THE IMPACT OF REAL EXCHANGE RATE VOLATILITY ON INDONESIA-US TRADE PERFORMANCE

Dampak Volatilitas Nilai Tukar Riil Terhadap Kinerja Perdagangan Indonesia-Amerika Serikat

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Naskah diterima: 03/11/2014 Naskah direvisi:15/1/2015 Disetujui diterbitkan: 30/3/2015

Abstrak

Studi ini mengkaji dampak volatilitas nilai tukar riil terhadap kinerja perdagangan bilateral Indonesia-Amerika Serikat (AS), dengan menggunakan data periode Q1:1990 sampai dengan Q3:2012. Studi ini menggunakan dua pendekatan untuk mengukur volatilitas nilai tukar riil, yaitu model *Autoregressive Conditional Heteroskedasticity* (ARCH-1) dan metode *Moving Average Standards Deviation* (MASD). Untuk menguji hubungan jangka panjang antara variabel penelitian, digunakan prosedur *Autoregressive Distributed Lag* (ARDL) *bounds testing*. Hasil analisis menunjukkan bahwa volatilitas nilai tukar riil berpengaruh negatif terhadap impor Indonesia dari AS tetapi tidak mempengaruhi ekspor Indonesia ke AS. Dengan demikian, semakin *volatile* nilai tukar maka volume impor Indonesia dari AS semakin rendah. Jika Indonesia ingin menjaga neraca perdagangan, maka dianjurkan untuk mempertahankan kebijakan nilai tukar yang mengambang dan terkendali.

Kata kunci: Volatilitas nilai tukar, model ARCH, metode MASD, ARDL.

Abstract

This study examines the impact of real exchange rate volatility on bilateral trade performance between Indonesia and the United States utilizing the data period between Q1:1990 to Q3 2012. This study deploys two approaches to measure real exchange rate volatility, Autoregressive Conditional Heteroskedasticity (ARCH-1) and Moving Average standard Deviation methods. To test the long run relationship between variables, it uses Autoregressive Distributed Lag (ARDL) bounds testing procedure. The result shows that real exchange rate volatility has negative influence on Indonesia's import from the United States but does not affect the Indonesia's export to the United States. Hence, high exchange rate volatility leads to a decrease of Indonesia's import volume from the United States. If Indonesia attempts to maintain it's trade balance, it needs to keep intact managed floating exchange rate.

Keywords: *Exchange rate volatility, ARCH model, MASD methods, ARDL.*

JEL Classification: *F14, F31, F41*

INTRODUCTION

In the middle of 2007, worldwide economy faced a global financial crisis triggered by the subprime mortgage crisis in the US banking system. The condition then worsen after the oil price jumped to more than USD 100 per barrel (IMF, 2009). By the middle of 2008, the US crisis started to have an adverse impact on Indonesia's economy. The Indonesia's banking system faced a liquidity problem due to psychological factors instigated by the US crisis (Ananta, Soekarni and Arifin, 2011). Worsening banking system and financial condition led to a depreciation of Indonesian Rupiah. In the first quarter of 2009, the Indonesian Rupiah depreciation was around 25.6% and the volatility of exchange rate increased (Bank Indonesia, 2012).

This condition forced Bank Indonesia to reduce its foreign exchange reserves up to USD 9 billion in order to maintain both the stability of the Indonesian Rupiah and economic stability (Bank Indonesia, 2010). As a result, the Indonesia's GDP reached USD 200 billion in 2011 or increased about 6.5% compared to the previous year. Indonesia became a country which has the fastest economic growth among South-East Asian countries.

Indonesia's economic growth was still expected to increase modestly about 6.3% in 2012 due to the global financial crisis (IMF, 2012). As a large country with a vast domestic market, Indonesia is predicted to be less affected by the impact of global financial crisis compared to other developing countries. However, the economic crisis is expected to hinder Indonesia's trade performance considering that the US is the third largest market of Indonesia's exports (Ministry of Trade Republic of Indonesia, 2013a).

Indeed, Indonesia's trade data in 2012 revealed that Indonesia suffered an increase deficit in its trade volume. In the same period, the Indonesian Rupiah devaluation has helped to boost Indonesia's export in terms of volume by 2.3%. However, the value of export was decreasing compared to the previous year by 6.3% (Ministry of TradeRepublic of Indonesia, 2013b). For instance, although the Indonesian Rupiah was depreciated of around 7% in 2012 against the USD, the exported goods could not adequately respond to change in price.

Exchange rate level indeed plays an important role for international trade flows. As an open and developing economy, Indonesia considers the exchange rate policy as one of the main instruments to increase the economic growth and to improve trade performance.

In order to promote trade, Indonesia applied free floating exchange rate since 2004 which is reflected in Act Law No. 3 article 7, 2004 concerning the Bank of Indonesia. The Bank of Indonesia implements an exchange rate policy to reduce excessive exchange rate volatility, as the excessive volatility of exchange rate may increase risk for domestic industries when they engage in the international market. Therefore, the knowledge of the effect of exchange rate volatility becomes crucial for policy makers in designing both exchange rate and trade policies.

Several studies have analyzed the impact of exchange rate volatility on international trade flows. However, there is no clear-cut relationship between exchange rate volatility and trade. Ekanayake and Chatrna (2010), for instance, stated that it is difficult to firmly establish the nature of the relationship. Some studies also failed to establish

statistically significant relationship between exchange rate volatility and trade, for example Bailey, Tavlas and Ulan (1987); Koray and Lastrapes (1989), Wei (1998), Selim and Ustaoğlu (2012), HallHondroyiannis, Swamy, Tavlas and Ulan (2010) and Caglayan and Di (2010).

Even if the studies are able to prove the statistical significant relationship between exchange rate volatility and trade, the sign of coefficient of exchange rate volatility can not be determined definitively. Some studies, such as Najia and Sana (2012), Chit, Rizov and Willenbockel (2010), Serenis and Tsounis (2013), Chowdhury (1993), Arize (1998), Arize, Osang and Slottje (2000), Sekantsi (2011), Wang and Barrett (2007), established that trade responds negatively to the exchange rate volatility, while the others,for instance, Daly (1998), Mckenzie (1998), Chou (2000), Baum, Caglayan and Okzan (2001) and Hooy and Choong (2010) stated that it could responded positively.

The above situation may led to a paradox and debatable question. At one hand, some researchers argued that high volatility in exchange rate will increase the uncertainty of the profit from trade in foreign currency contracts. So, the risk-neutral and risk-averse traders would prefer the domestic market which is not exposed to currency exchange rate risk. Therefore, they reduce trade in foreign market. On the other hand, risk-lover traders will consider that higher volatility of exchange rate that has higher risk reflects greater chance for profit (high risk market bears high expected return), so that they will increase trade to foreign market (Huchet-Bourdonand Korinek, 2011).

Siregar and Rajan (2004) studied the impact of exchange rate volatility on Indonesia's trade performance in 1990s. More specifically, they focused on whether the increase in exchange rate volatility after the economic and political crisis in 1998 hindered the trade performance. They examined the impact of exchange rate volatility on Indonesia's aggregate trade performance and Indonesia-Japan bilateral trade performance, and found that trade responded negatively to the high exchange rate volatility.

This study aims to reexamine the impact of the real exchange rates volatility on Indonesia–US bilateral trade performance. This study extends the work of Siregar and Rajan (2004), focusing on Indonesia-US bilateral trade over the period 1990-2012 by utilizing dummy variable of economic and political crisis to capture if there is any structural break due to Asian and political crisis in 1998. In order to measure the exchange rate volatility of Rupiah against the USD, this study uses Autoregressive Conditional Heteroskedasticity (ARCH) model and Moving Average Standards Deviation (MASD).

This paper is divided into four sections. The first section comprises the background of this research, the next section describes data and model specification used in this paper. Moreover, the results and discussion are provided in the third section and the final one is conclusion and policy recommendation of this research.

METHOD

Method of Analysis

As explained before, factors affecting exports and imports performance come from supply and demand aspects. To simplify the analysis, this paper will focus only on the demand side of exports and imports performance.

Two intrinsic factors influence the demand for exported and imported

goods. First is the real income of the relevant countries and second is the relative price of the imported and exported goods. This paper uses the real GDP as a proxy of a country's real income.

This paper follows Siregar and Rajan (2004) by adopting a set of exports and imports demand functions. Additionally, this paper includes a dummy variable to capture the situation before and after economic and political crisis that hit Indonesia after 1998. Hence, the functions used are:

$$X_t = \alpha_0 + \alpha_1 Y_t^{USA} + \alpha_2 RER_t + \alpha_3 V_t + \alpha_4 D + \varepsilon_{1t} \quad (1)$$

$$M_t = \beta_0 + \beta_1 Y_t^{local} + \beta_2 RER_t + \beta_3 V_t + \beta_4 D + \varepsilon_{2t} \quad (2)$$

where X_t denotes the natural logarithm of Indonesia's export volume to the US, M_t is the natural logarithm of Indonesia's import volume from the US, Y_t^{USA} is the natural logarithm of real US GDP used as an indicator of income effect for Indonesia's exports demand to the US, Y_t^{local} is the natural logarithm of real domestic GDP, RER_t is the natural logarithm of real exchange rate, denoting the relative price of import and export goods, served as an indicator of competitiveness. V_t measures the real exchange rate volatility (the Indonesian Rupiah against the US Dollar). Lastly, D is the dummy variable of the economic and political crisis, where D is equal to 1 after the crisis period in 1998 and 0 otherwise.

According to the international trade theory, the expected signs of α_1 and β_1 are positive because an increase in the real income of foreign country (domestic country) will lead to the increase of the volume of export (import) and vice versa. The expected signs of α_2 and β_2 are positive and negative, respectively. The depreciation (appreciation) in real exchange rate will cause the domestic goods cheaper and more competitive (less competitive) than foreign goods in the foreign markets, so the exports are expected to increase (decrease) and the imports will decrease (increase). The impacts of exchange rate volatility on both exports and imports equations are unclear. Hence, the signs of α_3 and β_3 can be either negative or positive.

To test the long run relationship between variables of interest in equations (1) and (2), this paper uses the ARDL bounds testing approach for cointegration proposed by Pesaran, Shin and Smith (2001). Sekantsi (2011), Siregar and Rajan (2004), Bahmani and Xu (2010) and Srinivasan and Kalaivani (2012) argue that ARDL bounds testing is better than Engle-Granger approach and Johansen cointegration test since it does not require pre-testing of unit root for those variables of interest. Notably the ARDL bounds testing approach allows for the testing of the existence of level relationship regardless whether the regressors are I(0), I(1) or mutually cointegrated (Pesaran, Shin and Smith,1999).

The conditional error correction model of equations (1) and (2) can be written as follows:

$$\Delta X_t = c_0 + c_1 t + \pi_1 X_{t-1} + \pi_2 Y^{USA}{}_{t-1} + \pi_3 RER_{t-1} + \pi_4 V_{t-1} + \pi_5 D + \sum_{i=1}^{p} \alpha_i \Delta X_{t-i} + + \sum_{j=1}^{q} \beta_j \Delta Y^{USA}{}_{t-j} + \sum_{k=1}^{q} \delta_k \Delta RER_{t-k} + + \sum_{r=1}^{q} \varphi_r \Delta V_{t-r} + \varepsilon_{1t} \quad (3)$$

$$\Delta M_t = c_0 + c_1 t + \pi_1 M_{t-1} + \pi_2 Y^{local}{}_{t-1} + \pi_3 RER_{t-1} + \pi_4 V_{t-1} + \pi_5 D + \sum_{i=1}^{p} \gamma_i \Delta M_{t-i} + \sum_{j=1}^{q} \rho_j \Delta Y^{local}{}_{t-j} + \sum_{k=1}^{q} \tau_k \Delta RER_{t-k} + \sum_{r=1}^{q} \vartheta_r \Delta V_{t-r} + \varepsilon_{2t} \quad (4)$$

Where c_0 and t are the intercepts and trends while the other variables are as previously defined in equations (1) and (2).

The first step of the ARDL bounds testing approach is to estimate equations (3) and (4) and statistically test the null hypothesis $H_0: \pi_1 = \pi_2 = \pi_3 = \pi_4 = \pi_5 = 0$ against the alternative hypothesis $H_1: \pi_1 \neq \pi_2 \neq \pi_3 \neq \pi_4 \neq \pi_5 \neq 0$. If the F-statistic value falls below the critical value of the lower bound, the null hypothesis of no co-integration can not be rejected. Simply put, there is no long run relationship between variables of interest. But if the F-statistic is larger than the critical value of the upper bound, it can be concluded that there exists a long run relationship between the variables of interest. However, if the F-statistic lies between the bounds, inference is inconclusive. The further investigation of the order of integration before making a conclusion is required.

In the second step, once long run relationship is established, the conditional ARDL (p, q_1, q_2, q_3) long-run model for X_t and (r, s_1, s_2, s_3) long-run model for M_t, i.e. equations (5) and (6).

$$X_t = c_0 + c_1 t + \sum_{i=1}^{p} \delta_1 X_{t-i} + \sum_{i=0}^{q_1} \delta_2 Y^{USA}{}_{t-i} + \sum_{i=0}^{q_2} \delta_3 RER_{t-i} + \sum_{i=0}^{q_3} \delta_4 V_{t-i} + \varphi_5 D + \varepsilon_{1t} \quad (5)$$

$$M_t = c_0 + c_1 t + \sum_{i=1}^{r} \gamma_1 M_{t-i} + \sum_{i=0}^{s_1} \gamma_2 Y^{local}{}_{t-i} + \sum_{i=0}^{s_2} \gamma_3 RER_{t-i} + \sum_{i=0}^{s_3} \gamma_4 V_{t-i} + \emptyset_5 D + \varepsilon_{2t} \quad (6)$$

This paper uses Schwarz's Bayesian Criterion (SBC) to determine the orders of ARDL (p, q_1, q_2, q_3) and ARDL (r, s_1, s_2, s_3). In the third step, the short run relationship between variables of interest is obtained by estimating an error correction model associated with the long-run estimates that are defined as:

$$\Delta X_t = \mu + \sigma t + \sum_{i=1}^{p} \alpha_i \Delta X_{t-i} + \sum_{j=0}^{q_1} \beta_j \Delta Y^{USA}{}_{t-j} + \sum_{k=0}^{q_2} \delta_k \Delta RER_{t-k} + \sum_{r=0}^{q_3} \varphi_r \Delta V_{t-r} + \pi_5 D + \omega ecm_{t-1} + \varepsilon_{1t} \quad (7)$$

$$\Delta M_t = \mu + \sigma t + \sum_{i=1}^{p} \gamma_i \Delta M_{t-i} + \sum_{j=0}^{s_1} \rho_j \Delta Y^{local}{}_{t-j} + \sum_{k=0}^{s_2} \tau_k \Delta RER_{t-k} + \sum_{r=0}^{s_3} \vartheta_r \Delta V_{t-r} + \pi_5 D + \omega ecm_{t-1} + \varepsilon_{2t} \quad (8)$$

where α, β, δ and φ describe the short run relationship between Indonesia's exports performance in equation (1), while γ, ρ, τ and ϑ describe the short run relationship between variables of interest in equation (2) and ω are the speed of adjustment (Fosu and Magnus, 2006). Definitions of some variables used in this study will be explained below:

<u>real exchange rate</u>

The real exchange rate of the Indonesian Rupiah against the US Dollar

is calculated based on the following equation:

$$RER = NER \times \frac{CPI^{USA}}{CPI^{IDN}} \quad (9)$$

Where CPI^{USA} and CPI^{IDN} are the Consumer Price Index of the US and Indonesia respectively, and NER is the nominal exchange rate of the Indonesian Rupiah against the US Dollar.

Volatility of Exchange Rate

This research paper uses two methods in measuring real exchange rate volatility, i.e., the ARCH model and MASD. For the MASD measure, real exchange rate volatility is calculated based on equation (10).

$$V_t = \left[\frac{1}{m}\sum_{i=1}^{m}(\ln RER_{t+i-1} - \ln RER_{t+i-2})^2\right]^{1/2} \quad (10)$$

where m=7 is the order of moving average following Arize et al. (2003). Estimation of RER volatility also has been utilized using different value with m=4, the estimates show the same sign irrespective of the m value. This measure of real exchange rate volatility using MASD methods is similar to other previous studies for example Chowdhury (1993), Arize (1998), Arize et al. (2000), Siregar and Rajan (2004) and Altintas, Cetin and Öz (2011).

The other measure of real exchange rate volatility is estimated by the ARCH model. The ARCH model is first introduced by Engle (1982) and was widely used to model and predict the conditional variance. The ARCH model allows the variance varying over time. Equations (11) and (12) are the simplest ARCH (1) model.

$$\Delta RER_t = \theta_0 + \theta_1 \Delta RER_{t-1} + u_t$$

$$u_t \sim N(0, {\sigma_t}^2) \quad (11)$$

$${\sigma_t}^2 = \lambda_o + \lambda_1 {u^2}_{t-1} \quad (12)$$

Where ${\sigma_t}^2$ is the conditional variance of the natural logarithm of real exchange rate that will be used as a measure of exchange rate volatility, λ_o and λ_1 are the interest parameters to be estimated in the model. The values of λ_o and λ_1 are expected to be positive, the positive signs of λ_o and λ_1 are the sufficient condition in ARCH models.

Data

This study uses secondary data obtained from various sources such as the Center for Trade Data and Information of the Indonesia's Ministry of Trade, Statistics Indonesia (BPS) and the International Financial Statistics of the International Monetary Fund (IMF). The data consist of total volume of Indonesia's exports to and imports from the US, US real GDP, Indonesia's real GDP, real exchange rate (the Indonesian Rupiah against the US Dollar) and real exchange rate volatility. The data are quarterly data from Q1 of 1990 until Q3 of 2012.The volume of Indonesia's exports and imports are obtained from the Center for Trade Data and Information of the Indonesia's Ministry of Trade. Real Exchange rate (the Indonesian Rupiah against the US Dollar) and the Indonesia's real GDP are obtained from Statistics Indonesia, while the US real GDP data are obtained from International Financial Statistics of the IMF.

RESULTS AND DISCUSSION

To estimate the long run relationship between Indonesia–US bilateral trade performance (exports and imports) and its determining factors, including real exchange rate volatility, the measurements of real exchange rate

volatility using the two methods described above are required to be utilized.

Measuring Exchange Rate volatility (ARCH Model)

Before applying the ARCH model, the existence of variance clustering needs to be ensured. This paper uses Lagrange Multiplier-ARCH (LM-ARCHtest) to test if there exists the variance disturbance under the null hypothesis $H_0: \lambda_i = 0$; where $i = 1,2, \ldots q$ against the alternative hypothesis H_1: there exist at least one ($\lambda_i > 0$)/ ARCH(p) disturbance.By using the LM test, the statistical test results were presented in Table 1 below.

Table1. LM Test for Autoregressive Conditional Heteroskedasticity (ARCH)

lags(p)	Chi-square	Df	Prob
1	23.353	1	0.0000

Table 1 shows that the null hypothesis can be rejected at 5% significance level, meaning that variance clustering (or ARCH effect) is found. Accordingly, this paper uses the ARCH model stated in equations (11) and (12) to model the variance of the real exchange rate.

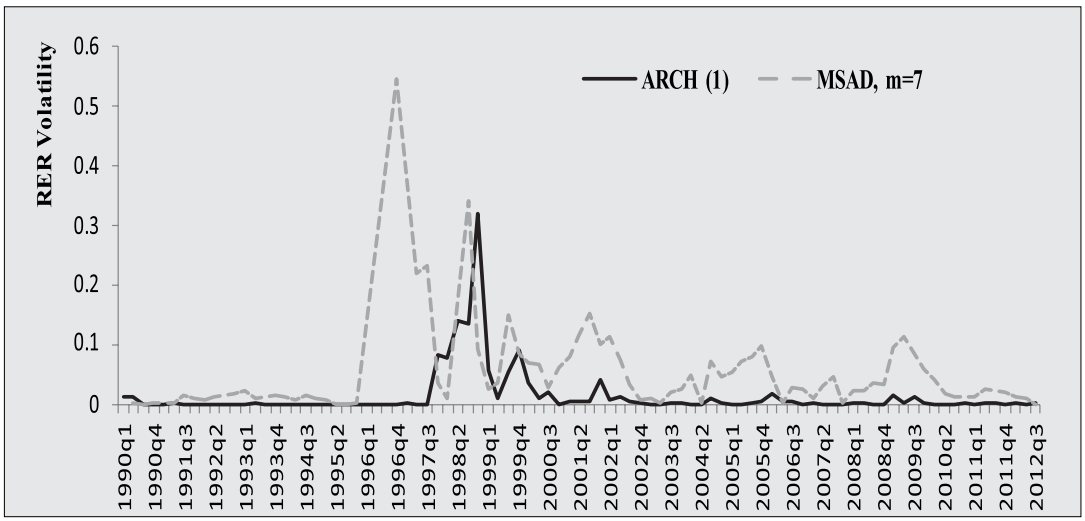
Table 2 provides the estimated coefficients for the ARCH (1) model. Estimating exchange rate volatility has been conducted using higher order of ARCH and GARCH model. After checking the significance of parameters and the behavior of the residuals, ARCH (1) is the best model to forecast variance of real exchange rate (Rupiah against USD) among those competing models.

Table 2. Estimates of Parameters for ARCH (1) Model

	OPG			
RER	**Coef.**	**Std. Err.**	**Z**	**P>|z|**
$\hat{\theta}_0$	- 0.013	0.009	-1.47	0.141
$\hat{\theta}_1$	0.156	0.071	2.21	0.027
ARCH				
$\hat{\lambda}_1$	0.991	0.418	2.37	0.018
$\hat{\lambda}_0$	0.002	0.000	9.07	0.000

*Note: OPG stands for Outer Product of the Gradient

Table 2 confirms that ARCH terms, i.e., $\hat{\lambda}_0$ and $\hat{\lambda}_1$, are significant at 5% significance level. The coefficient (λ_1) approximately equals to 1. However, this process is still considered to be a stationary process.



Graph 2. RER Volatility (the Indonesian Rupiah against the US Dollar)

Graph 2 depicts the real exchange rate volatility of the Indonesian Rupiah against the US Dollar measured by ARCH (1) model and MASD methods in equation (10). It implies that during 1997-1999, when the financial crisis just started, Indonesia suffered very high volatility of real exchange rate against the US Dollar.

Cointegration Test Results

In this section, the relationship between Indonesia's trade performance and its determining factors, including real exchange rate volatility, is examined. Although, the ARDL bounds testing approach does not require pre-testing of unit root, this paper still examines the stationarity (unit root test) of the data to convince the compatibility of the methods used.

Table3. Dickey Fuller Unit Roots Test

Variable		ADF test Statistics for test type			Order of Integration
		no drift and no trend	with drift	with drift and trend	
X_t	Level	-5.522	-5.522	-6.156	*I*(0)
M_t	Level	-4.152	-4.152	-5.886	*I*(0)
RER_t	Level	-2.048	-2.048	-1.967	*I*(0)
	1st difference	-7.757	-7.757	-7.739	*I*(1)
Y_t^{USA}	Level	-1.103	-1.103	-0.628	*I*(0)
	1st difference	-8.101	-8.101	-8.100	*I*(1)
Y_t^{local}	Level	-1.440	-1.440	-1.136	*I*(0)
	1st difference	-7.215	-7.215	-7.243	*I*(1)
V_t^{ARCH}	Level	-4.771	-4.771	-4.775	*I*(0)
V_t^{MSAD}	Level	-3.354	-3.354	-3.390	*I*(0)

Note: ADF test at 5% significance level

Table 3 shows that variables of interest, RER_t, Y_t^{USA} and Y_t^{local} are integrated in order 1. However, X_t, M_t, the natural logarithm of real exchange rate volatility, measured by ARCH denoted as V_t^{ARCH}, and the natural logarithm of real exchange rate volatility measured by MASD denoted as V_t^{MSAD} are all stationary.

These results indicate that not all regressors are integrated in order 1. Hence, different orders of integration of variables of interest support the use of the ARDL bounds testing to test the level relationship between dependent variables and regressors in equations (1) and (2).

In the first step of the ARDL bounds testing approach, the F statistical test on the equations (3) and (4) is applied to test the long run relationships among variables of interest. Table 4 provides the test results.

Table 4. F-statistic Test of Long Run Cointegration

Dependent Variable	F-statistic [p-value]		Decision
	V_t^{ARCH}	V_t^{MSAD}	
X_t	5.07 [0.000]	5.04 [0.000]	Reject the null hypothesis
M_t	4.95 [0.000]	4.94 [0.000]	Reject the null hypothesis

Note: F-test at 5% significance level;

$H_0: \pi_1 = \pi_2 = \pi_3 = \pi_4 = \pi_5 = 0$ or $H_1: \pi_1 \neq \pi_2 \neq \pi_3 \neq \pi_4 \neq \pi_5 \neq 0$

The results show that the null hypothesis can be rejected at 5% significance level. In other words, the values of the F-statistic are all larger than the upper bounds critical values (Table 4). Therefore, there exists a long-run bilateral trade relationship between Indonesia-US. The results also suggest that exports and imports demand functions in equations (1) and (2) are well defined and stable in the long run.

Once the long-run relationship are confirmed, the ARDL (p, q_1, q_2, q_3) and ARDL (r, s_1, s_2, s_3) models in equations (5) and (6) are estimated and the estimates on exports (X_t) and imports (M_t) are normalized respectively in order to obtain the long run relationship between variables of interest in equations (1) and (2). The orders of the ARDL are selected based on the SBC. Table 5 presents the long run relationship between Indonesia's exports performance to the US and its regressors (US real GDP, real exchange rate, real exchange rate volatility and dummy variable).

Table 5. Long Run Relationship between Indonesia's Exports to the US and Its Factors

	Regressor	Coeff.	T-Ratio[Prob]
i. ARDL (1,0,0,0)	RER_t	- 0.183	-0.693 [0.491]
	V_t^{ARCH}	0.964	1.076 [0.286]
	Y_t^{USA}	3.849	2.801 [0.007]**
	D	- 0.069	-0.246 [0.806]
	C	- 34.391	-2.190 [0.032]**
	T	- 0.025	-3.538 [0.001]**
ii. ARDL (1,0,0,0)	RER	- 0.119	-0.435 [0.665]
	V_t^{MSAD}	- 0.033	-0.087 [0.931]
	Y_t^{USA}	3.708	2.696 [0.009]**
	D	- 0.029	-0.098 [0.922]
	C	- 33.350	-2.112 [0.038]**
	T	- 0.025	-3.416 [0.001]**

**) significant at 5% significance level; c: constant and t: trends
(i)ARCH (1) model is used to measure RER volatility
(ii) MASD method is used to measure RER volatility

In the long run, almost all the estimated coefficients show expected signs, except the coefficient of the real exchange rate (RER_t). The statistically significant estimates of the US GDP (Y_t^{USA}) coefficients are 3.849 and 3.708 in Table 5 (i) and (ii) respectively. Both values are larger than 1, indicating the income is elastic, and consistent with estimates found in other studies, for the examples Ekanayake (1999), Cosar (2002) and Sekantsi (2011). The real exchange rate shows an unexpected but insignificant negative sign,it may due to the use of quarterly data, i.e. firms may have enough time within a quarter to respond to the change of exchange rate by revising the trading contract.

The real exchange rate volatility measured by the ARCH model has a positive and insignificant effect, while exchange rate volatility measured by MASD method bears a negative insignificant impact on Indonesia's export to US. Meanwhile the dummy variable is insignificant which means that in the long run, the economic and political crisis in 1998 does not fundamentally change the trade relationship between Indonesia and the US.

Table 6 presents the short run relationship between Indonesia's exports to the US and its regressors. The results of short run relationship are obtained from the Error Correction Model (ECM) equation (7).

Table 6. Short Run Relationship between Indonesia's Exports to the US and Its Factors

	Regressor	Coeff.	T-Ratio [Prob]
i. ARDL (1,0,0,0)	ΔRER_t	-0.137	-0.675 [0.502]
	ΔV_t^{ARCH}	0.721	1.036 [0.304]
	ΔY_t^{USA}	2.880	2.569 [0.012]**
	C	-25.729	-2.096 [0.040]**
	T	-0.019	-3.054 [0.003]**
	D	-0.051	-0.247 [0.806]
	ecm(-1)	-0.748	-6.007 [0.000]**
ii. ARDL (1,0,0,0)	ΔRER_t	-0.089	-0.431 [0.668]
	ΔV_t^{MSAD}	-0.025	-0.087 [0.931]
	ΔY_t^{USA}	2.780	2.518 [0.014]**
	C	-25.004	-2.039 [0.045]**
	T	-0.018	-3.021 [0.003]**
	D	-0.021	-0.099 [0.922]
	ecm(-1)	-0.750	-6.330 [0.000]**

**) significant at 5% significance level; c: constant; t: trends
(i) ARCH (1) model is used to measure RER volatility;
(ii) MASD method is used to measure RER volatility

In the short run, the US GDP significantly affects the Indonesia's exports performance to the US. Notably, as US GDP increases, the export from Indonesia to the US tend to increase as well. Furthermore, Tables 5 and 6 imply

that Indonesia's aggregate export is elastic to the US GDP in both the short and long runs.

Nevertheless, the real exchange rate and real exchange rate volatility are both insignificant at any conventional significance levels. Interestingly, these results suggest that Indonesia's exported goods to US are price inelastic. The estimated coefficient of equilibrium correction is about -0.75, showing a quick speed of adjustment to the equilibrium after a shock, i.e. 75% of the errors from last period will be corrected. The long run relationship between Indonesia's imports from the US and its factors (the Indonesia's GDP, real exchange rate, exchange rate volatility and dummy variable) are reported in Table 7.

Table7. Long Run Relationship between Indonesia's Imports from the US and Its Factors

	Regressor	Coeff.	T-Ratio [Prob]
i.ARDL (1,0,0,1)	RER_t	1.022	1.976 [0.052]*
	V_t^{ARCH}	- 1.701	-1.802 [0.076]*
	Y_t^{local}	0.601	1.918 [0.059]*
	C	- 6.828	-1.039 [0.302]
	T	0.009	2.114 [0.038]**
	D	0.009	0.031 [0.976]
ii.ARDL (1,1,0,1)	RER_t	1.086	1.932 [0.057]*
	V_t^{MASD}	- 0.205	-0.489 [0.627]
	Y_t^{local}	0.478	1.457 [0.149]
	C	- 6.515	-0.928 [0.356]
	T	0.012	2.822 [0.006]**
	D	- 0.283	-0.886 [0.379]

**) significant at 5% significance level; *) significant at 10% significance level;
c: constant and t: trends
(i) ARCH (1) model is used to measure RER volatility
(ii) MASD method is used to measure RER volatility

Table 7 shows that almost all of the estimated coefficients show expected signs, except the real exchange rate (RER_t). The relative price of imported goods, approximated by the real exchange rate, shows a positive and significance effect on Indonesia's imports performance from the US. This result is quite surprising because the sign of the coefficient is expected to be negative. This may be explained by the fact that the majority of Indonesia's imports from the US are capital and highly technological goods and military equipments, for example aircraft, spacecraft, machinery, nuclear reactors and miscellaneous chemical products, making it difficult for Indonesia to find the substitutes for the US.

The Indonesia's GDP has a positive and significant effect on import performance in Table 7(i) at 10% significance level but shows insignificant effect when using the MASD method

to measure the exchange rate volatility in Table 8 (ii).The real exchange rate volatility measured by the ARCH (1) model has a negative and significant effect at 10% significance level, while exchange rate volatility measured by the MASD also shows adverse effect but fail to exhibit significant impact on Indonesia's imports performance from the US.This finding shows the same resultas Zhang and Kinnucan (2014) who revealed that exchange rate volatility could reduce the imports.

Table 8 presents the short run relationship between Indonesia's imports performance from the US and its regressors. The results of short run relationship are obtained from the ECM equation (8).

Table 8. Short run Relationship between Indonesia's Imports from the US and Its Regressors

	Regressor	Coeff.	T-Ratio[Prob]
i. ARDL (1,0,0,1)	ΔRER_t	0.657	1.940 [0.056]*
	ΔV_t^{ARCH}	-1.093	-1.800 [0.076]*
	ΔY_t^{local}	1.042	2.564 [0.012]**
	C	-4.389	-1.036 [0.304]
	T	0.006	2.048 [0.044]**
	D	0.006	0.031 [0.976]
	ecm(-1)	-0.643	-6.361 [0.000]**
ii. ARDL (1,1,0,1)	ΔRER_t	1.773	2.779 [0.007]**
	ΔV_t^{MSAD}	-0.134	-0.492 [0.624]
	ΔY_t^{local}	1.870	3.226 [0.002]**
	C	-4.268	-0.933 [0.354]
	T	0.008	2.756 [0.007]**
	D	-0.186	-0.904 [0.369]
	ecm(-1)	-0.655	-6.341 [0.000]**

**) significant at 5% significance level; *); significant at 10% significance level; c: constant and t: trends
(i) ARCH (1) model is used to measure RER volatility
(ii) MASD method is used to measure RER volatility

Table 8 implies that in the short run, the real exchange rate, real exchange rate volatility measured by the ARCH (1) model and Indonesia GDP play important role in determining Indonesia's imports performance from the US, although the sign of the coefficient of the real exchange rate shows unexpected sign. The results given in Tables 7 and 8 imply that Indonesia's imports demand from the US is income elastic in both the short and long runs. A 1% increase in Indonesia GDP leads to more than 1% increase in Indonesia's volume of imports from the US.

The real exchange rate volatility measured by the ARCH (1) model shows a negative and significant effect at 10% significance level on imports performance in the short and long runs. These outcomes suggest that high volatility in real exchange rate will cause contraction on Indonesia's imports from the US. The estimated coefficient of

equilibrium correction (ECM) exhibits significant and a quick speed of adjustment to the equilibrium.

CONCLUSION AND POLICY RECOMMENDATION

This study shows that the real exchange rate volatility reveals adverse impact on Indonesia's imports from the US, but does not have a significant impact on Indonesia's export to US. This result shows that Indonesia's exports to the US are inelastic to the real exchange rate volatility while Indonesia's imports from the US are elastic to real exchange rate volatility. This is due to the fact that Indonesian exported goods to the US are dominated by primary products. These findings suggest that the negative impact of exchange rate volatility on Indonesia's import from the US could be considered as an important tool in managing the excessive imports from the US. However, on the other side the import performance is directly correlated with the export since Indonesia's manufactured products or domestic industries are highly dependent on the imported raw materials. Hence, the imports performance positively impacts the exports. If Indonesia attempts to decrease the deficit of trade balance, the government should focus on increasing export rather than decreasing import. Therefore, Indonesia should preserve adhering free floating exchange rate and minimise excessive rate volatility to maintain the foreign trade perfomance.

ACKNOWLEDGEMENT

The author would like to express deepest gratitude to Assistant Professor Wang Wei Siang and Professor Dr. Ir. Dewa Ketut Sadra Swastika who were abundantly helpful and offered invaluable assistance for this article.

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