaysia. Meanwhile, the terms of trade for Japan have a negative and significant effect on exports at the 10 per cent level of significance. The estimated coefficient of this variable ranges from -0.46 for the USA to -0.30 for Hong Kong and -0.44 for Japan.

The findings underscored by our models are valid and reliable because all the short-run models for these countries conform to the assumptions of the classical linear regression model. Each estimated model fulfils the conditions of serial non-correlation, homoscedasticity, and absence of specification errors. The adjusted values of R^2 range from 0.22 to 0.39. The low R^2 values are because the regressions are based on the first differences in the variables.

V. SUMMARY AND POLICY IMPLICATIONS

5.1 Summary Findings

In this paper, we investigated the effect of exchange rate volatility on the volumes of Indonesian exports to each of its five major trading partners: the USA, Japan, Hong Kong, Singapore, and Malaysia. Our empirical methods relied on the theory of cointegration and error-correction representation of the cointegrated variable.

The estimates were based on three exchange rate volatility measures; the standard deviation of the log real exchange rate, the moving average standard deviation (MASD) of the quarterly log of bilateral real exchange rate, and the conditional volatilities of the exchange rates estimated using the ARCH model. To compare the performance of the various exchange rate volatility measures, each export equation was re-estimated as a single model using the different proxies (SD, MASD, ARCH), and then the optimal one was selected based on the relevant model selection criteria, the Akaike Information Criterion (AIC). The final model that minimised AIC was chosen in preference to the others.

The empirical results based on cointegration analysis show that Indonesian export volumes are cointegrated with foreign income, terms of trade, and real exchange rate volatility for all countries at the 5 per cent significance level, meaning that there is a long-run equilibrium relation among those variables. It is also suggested that those variables do not drift far apart in the long run, and so may not be considered independent of each other. Furthermore, the effect of exchange rate volatility on export volumes is not the same for all destination markets. The study finds that real exchange rate volatility has a significant negative effect on real export volumes to the USA, Hong Kong, and Malaysia, but a significant positive effect on real export volumes to Japan and Singapore, at the 5 per cent level of significance. These results are consistent with the general empirical ambiguity observed in the current literature on the effect of exchange rate volatility on trade volumes.

Nevertheless, the signs of these foreign income terms are not entirely as expected in the long run. The volatility relations with import incomes for Japan, Hong Kong, and Singapore are statistically significant at the 5 per cent level, but neither the USA nor Malaysian incomes are statistically significant. Furthermore, each of the import incomes for Japan, Hong Kong, and Singapore has negative relation to Indonesian real export volumes. Terms of trade for the USA, Hong Kong, and Singapore do not have a significant effect on Indonesian export volumes. In contrast, terms of trade have a negative influence on Indonesian exports to Japan and Malaysia at the 5 per cent level of significance.

In addition, taking an error correction model into account, this study provides estimates of the speed of adjustment or the average time lag for adjustment of exports to changes in the explanatory variables, as well as the short-run effects of exchange rate volatility on exports. In the short term, the relation between exchange rate volatility and export volumes is also negative and significant for the USA, Hong Kong, and Malaysia, but it is positive and not significant for Japan and Singapore. The estimated coefficients of the error term (ECT) of all countries are negative and significant at the 5 per cent level of significance, implying that part of the changes in exports represents an adjustment to the last period deviations from long-run steady state equilibrium, so the time paths of these variables do not diverge in the long run. Furthermore, the signs of the estimated coefficients of income of all countries are positive but not significant, even at the 10 per cent level, with the exception of Japan's income which has a significant negative effect on export demand. Terms of trade provide a negative significant effect in affecting exports at the 5 per cent

level of significance, but only in the cases of the USA, Hong Kong, and Malaysia.

Overall, these results provide consistent evidence of the effect of exchange rate volatility on export volumes, supporting those who point out that exchange rate volatility has a negative effect on trade. This suggests that risk-averse exporters will limit their activities, switch sources of supply and demand, or change prices to minimise their exposure to the influence of exchange rate risk. One can make the generalisation that policy makers or the Indonesian Government should consider the existence and the degree of exchange rate volatility, and bear in mind the likely effect of the exchange rate volatility for each trading partner in implementing of trade policies.

5.2 Policy Implications

The empirical results obtained in the present study have important implications for Indonesian exchange rate and export policies. The change of the exchange rate regime in 1997 from a managed floating exchange rate to a free floating exchange rate arrangement resulted in higher exchange rate risk and transaction costs that can impede international trade and investment (Tavlas, 1994). Volatility of the exchange rate creates uncertainty about international transactions, adding a risk premium to the costs of goods and assets traded across borders (Broz *et al.*, 2008); therefore, a risk-averse commodity trader would reduce the volume of exports in the face of uncertainty. The results of the present study indicate that, in the long run, exchange rate volatility has a statistically significant negative effect on export volumes for the USA, Hong Kong, and Malaysia, but a positive effect on real export volumes to Japan and Singapore. Therefore, in general, policy makers or Indonesian Government should take into account the existence and the degree of exchange rate volatility and notice its likely effect on their trading patterns, as well as those of their trading partners, in the implementation of trade policies. This is because trade adjustment programmes in developing countries, especially Indonesia, that stress the need for expansion may lose their appeal to domestic policy-makers during periods of high exchange rate volatility (Poon *et al.*, 2005).

Although the Indonesian exchange rate system is free floating, exchange rate stability is still needed to avoid any harmful effects of exchange rate volatility on Indonesian exports (Prijambono, 2006). He noticed that the stability of the exchange rate is needed, not at a specific level, but by controlling exchange rate volatility using the exchange rate target zone. Hence, as long as the exchange rate falls within the tolerance band, there will be no intervention, and market forces will determine the exchange rate. As soon as the exchange rate moves

above or below the predetermined limits, however, the country will cease to allow the exchange rate to float freely and will intervene to move the price of the currency back within the tolerance band or zone.

Furthermore, given a long-term appreciation of the Indonesian (rupiah) exchange rate, exporters would face difficulties competing in the world market, resulting in export values dropping in line with the strengthening of rupiah. This is because a much stronger currency would make Indonesian export products relatively more expensive than products from other countries, whose currencies are weaker or are not appreciating as fast as rupiah (Irawan, 2008). However, Irawan notes, experience shows that depreciation of rupiah has never been a major influence on export competitiveness. For example, when the rupiah depreciated against the US dollar in 1998 (IDR to USD at 11,590), the value of exports in that year was still lower than in 1997 when the rate was 4000 rupiah to the US dollar. The value of exports in 1998 was 98.8 billion rupiah, but in 1997 it was 121.2 billion rupiah. Instead, security, reliable transport, easier port handling, efficient customs clearance, and low interest on working capital loans seem to be the strongest boosters of export competitiveness.

Additionally, using a free-floating exchange rate system implies that the exchange rate for rupiah is determined solely by the market (Arintoko and Wijaya, 2005). Thus, the exchange rate reached reflects the interaction of supply and demand. In order to smoothen short-run volatility and avoid misalignment in exchange rates, Bank Central (the central bank of Indonesia) should perform sterilisation of the foreign exchange market at certain times, especially during irregular fluctuations of the exchange rate. However, when there are sharp movements in exchange rates, there is little that the government can do about larger movements in the major currencies because of difficulties in predicting the direction of the market (Basri and Hill, 2008), so these authors have recommended a new paradigm in reserve management. The first instinct of a central bank in managing its currency reserve is to take a conservative stance and avoid risk. This approach, however, is only appropriate in normal conditions, whereas in times of turmoil, when normal relations among market forces are crumbling, this conventional way of managing exchange rate risk could result in losing the opportunity for making gains. In managing exchange risk, the government and Bank Central need foresight, better forecasting and a willingness to undertake calculated risk. Unless the government and Bank Central realise this, they cannot avoid suffering losses from their exposure to volatility.

Further, to avoid exchange rate risk in the short term, firms may respond

in a number of ways, including hedging their currency exposures.[4] Hedging is very important to protect against potential loss and reduce the variance of future cash flow, so it is expected to reduce the risk of uncertainty (Eitman *et al.*, 2004). Besides, firms may also respond to exchange rate fluctuations by exploiting their worldwide network; for example, by using internal exchange rates on intra-firm transactions. Hedging the exchange rate over the medium to long term is arguably more difficult because forward contracts are typically for the short term (Cote, 1994). Specifically, it has been argued that hedging may be more difficult and costly for a manufacturing firm that enters longer-term sales contracts. Therefore, firms should increase productivity, create new products, and actively seek out new markets to maintain competitiveness.

[4] Hedging is the taking of a position, acquiring a cash flow, an asset, or a contract (including a forward contract) that will rise (fall) in value and offset a fall (rise) in the value of an existing contract (Eiteman et al., 2004).

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