

The Exchange Rate Misalignment, Volatility and the Export Performance: Evidence from Indonesia

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Abstract

This study investigates the short-run and long-run impact of real exchange rate misalignment and volatility on Indonesian export to the US by exploiting the disaggregated data of export volume. The proxy of real exchange rate misalignment was obtained by estimating the fundamental equilibrium exchange rate (FEER) model, and the exchange rate volatility measured by employing the GARCH (1,1) model. We employed the ARDL bound test approach to check the existence of long-run equilibrium between export volume and the variable under consideration. Both the short-run estimation using the error correction model and the long-run model indicates that half of the commodities are significantly and positively affected by real exchange rate misalignment. However, only a small number of commodities is significantly affected by the exchange rate volatility.

Keywords: Misalignment, Volatility, Export, Exchange Rate.

JEL Classification: F1, F31.

1. Introduction

1.1 Motivation

During the period of 1978 - 1997 Indonesia was implementing a managed floating exchange rate system; Indonesian authority then change to the free floating exchange rate system directly after the East Asia financial crisis of July 1997. This implies that Government totally gave up the exchange rate value of Indonesian Rupiah (IDR) againsts the US Dollar (USD) to the currency demand and supply mechanism. Moreover the new regime bring the Indonesian Rupiah

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(IDR) into an excessively volatile period. At the same time, export of industrial product which the performance closely related to the exchange rate level had become a very effective and significant leverage of the economic growth in the developing country since two decade ago (Lee and Huang, 2002). As the result, in order to enhance its foreign trade performance, especially export, Indonesia started to apply some policy regulation in the area. Among them are “*paket Januari 1982*” and “*Inpres No. 4 tahun 1985*” regarding the technical execution of foreign trade and the management of foreign exchange, and “*6 Mei 1986 policy*” which was aiming to enhance the export of non-oil commodities and increase foreign direct investment.

This in turn promotes a question about the relation between the two economic variables. There are two issues that has been discussed for years in the literature regarding the effect of exchange rate level on a country’s foreign trade performance. The first one is volatility and the second one is the misalignment of the exchange rate from its equilibrium. Exchange rate misalignment generally defined as a persistent departure of the real exchange rate value from its steady state level; either it is undervalued or overvalued. whereas exchange rate volatility is generally understood as the impermanent variability of exchange rate which is nowadays commonly derived from the conditional variance of the exchange rate. Kaminsky, Lizondo, & Reinhart (1998) mentioned that real exchange rate misalignment has a substantial contribution upon the sustainability of current account. Jongwanich (2009) moreover stated that the equilibrium of an economy could be strongly affected by the real exchange rate misalignment. Therefore, involving real exchange rate volatility and misalignment could help us to get a better insight of foreign trade behaviour, in a sense that we evade the omitting variable bias (Arize, 1995).

The issue regarding the influence of exchange rate on trade performance has been widely discussed theoretically and investigated empirically in a large number of papers. Even though the definite sign of exchange rate effect is ambiguous, the existence of exchange rate effect on international trade is generally accepted. In the case of Indonesia, Rupiah devaluation againts the US dollar in 1983 was followed by the increasing of non-oil export in the same year. This

was not the case of previous year, when Indonesian non-oil export experienced a contraction. Another example of the rupiah devaluation positive effect on export takes place in september 1986 when 31 percent rupiah devaluation followed by 11 percent and 30 percent rise in non-oil export in the next two consecutive year (Rosner, 2000). This is clearly showing the existence of exchange rate effect on Indonesian foreign trade which needed to be formally investigated. In addition, the fact that compare to other East Asian Countries, Indonesia experienced the highest exchange rate volatility after the financial crisis according to the finding of Siregar and Rajan (2004) might help us to clearly identified the impact of exchange rate volatility on foreign trade.

This study aim to investigate empirically the effect of exchange rate misalignment and variability on Indonesian export performance, in the short-run and long-run. Here, we employ the bilateral trade data sample between Indonesia and USA. We intentionally do not utilize the aggregate multilateral data sample since we have no acceptable reason to assume that the effect amongst country pairs will have the same level and direction (McKenzie, 1998).

Egert and Morales-Zumaquero (2008) stated that an investigation of disaggregated export data at the very specific level will be fruitful in a sense that it gives us more precise information about how the exchange rate variability and misalignment affect the export performance. Regarding this issue Byrne et al. (2008) indicated that an estimation which utilises an aggregated data tend to give bias result due to the different characteristic of each commodities in term of price elasticity and degree of risk-aversion. Accordingly, instead of employing Indonesian's total export, we use the 2 digit harmonized system(HS) commodity code.

1.2 Contribution

To the best of our knowledge it is the first paper which augmented the Indonesian export demand model with both exchange rate misalignment and volatility. The previous study by Siregar and Rajan (2004), and Bustaman and Jayanthakumaran (2007), simply incorporate exchange rate volatility to the export demand model. In addition, the utilization of disaggregated export volume may give us

the more reliable information regarding the influence of exchange rate variability and misalignment on export performance.

The rest of the paper is organized as follows: Section 2 briefly review previous empirical and theoretical studies on the impact of exchange rate volatility and misalignment on export. Section 3 will contain the empirical model, econometric methodology, and the source of data. Section 4 is devoted to the result of the measurement of exchange rate volatility and misalignment, and the econometric estimation of export demand model. The last section will presents the conclusion of the paper.

2. Literature Review

One of the basic theoretical model developed to explain the relation of exchange rate volatility and export demand is the one produced by Hooper and Kohlhagen (1978). The theory associates exchange rate variability as the risk in trade since it cause an increase in the volatility of revenue. They stated that if the transaction is using importers currency then the increase of exchange rate variability will decrease the volume of export supply. Alternatively, if the transaction is using exporters currency, the import demand will fall down. Hence, the volume of international trade will decrease as the impact of a higher exchange rate variability. More over, the higher the degree of importers' and exporters' relative risk aversion level, the higher the effect will be.

De Grauwe (1988) presented a different point of view in this issue. Here, exchange rate volatility is not only result in risk but also create an opportunity for getting higher profit. However the position taken by a firm depends on the degree of its risk-aversion, when the firm is fairly risk averse, a rise in risk comes from a rise in exchange rate uncertainty leads to a higher expected marginal utility of total revenue. Hence the firm will produce more output so it can gain more from the higher utility. Conversely, if the firms is fairly risk-taker, then Firms will decrease its production level due to the lower expected marginal utility of total revenue.

A big number of empirical work has been conducted regarding the issue of the relationship between exchange rate misalignment and trade performance. Ghura and Grennes (1993) and Jongwanich (2009)

find that export is affected negatively by currency overvaluation, while undervaluation promote export performance. Conversely, the finding of Bouoiyour and Rey (2005) in the case of Morocco indicated that RER misalignment negatively affects export performance.

Concerning the relationship between exchange rate variability and trade performance, Arize et al. (2003) found an interesting result from their estimation which indicated that exchange rate volatility showed a negative and significant effect to export performance of nine developing countries. The same findings also shown by the paper of Byrne et al. (2008) in his investigation on the US bilateral trade using sectoral industrial price indices. Barret and Wang (2007) estimated Taiwan's agricultural export and indicated that Exchange rate variability tend to depress exports performance. Choudhry T. (2005) and Rahman and Serletis (2009) are also among them whose the results of estimating exchange rate volatility and export performance are negatively correlated. Conversely, study by Baum and Caglayan (2010) has provided empirical evidence of the positive effect of exchange rate uncertainty on export. It is worth noting here the investigation of Aristotelous (2001) and Tenreyro (2007) which indicated that the impact of exchange rate variability on trade performance is not statistically significant.

3. Research Method

3.1 Empirical Model

3.1.1 Estimating Exchange Rate Misalignment

Misalignment indicating the persistent divergence of the Real Exchange rate from its long-run steady state level (Edwards,1989). Hence before measuring exchange rate misalignment, we must estimate the real exchange rate equilibrium. Among all of different approaches to get the equilibrium value, there are purchasing power parity (PPP) and fundamental equilibrium exchange rate (FEER). Here, we estimates equilibrium real exchange rate utilising the fundamental equilibrium exchange rate (FEER) developed by Edwards (1988). In order to estimate long run equilibrium of real exchange rate, the model incorporated internal and external circumstances of the economy, which is represented by the fundamental economic variables. Therefore the model will fit an open

economy like Indonesia, where the equilibrium real exchange rate is affected by external shock and local monetary and fiscal policy (Zakaria, 2010).

Real exchange rate (RER) defined as the comparative price of two different goods, that is tradable to nontradable. However, calculation of RER based on the above definition is not feasible since the information concerning the price of tradable and nontradable goods is not available in most of countries. Hence, domestic price index (P*) is taken as the proxy of domestic nontradable price and foreign price index (P) as global tradable price, as follows:

$$\text{RER} = \text{Nominal ER}(P^*/P) \quad (1)$$

The following econometric model show the relationship of real exchange rate and its fundamental variables

$$\text{RER} = \alpha_1 + \alpha_2 \text{TOT}_t + \alpha_3 \text{RGC}_t + \alpha_4 \text{OPEN}_t + \alpha_5 \text{FXR} + \alpha_6 \text{DC} + \alpha_7 \text{D} + \varepsilon_t \quad (2)$$

RER is indonesia real exchange rate (Indonesian Rupiah againts the US Dollar), TOT is ratio of export price index to the import price index, RGC is real government consumption, FXR is foreign exchange reserve, OPEN is trade opennes, DC is domestic credit creation, D is dummy variable represents the 1998 Asian financial crisis. All the selected fundamental variables has been used in many previous studies which employed Fundamental equilibrium exchange rate (FEER) model (Zakaria, 2010; Mongardini, 1998; Edwards, 1988).

The effect TOT on RER is not definite, depending on wether income effect or substitution effect is stronger (Edwards, 1988). Income effect occures when the export prices increase or the price of import decrease, followed by an increase in the domestic income. The additional income then spent into tradables and nontradables goods. However, since the price of tradable income were exogeneous in the domestic system (determined by international market), the price of nontradable goods going up relative to the tradable, followed by an

appreciation of the real exchange rate. The substitution effect occurs because the rise of export price also reduce the export demand, which in turn shift away the supply of production resource to the nontradable goods, followed by the fall of nontradable good's prices. Clearly, it will cause the depreciation of real exchange rate. Therefore, we can not determined the effect of TOT's movement in advance.

The sign of RGC is ambiguous since it depends on the proportion to which the consumption being spent; is it on nontradable or tradable goods? When the proportion of spending to nontradable goods is higher, then its price will increase relative to tradable goods. Consequently the current account will perform better due to the lower relative prices of tradable goods, followed by an appreciation of real exchange rate (Edwards, 1988). The opposite effect applies when the government spend more on tradable goods. However, the investigation by Mongardini (1998) indicated that the government tend to allocate more portion of the spending into the nontradable goods than to tradable goods, which result on the negative effect to the real exchange rate.

Similar to real government consumption, the effect of accumulation of foreign exchange reserves (FXR) on real exchange rate movement also depends on whether the reserves were devoted into tradable or nontradable goods (Razin and Collins, 1997; Edwards, 1988). Hence, we can not expect an obvious sign of the estimation results.

We use the sum of total export and import divided by GDP to represents the trade openness, since we can expect that the high value of OPEN variable were indicating the high degree of foreign trade openness, which implies more demand of tradable goods from the domestic supply. Consequently, the price of tradable goods goes up. As the result, ERER needs to depreciate so the domestic demand of tradable goods automatically shifted to the nontradable goods, which is necessary to set back the equilibrium (Jongwanich, 2009).

Domestic credit creation (DC) is representing the monetary policy upon the quantity of money in circulation. Given the other term remain unchanged, more credit creation leads to a money value depreciation (inflation). Consequently, it reduces the demand of tradable and nontradable goods since real wealth is decreasing, since the price of tradable goods were exogenous, it will followed by the

fall of nontradable goods prices (Zakaria, 2010). On the other hand, more money in the circulation will be devoted on tradable and non tradable goods, followed by the rise relative price of nontradable goods. Since the two effects works on the opposite direction, we can not expect the sign of DC's parameter.

As mentioned before, real exchange rate misalignment (MIS) described as the continuous discrepancies of real exchange rate (RER) from its long run steady state (ERER). To get the value of ERER, we estimates the fundamental parameters in model 2, then we assign the value of the permanent component of fundamental variables into the estimated equation. Further, we calculate exchange rate misalignment based on the equation below

$$\text{MIS} = \text{RER} - \text{ERER} \quad (3)$$

When the value of misalignment is positive, it implies that the actual RER is undervalued. Alternatively, when the misalignment is negative, it implies that the actual RER is overvalued.

3.1.2 Exchange Rate Volatility Measurement

This study measures the exchange rate volatility by means of the Generalized Variance of ARCH (GARCH) to enable the variance to vary as the period changes. Following is The ARCH (4) and GARCH (5) process :

$$\Delta \text{ER} = \alpha_0 + \alpha_1 \Delta \text{ER}_{t-1} + \mu_t \quad (4)$$

ΔER = difference of the exchange rate

$$\mu_t \sim N(0, h_t)$$

where the residual μ_t is standard normal distributed with zero mean and variance h_t .

$$h_t = \beta_1 + \beta_2 \mu_{t-1}^2 + \beta_3 h_{t-1} \quad (5)$$

h_t = variance of the error term

μ_{t-1}^2 = ARCH term

h_{t-1} = GARCH term

The ARCH model was developed into GARCH model by Bollerslev (1986) by augmenting the estimation of the conditional variance, h_t , which originally just the function of the lagged squared

residual (μ_{t-1}^2), by now it is also the function of lagged conditional variance (h_{t-1}). Hence, in addition to the superiority of ARCH model which allows the conditional variance to be different in every period, The GARCH model gives us more precise measurement of volatility in every different period (Bollerslev, 1986). This is very advantageous for the study, since the sample period are covering the financial crisis situation and the free float exchange rate regime where the fluctuation will be considerably intense. Concerning the issue whether real exchange rate or nominal exchange rate is affecting more to the export performance. McKenzie and Brooks (1997) stated that in term of volatility, there is no significant difference between nominal and real exchange rate since the volatility is occur simply from the movement of nominal exchange rate. It is also worth noting, Since the conditional variance of the process is necessarily positive, then we need to ensure $\beta_1, \beta_2, \beta_3$ to be positive ($\beta_1 > 0, \beta_2 > 0, \beta_3 > 0$).

3.1.3 Export Demand Model

According to Hooper and Marquez (1993) the most important variable to determine export demand is foreign income and relative price of export. Whereas Foreign income represents the capability of the market country to purchase the commodities of the exporters country. Relative price of export which is proxied by term of trade is capturing the “price effect” in the trade. The model then extended by incorporating the exchange rate volatility variable. Here we have the same model employed by McKenzie (1998), Siregar and Rajan (2004), and Arize et al. (2003). Moreover, following Ghura and Grennes (1993) and Jongwanich (2009) we augmented the model by adding the term namely real exchange rate misalignment into the model. In accordant to our discussion in the beginning of this paper, we also add dummy variable in order to take into account the effect of financial crisis. Following is the export demand model resulted from integrating all variable of interest

$$\ln X_t = \beta_0 + \beta_1 \ln FI_t + \beta_2 \ln PEX_t + \beta_3 \ln MIS_t + \beta_4 \ln VOL_t + \beta_5 D1_t + \varepsilon_t \quad (6)$$

$\ln X_t$ = natural logarithm of real exports of goods and

services

ln FI	= natural logarithm of real foreign income
ln PEX	= natural logarithm of price of export
ln MIS	= natural logarithm of exchange rate misalignment
ln VOL	= natural logarithm exchange rate volatility
D1	= Financial crisis dummy
ε_t	= disturbance term

Based on the standard demand theory, export quantity to the partner country is expected to increase as the real income of the export destination goes up, on the contrary, export demand is expected to decrease as the real income fall down. Therefore we can expect $\beta_2 > 0$. At the same time price export work to the different direction, because an increase in the term of trade is an indication that the price of the domestic commodities becomes more expensive, it will be followed by lower export demand. Therefore we can expect $\beta_3 < 0$. We defined misalignment as $MIS = RER - ERER$. Thus when MIS positive, it implies the exchange rate is undervalued, hence it will bring the domestic commodities becomes more competitive, vice versa. Therefore we can expect $\beta_4 > 0$. Exchange rate volatility is not only seen as a risk but also as an opportunity to achieve higher profit. A firm that is risk averse, expect that an escalation of exchange rate volatility will induce a higher expected marginal utility of total revenue. The condition where the firm will produce more output so it can gain more from the higher utility. Conversely, if the firms is fairly risk-taker, then Firms will decrease its production level due to the lower expected marginal utility of total revenue, the effect of exchange rate volatility on exports is ambiguous. Therefore β_4 can be either positive or negative.

3.2 Econometric Methodology

3.2.1 Exchange Rate Misalignment

Before we proceed the cointegration test to examine the existence of long-run relationship in the fundamental equilibrium exchange rate (FEER) model, it is important to investigate the integration order of every single variable. In order to do the investigation for all variables we run the unit root test, known as standard Augmented Dickey-Fuller

and Philips-Perron (PP) test. Instead of utilizing Engel-Granger cointegration test, the test will be conducted by employing the method developed by Johansen(1988) and Johansen and Juselius (1990) which is very common in the empirical investigation. According to Arize (1996) one of the reason why the Johansen-Juselius cointegration test can give a more reliable result is due to its better capability to detect the existence of cointegration relationship, besides its also conduct the test statistics for more than one cointegrating vectors. Once we get the result of the cointegration test, we estimates the fundamental equilibrium exchange rate (FEER) utilizing the standard ordinary least square (OLS) method.

3.2.2 Exchange Rate Volatility

In order to investigate the exchange rate volatility, we engage the GARCH (p,q) model as we have discussed in the previous part of the paper. Following that, we need to verify the order of the ARMA model. Hence we utilized The Akaike Info Criterion (AIC) and Schwartz Bayesian Criterion (SBC) to figure out what is the best order to be selected.

3.2.3 Cointegration Test

We will utilise the Autoregressive Distributed lag (ARDL) bound test developed by Pesaran et al. (2001) to generate the export demand model. One important properties of this method is its capability to arrange the test irrespective of the stationarity state of the independent and dependent variables, hence the test is reliable both in the case when all the regressors are stationary in level or in first difference. this feature is very important due to the fact that in a typically time series study, it was very rare that all the variables will be in the same cointegration order. The bound test method also considerably reliable even though the studies employed only a small number of samples.

The Following augmented ARDL model of export demand equation is necessary so we can execute the ARDL bound test

$$\Delta \ln X_t = \beta_0 + \beta_1 \ln FI_{t-1} + \beta_2 \ln PEX_{t-1} + \beta_3 \ln MIS_{t-1} + \beta_4 \ln VOL_{t-1} + \beta_5 \ln X_{t-1} + \sum_{i=1}^n \alpha_1 \Delta \ln X_{t-i} + \sum_{i=1}^n \alpha_2 \Delta \ln FI_{t-i} + \sum_{i=1}^n \alpha_3 \Delta \ln PEX_{t-i} + \sum_{i=1}^n \alpha_4 \Delta \ln MIS_{t-i} + \sum_{i=1}^n \alpha_5 \Delta \ln VOL_{t-i} + \varepsilon_t$$

(7)

Where Δ represents first difference, and ε_t is white-noise disturbance error term.

First of all, we apply the method of AIC, HQC and BIC to get the appropriate lag order of the model. To check the existence of long-run relationship, we implement the F-test for the null hypothesis $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ which implies the absence of long-run effect, against the alternative hypothesis $H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$. The procedure of the test is by check the estimated F-statistic with the critical value tabulated by Pesaran et al. (2001), which consist of upper and lower limit. Whenever the F-statistic is higher than the upper limit, we should reject our null hypothesis. Alternatively, if the F-statistic is below the lower limit, we should accept our null hypothesis. Nevertheless, one of the drawback from using ARDL test bound is that we can not infer any conclusion if the F-statistic come up between the two limits.

To get the value of the short-run parameters, we implement the widely known error correction term into the long-run specification as follows:

$$\Delta \ln X_t = \alpha_0 + \sum_{i=1}^n \alpha_1 \Delta \ln X_{t-i} + \sum_{i=1}^n \alpha_2 \Delta \ln FI_{t-i} + \sum_{i=1}^n \alpha_3 \Delta \ln PEX_{t-i} + \sum_{i=1}^n \alpha_4 \Delta \ln MIS_{t-i} + \sum_{i=1}^n \alpha_5 \Delta \ln VOL_{t-i} + \alpha_6 \mu_{t-1} + \varepsilon_t \quad (8)$$

Where μ_{t-1} is the error correction term represent the time needed to adjust from the short-run condition to the long-run steady state. The higher the value of error correction term indicate the less time needed for the system to return to its equilibrium condition, vice versa.

3.3 Data

The study focus on the period between 1990:Q1 and 2007:Q3 which applied both the managed floating regime during Q1 : 1990 to Q3 : 1997 and the free floating regime from 1997:Q4 to 2007: Q4. Most of the data are available in the *International Financial statistics* issued by IMF. Exchange rate (IDR:USD), consumer price index, industrial production index, and GDP deflator. For the term of trade and domestic credit we get the data from the development indicator issues of World Bank. Whereas, the commodity base export volume are

taken from data team service, Indonesian Ministry of Trade. All of the data are in quarterly basis, so we have 72 series in total for each variable. However we have to conduct an interpolation for some variables to convert the yearly base into quarterly base as we run the export demand model in quarterly basis.

4. Estimation Result and Analysis

4.1 Real Exchange Rate Misalignment

Table 1: Result of Stationarity Test

Variable	ADF		PP	
	Without Trend	Trend	Without Trend	Trend
	Level			
RER	-2,3	-2,32	-2,36	-2,5
RGC	-0,54	-1,44	-2,53	-3,81
TOT	-1,42	-2,45	-1,52	-2,56
FXR	1,76	-1,29	1,47	-0,26
BOP	-2,15	-4,22*	-1,7	-4,17*
DC	1,26	-1,64	3,17	-1,12
	First Difference			
RER	-6,44*	-6,43*	-8,15*	-8,29*
RGC	-3,65*	-3,72*	-17,35*	-20,88*
TOT	-8,22*	-8,25*	-8,22*	-8,25*
FXR	-5,98*	-6,17*	-5,94*	-6,08*
BOP	-10,64*	-10,57*	-15,88*	-15,53*
DC	-1,21	-2,05	-2,82**	-3,92*

(*) and (**) indicates statistically significant at 5 percent and 10 percent level, respectively.

From Table 1 we can conclude that the unit root test result based on both ADF and Philips-Peron method noticeably indicated that all variables are nonstationary in level. Interestingly, based on ADF test there is one variable which shown a nonstationarity in first difference, namely domestic credit (DC). However, the test based on Philips-Peron method stated that all variables are stationary in first difference. Hence, we can carry on to the long-run cointegration test of real

exchange rate model utilizing Johansen-Juselius approach.

Table 2: Cointegration Test Result

H_0	Trace	5 % critical value	λ -max	5 % critical value
$r = 0$	116.05*	88.8	45.75*	38.33
$r \leq 1$	70.29*	63.87	28.19	32.11
$r \leq 2$	42.1	42.9	20.89	25.82
$r \leq 3$	21.21	25.87	14.43	19.38
$r \leq 4$	6.77	12.5	6.77	12.51

Note: r represents the number of cointegrating vector, the optimal lag in the system based on AIC and HQ is 6. (*) indicate statistically significant at 5 percent level.

Table 2 presents the results of Johansen-Juselius cointegration test. The null hypothesis indicates that no more than r cointegrating equations exist. On the other hand the alternative hypothesis indicates that there are at least $r + 1$ equations that are integrated. As we see in the table, the estimated trace statistic clearly indicates that null hypothesis $r = 0$, $r \leq 0$, $r \leq 1$ are rejected based on 5 percent critical value. Further, the λ -max statistic also tell us to reject null hypothesis $r = 0$, $r \leq 0$. Hence, we can surely infer that there exist at least one cointegrating equations in the long-run.

Table 3: Real Exchange Rate Estimation Results

Variable	Original Specification	Final Specification
Constant	18127 (4.9)*	10.364.62 (5.38)*
Real government consumption	-1.05E9 (-5.13)*	-6.32E-9 (-3.27)*
Term of trade (TOT)	-28 (-0.9)	
Foreign exchange reserves (FXR)	-3.43E-10 (-3.45)*	-2.44E-10 (-3.02)*
Opennes (OPEN)	8.05E-7 (2.16)*	5.61E-7 (3.03)*
Domestic credit (DC)	4.95E-11 (4.75)*	3.11E-11 (3.72)*
Dummy	5430 (5.97)	3970.85 (4.59)*
AR(1)		0.37

Variable	Original Specification	Final Specification
		(3.99)*
R ²	0.80	0.84
Adjusted R ²	0.78	0.82
DW without AR(1)	1.5	1.59
with AR(1)		1.72

Note : The numbers in parentheses are t-statistics. (*) and (**) represents the significance

of t-statistics at 5 percent and 10 percent, respectively.

Table 3 reports the estimation results of long-run equilibrium real exchange rate equation. In the original specification all variable are significant except TOT. Hence, we eliminate the TOT variable so that we have all variables in the specification as significant. The value of R² and adjusted R² are sufficiently high so we can say that the model appropriately comprehend the data sample. Only 16% of the independent variable movement can not be explained by the dependent variable. Following the presence of autocorrelation indicated by the low value of DW statistics, we incorporated the AR(1) term into the model. As the result, the value of Durbin-Watson statistic improved moderately from 1.59 to 1.72 which now exceed the upper limit of Durbin-Watson critical value ($d_U = 1.64$), this obviously prove the non-existence of autocorrelation.

In order to get the equilibrium level of RER we need to decompose the fundamental variable into its transitory and permanent component. Among all method that developed to carry out the task, we will employ the Hodrick-Prescott filter for the purpose of this study. Once we get the permanent component of all fundamental variables, we assign the value into the long-run equation that has been estimated.

Figure 1 presents the evolution of IDR:USD exchange rate misalignment during the period of 1990Q1 to 2007Q4. Undervaluation (overvaluation) is commonly interpreted as a condition whenever a currency is higher (lower) than its long-run equilibrium. Figure 1 shows that IDR is tend to persistently below its equilibrium level during the period of 1990 to 1995, except in 1992. This the period when the managed floating exchange rate regime were implemented. The average deviation from the equilibrium both undervalued and overvalued is

about 5% , which is reasonably small. The IDR overvaluation was going higher by the middle of 1995, the appreciation continued until it reached the turning point which was took place in the first quarter of 1998, right after the occurrence of the financial crisis. Moreover, the IDR experienced an undervaluation during the peak of crisis, that is from 1998:Q1 until 1998:Q3. This is due to the change of government policy regarding the exchange rate regime from managed floating turn out to be independent free floating regime. As the results, the currency experienced a dramatic shift from 23 % overvaluation into 61 % undervaluation in the first quarter of 1998. The undervaluation persistent at the level of approximately 55 % before it starts to overvalued in the fourth quarter of 1998 until first quarter of 2000. During 2000:Q2 until 2002:Q3 the IDR tend to be undervalued before experienced another persistent overvaluation from 2002:Q4 until 2007:Q4, interrupted only by a small and short undervaluation in 2005Q3. This seems to be a sign of the upcoming 2008 world financial crisis, just like the IDR overvaluation prior to the 1998 financial crisis.

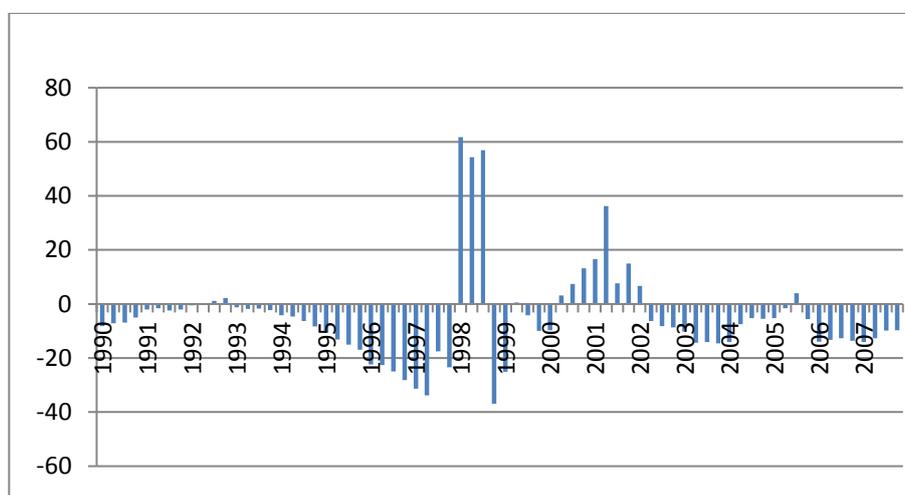


Figure 1: The Indonesian Real Exchange Rate Misalignment

Note: the level of misalignment = $[(RER-ERER)/ERER]*100$. The positive (negative) value indicates undervaluation (overvaluation).

Table 4 reports the outcome of estimating GARCH (1,1) model. The report clearly shows the existence of ARCH effect, since the coefficient of e_{t-1}^2 is statistically significantly. By the significance of

GARCH term (h_{t-1}). The estimation results also tell us that the conditional variance of one lagged period also affect the current conditional variance.

4.2 Real Exchange Rate Volatility

Table 4: The Results of GARCH Model Estimation

$\ln RER = 0,400953 + 0,954 \ln RER(-1) + e_t$		
(1,79)*	(19,5)*	
$h_t = 5,63E-05 + 2,932 e_{t-1}^2 + 0,139 h_{t-1}$		
(0,92)	(3,19)*	(3,54)*
D-W statistic = 1,5		

Note: t-statistic in the parentheses, (*) indicates statistically significant at 1 percent.

Figure 2 presents the series of IDR exchange rate againsts USD. The figure clearly shows that before the 1998 financial crisis the volatility was very small. This is also indicates that the managed floating exchange rate regime works good enough in maintaining the stability of Indonesian exchange rate. Further, the volatility rise up drastically during the financial crisis which was taken place during 1997:Q4 until 1999:Q2. The high uncertainty then turn out to be moderate in the post crisis period. However, the volatility of post-crisis period still reasonably high compare to that of the pre-crisis

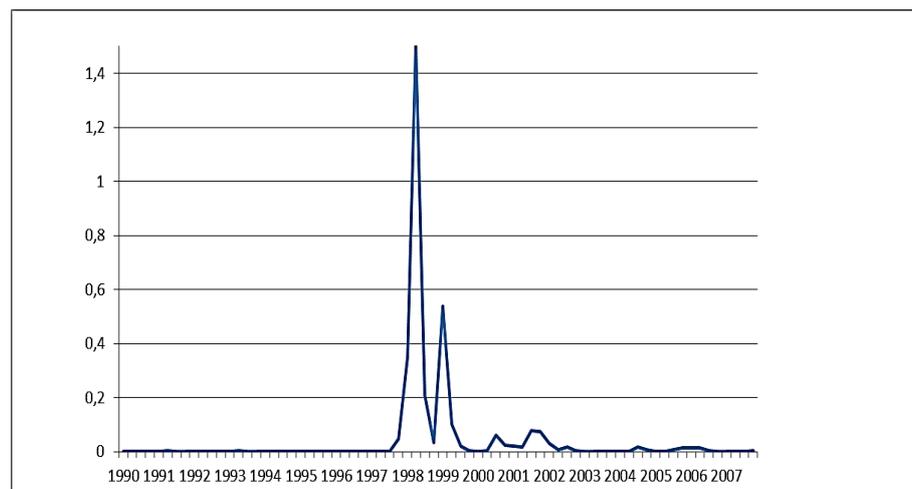


Figure 2: IDR: USD Exchange Rate Volatility

period. More specifically, the average of post-crisis volatility was 22 times higher than the pre-crisis one.

4.3 Export Demand Model

Table 5: The Result of Stationarity Analysis

Variable	Levels		First difference		Integration order
	ADF	Probability	ADF	Probability	
9	-1	0.6	-10	0.0001	I(1)
16	-3.6	0.007	-7.8	0.0000	I(0)
18	-5.7	0.000	-10	0.0000	I(0)
19	-1.3	0.5	-9.2	0.0000	I(1)
20	-3.4	0.01	-8.6	0.0000	I(0)
24	-6.7	0.000	-7.7	0.0000	I(0)
33	-6.7	0.000	-10.9	0.0000	I(0)
40	-6.1	0.000	-9.3	0.0000	I(0)
44	-4.1	0.001	-9.4	0.0000	I(0)
58	-1.5	0.48	-12.8	0.0000	I(1)
63	-2	0.26	-10.8	0.0001	I(1)
64	-2.4	0.12	-8.1	0.0000	I(1)
69	-1.8	0.36	-10.5	0.0001	I(1)
70	-1.8	0.35	-8.6	0.0000	I(1)
71	-7.1	0.000	-9.6	0.0000	I(0)
72	-2.6	0.095	-7.7	0.0000	I(1)
73	-3.49	0.01	-7.6	0.0000	I(0)
84	-2.1	0.21	-7.7	0.0000	I(1)
85	-2	0.27	-3.48	0.0112	I(1)
87	-1.5	0.5	-9.99	0.0000	I(1)
94	-1.4	0.5	-15	0.0001	I(1)
Total Volume	-3.6	0.008	-9.6	0.0000	I(0)
FI	-0.68	0.8	-5.6	0.0000	I(1)
PEX	-2.8	0.6	-9.25	0.0000	I(1)
MIS	-4.5	0.000	-7.7	0.0000	I(0)

VOL	-6.04	0.000	-11.1	0.0001	I(0)
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Prior to the cointegration test we conduct the test of stationarity condition for all variable in the spesification. Here we utilize the Augmented Dickey-Fuller unit root test. The output of the test are reported in Table 5.

Based on the unit root test at level, the ADF test accept the null hypothesis of nonstationarities for some series and reject the null hypothesis for the other. Whilst at first difference, the ADF test reject null hypothesis for all series. The result clearly implies that the series under consideration are integrated at different orders. Following this, ARDL approach of cointegration test by Pesaran et al. (2001) offers better reliability whenever the series in the model are integrated in the different order.

Table 6: Optimal Lag Length Analysis

Commodity Code	Optimal Lag	Akaike Information Criterion	Schwarz Bayesian Criterion	Hannan-Quin Criterion
9	1	34.04	34.45*	34.20*
16	1	31.74*	32.16*	31.91*
18	1	35.92	36.34*	36.09*
19	1	30.33	30.74*	30.49*
20	1	33.40*	33.82	33.57*
24	1	30.36*	30.77	30.52*
33	1	25.63*	26.05*	25.79*
40	1	36.42*	36.84*	36.59*
44	1	37.41*	37.83*	37.58*
58	3	23.18	23.93*	23.48*
63	1	29.58*	29.99*	29.74*
64	3	31.72*	32.47	32.02*
69	1	34.28*	34.70*	34.45*
70	5	31.29	32.39*	31.73*
71	1	27.99*	28.40*	28.15*
72	5	35.59*	36.69	36.02*
73	1	33.44	33.85*	33.60*
84	1	31.02*	31.43*	31.18*

Commodity Code	Optimal Lag	Akaike Information Criterion	Schwarz Bayesian Criterion	Hannan-Quin Criterion
85	5	32.14*	33.23	32.57*
87	1	29.11	29.53*	29.28*
94	3	33.71*	33.47	34.01*
Total Volume	3	38.54*	39.29	38.84*

Note: (*) represents the lowest value of each criteria, we selected the lag chosen by two of three criteria.

Before employing the long-run cointegration test between the export volume and the real exchange rate variability and misalignment, we check the optimal lag length of the model by the method of Ordinary Least Square. Here, we utilise the Akaike Information, Schwarz Bayesian, and Hannan-Quin criteria as presented in Table 6. Once we get the optimal lag length for each commodities, we can regress the export demand model and conduct the test to determine the existence of long-run cointegration.

Table 7: Long-run Equilibrium Test

Variable	F-statistics		Variable	F-statistic	
9	7.75	*	64	7.77	*
16	7.08	*	69	1.55	X
18	7.39	*	70	11.5	*
19	6.13	*	71	6.51	*
20	6.61	*	72	3.69	-
24	7.20	*	73	4.50	*
33	5.70	*	84	3.77	X
40	10.6	*	85	2.85	X
44	6.96	*	87	5.87	*
58	5.95	*	94	6.01	*
63	5.27	*	Total Volume	3.04	*

Note: the ARDL bound test critical value is 2.62 for the lower bound and 3.79 for the upper bound. (*) stand for reject H_0 , (x) stand for accept H_0 , and (-) indicate that the result is indefinite.

Table 7 shows the F-statistics of Wald test by restricting the

coefficient of lagged one variables equals zero, i.e null hypothesis $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$. Using 95 percent critical value from Pesaran et al. (2001) and number of variable $k = 5$ we get the lower bound 2.62 and the upper bound 3.97. the rule of the test is we reject H_0 if the F-statistics is higher than the upper limit and we accept H_0 if the F-statistics is below the lower limit of critical value. however we are unable to take any conclusion whenever the F-statistics fall in between the two limit. Further, Table 7 indicated that the test of all commodities are succeed to reject the H_0 of no long-run cointegration except three commodities namely ceramics product(69), mechanical appliances(84) and electrical machinery(85). The test is unable to reject the H_0 , whilst for iron(72) the result is undefinite. However, since the order of the integration among the variables in the model is not same, we may confidently conclude the absence of no long-run cointegration. Following the result of the cointegration test, for the next analysis we only proceed with the commodities that showed the presence of long-run relationship.

Table 8: Result of Long-Run Relationship Estimation

Commodity Code	FI	PEX	MIS	VOL	Constant	Dummy
16	1.00 (1.95)***	1.23 (2.36)**	0.27 (2.06)**	-0.02 (-0.47)	8.76 (2.77)*	-0.49 (-1.67)***
19	1.66 (2.06)**	3.55 (4.47)*	0.68 (3.35)*	0.06 (1.04)	1.81 (0.37)	-2.43 (-5.43)*
63	5.26 (11.06)*	-0.48 (-1.02)	0.28 (2.36)**	-0.009 (-0.22)	-11.7 (-4.13)*	-1.47 (-5.55)*
70	2.57 (7.27)*	-0.46 (-1.33)	0.28 (3.13)*	-0.01 (-0.44)	1.8 (0.85)	-0.68 (-3.48)*
73	2.02 (5.41)*	-1.76 (-4.78)*	0.22 (2.37)**	0.01 (0.43)	4.83 (2.16)**	-0.84 (-4.07)*
87	4.58 (12.01)*	0.17 (0.45)	0.2 (2.16)**	-0.01 (-0.59)	-8.34 (-3.67)*	-0.08 (-0.38)
9	1.26 (2.36)**	1.05 (1.99)**	-0.27 (-2.00)**	0.08 (1.96)***	13.43 (4.19)*	0.07 (0.24)
33	0.47 (1.39)	-0.44 (-1.31)	0.16 (1.94)**	-0.05 (-1.95)**	8.22 (4.01)*	0.13 (0.68)

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Commodity Code	FI	PEX	MIS	VOL	Constant	Dummy
94	4.86 (16.2)*	-0.5 (-1.71)***	0.42 (5.63)*	-0.05 (-2.39)**	-0.91 (-5.52)*	-8.72 (-4.89)*
58	4.77 (2.33)*	2.98 (1.48)	-0.83 (-1.61)	0.41 (2.44)**	-0.78 (-0.06)	-4.11 (-3.61)*
71	6.63 (5.56)*	-3.13 (-2.66)*	-0.002 (-0.007)	-0.16 (-1.69)***	-21.31 (-2.99)*	0.19 (0.3)
18	1.40 (2.47)**	-0.54 (-0.97)	-0.09 (-0.67)	0.11 (2.50)**	11.99 (3.55)*	-0.30 (-0.96)
20	2.02 (5.19)*	-0.47 (-1.23)	0.15 (1.56)	-0.0001 (-0.003)	5.92 (2.55)**	-2.04 (-9.46)*
24	0.40 (0.69)	0.42 (0.73)	0.03 (0.23)	0.02 (0.49)	12.38 (3.56)*	-0.38 (-1.17)
40	0.47 (3.62)*	-0.04 (0.35)	-0.01 (-0.36)	-0.009 (-0.85)	16.76 (21.35)*	0.13 (1.87)**
44	0.47 (3.62)*	-0.04 (-0.35)	-0.01 (-0.36)	-0.009 (-0.85)	16.76 (21.35)*	0.13 (1.87)**
64	-0.16 (-0.44)	-0.88 (-2.5)**	0.06 (0.73)	-0.03 (-1.34)	15.8 (7.45)*	-0.12 (-0.64)
Total volume	1.07 (7.7)*	-0.46 (-3.42)*	0.07 (2.22)**	0.009 (0.833)	14.4 (17.4)*	-0.03 (-0.43)

Note: (*), (**), and (***) represents statistically significant at 1 percent, 5 percent, and 10 percent, respectively

Table 8 reports the results of long-run export demand relationship. As we expected in the beginning, the results for almost all of commodities shows that Indonesian export to US are positively affected by the foreign income. Seventeen commodities out of eighteen are showing the positive sign, where fifteen of them are statistically significant. Nevertheless the magnitudes are various. for instance, given the others are equal, the export volume of (24)Tobacco change only 0.4 percent following 1 percent increase of foreign income. On the other hand, 1 percent increase of foreign income leads to a 6.63 percent increase in the export volume of (71) pearls and jewelry.

As in the standard demand theory, the price of exports also shows the negative sign for 12 commodities including the total export volume. Only six commodities are showing a positive sign and three

of them are not significant. Moreover the magnitude of the negative impact is quite substantial, on average 1 percent increase in price export depress the export volume by 0.76 percent.

The result for the real exchange rate misalignment is quite interesting. It has been discussed at the beginning that negative misalignment implies that the currency is in an overvalued state, vice versa. Hence, we can expect that overvaluation of currency affect the export volume negatively, in other words negative misalignment negatively affect the export volume. Both variables are go in the same direction, or we can say the relationship is positive. The result presented in the table indicates that ten commodities are significantly affected by the misalignment term, nine of them are positive. Further, the magnitudes are considerably modest; the highest one is a 0.68 percent increase of export volume following 1 percent increase of real exchange rate undervaluation.

For the volatility term, only six commodities are significantly affected by real exchange rate variability, whilst the other twelve commodities are not significantly affected. One important thing to note here is the insignificant effect of exchange rate volatility on total export volume. These clearly prove the importance of utilising the disaggregated data to detect the effect of exchange rate volatility on export volume in the long-run. Amongst the significant, three commodities are in positive direction and the other three are negative. saying that the insignificant is due to the forward exchange rate is irrelevant in this case, since the access just exist in Indonesia by 2013. One possible explanation was proposed by De Grauwe (1988) as we discussed before. The impact of exchange rate volatility on export volume depends on the degree of risk aversion of the firm producing the commodities. When the firm is highly risk-averse they will export more to avoid the lower total revenue, the opposite action will be taken by firm when they are considerably risk-takers. However we may expect that the exchange rate volatility won't affect firm's behaviour regarding its export volume when its degree of risk aversion is moderate.

It is also worth noting here that the dummy variable which represents the financial crisis, deter the export volume of most commodities. More precisely, the export volume of thirteen commodities was decreasing due to the occurrence of financial crisis,

where eight of them are statistically significant. To ensure that our estimation is stable, we conduct the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of square of recursive residuals (CUSUMSQ) upon all of commodities, which the outcome tells us that the coefficient of most estimation are stable.

Table 10 : Result of Short-Run Relationship Estimation

Commodity Code	Δ MIS	Δ MIS (-1)	Δ VOL	Δ VOL(-1)	ECT(-1)	Dummy	R ² & Adjusted R ²
9	-0.16 (-1.12)	0.04 (0.36)	0.04 ((0.99)	0.09 (1.94)***	-0.7 (-5.32)*	-0.24 (-0.91)	0.45 0.35
18	-0.11 (-0.87)		0.05 (1.23)		-0.88 (-6.46)*	-0.17 (-0.56)	0.43 0.38
19	0.57 (2.61)**	0.02 (0.14)	0.12 (1.77)***	-0.14 (-1.77)***	-0.63 (-4.65)*	-0.46 (-1.09)	0.41 0.30
24	0.10 (0.88)		0.06 (1.36)		-0.90 (-7.99)*	-0.32 (-1.18)	0.54 0.50
33	0.07 (0.90)		-0.04 (-1.45)		-0.9 (-7.01)*	0.07 (0.44)	0.45 0.40
40	-0.06 (-1.93)***	-0.02 (-0.91)	-0.02 (-1.91)***	0.009 (0.77)	-1.16 (-8.71)*	0.01 (0.15)	0.57 0.50
44	0.02 (0.66)		0.005 (0.39)		-0.70 (-6.02)*	0.07 (0.78)	0.40 0.34
70	0.4 (5.53)*	0.01 (0.26)	-0.006 (-0.3)	-0.07 (-2.6)**	-0.41 (-3.08)*	0.03 (0.27)	0.51 0.42
71	0.70 (2.6)*		-0.21 (-2.24)**		-0.82 (-6.2)*	0.04 (0.07)	0.41 0.45
73	0.22 (2.64)**		0.009 (0.29)		-0.58 (-4.73)*	-0.09 (-0.56)	0.37 0.32
87	0.27 (3.5)*		-0.03 (-1.33)		-0.40 (-3.43)*	0.11 (0.76)	0.35 0.29
64	0.13 (2.5)**		-0.07 (-4.17)*		-0.17 (-1.7)***	0.16 (1.22)	0.43 0.28
94	0.45 (6.18)*	-0.37 (-4.86)*	-0.09 (-4.01)*	0.03 (1.33)	-0.7 (-4.26)*	-0.07 (-0.47)	0.82 0.78
Total	0.07 (2.54)**		-0.01 (-1.55)		-0.71 (-6.48)*	0.02 (0.51)	0.50 0.45

Note: (*), (**), and (***) represents statistically significant at 1 percent, 5 percent, and 10 percent, respectively

Table 10 shows the result of short-run dynamics utilising error correction model. First, we conduct some statistical diagnostic test to check the reliability of the specification. Based on the Jarque-Berra normality test, the probability value of six specifications are above the 5% critical value, implies that the residual of this eight specifications are not normally distributed. The diagnostic also indicated that four of those six export demand specifications failed the CUSUM and CUSUMSQ stability test. Consequently we drop those four commodities namely commodities with HS code 16, 20, 58, and 63 so we can analyze the model based on the reliable estimation only. However, we do not need to put too much concern on this four commodities since the total market share is only 4.1 percent of our total commodities. Next, we run the Lagrange Multiplier Statistics (LM) to test whether exist serial correlation among the residual, here we found only three models are statistically significant, meaning there exist serial correlation. However, Laurenceson and Chai (2003: 30) has shown that residual autocorrelation does not violated the robustness of error correction model. Further, the Ramsey's RESET test to check the misspecification of the model only found two commodities are significant, meaning most of the models are well specified. The goodness of fit indicator, R^2 , ranging from 0.46 to 0.82, which is reasonably acceptable since the model were estimated in first difference.

The short-run estimation gives an appealing result, the coefficient of error correction term for all commodities shows negative sign and statistically significant. This is very meaningful for our study, as it ascertain our previous test that indicated the existence of long-run steady state amongst the variables of interest (Banerjee et al, 1993). All of the coefficients are significant at 1 percent critical value except commodity with HS code 64. The average speed of adjustment to the equilibrium following the first shock is 70 percent. In other words, the system get back to its equilibrium within less than two period, which is considerably fast.

The variation of real exchange rate misalignment were significantly affect the export volume's movement of nine commodities. As it has been predicted, most of them are positive, except for the HS code 40 the sign were negative. The result of commodities with HS code 94

were interesting since the sign of MIS lagged zero and lagged 1 were different. This is possible for commodities whose the material is taken not only from domestic but also imported from other countries. Hence, following the positive impact of undervaluation, the price of the commodity will rise due to the increase of imported material, which in turn depress the export volume. Another interesting result we need to report is that six commodities with HS code 19, 70, 73, 87,94, and total export volume, which were significantly and positively affected by real exchange rate misalignment in the short-run, were also affected in the same direction in the long-run. The finding tells us that the effect were strong and persistent, and to some extent confirm the robustness of our estimation.

The exchange rate volatility indicates a substantial effect to half of all commodities. The direction were negative for commodities with HS code 40, 64, 70, 71, 94 and positive for HS code 9 and 19. In addition, among those commodities which is significantly affected by exchange rate volatility in the short-run, only commodities with HS code 9, 71, and 94 were also significantly affected in the same direction in the long-run. Further more, it is also important to notes here that the total export volume were among the group that insignificantly affected by exchange rate volatility. These result ascertain the significant of utilising disaggregated data sample in order to investigate the effect of exchange rate volatility on export performance.

5. Summary and Conclusion

The main purpose of this study is to examine the impact of real exchange rate misalignment and variability on Indonesian export performance. In order to acquire the most precise result regarding export volume behaviour, the study engaged the disaggregated Indonesia-US export volume of Indonesian's priority commodity. We employed the quarterly data sample over the period 1990:Q1 – 2007:Q4. The IDR:USD exchange rate volatility measured based on GARCH approach was sufficiently low prior the financial crisis and become excessively volatile after the crisis due to the change of exchange rate regime.

To check the presence of long-run relationship, the ARDL

cointegration test was utilized since the order of integration amongs the variable of interest were different. The test indicated that 17 commodities and the total export has long-run equilibrium relationship with the variable of interest. Furthermore, the long-run estimation shows that 10 out of 18 commodities were significantly affected by real exchange rate misalignment, and 9 of them were positive. The exchange rate volatility at the same time significantly affected only 6 commodities, 3 or them were negative and the other three were positive. In the short-run, 9 commodities were significantly affected by real exchange rate misalignment, where 8 of them has positive sign. in addition, amongst 7 commodities that significantly affected by exchange rate volatility, 6 commodities were affected shows the negative sign. Furthermore, The significance and negative error correction term in the dynamic short-run estimation ascertain the presence of long-run steady state relationship. The average value of error correction term were 0.7 which indicated that the system rapidly set back to the equilibrium.

Our conclusion is that exchange rate volatility significantly affected the export volume of only few commodities in the short-run, and the effect is last into the long-run for even smaller number of commodities. For the real exchange rate misalignment, the positive effect in both the short-run and the long-run. It implies that when the price of tradable goods relatively higher than the nontradable goods, some of the production resources will automatically move from the production of nontradable to that of tradable goods. The biggest impact to the Indonesian export volume in the long-run were contributed by the income of its trading partner. Here, 17 commodities shows positive effect, where 15 of them are positive.

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