



Exchange Rate Volatility in Indonesia During the Covid-19 Pandemic

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Abstract. Exchange rate volatility is an essential indicator of macroeconomics and the key variable of international trade. The COVID-19 pandemic has seriously impacted all economies, including Indonesia. This study reviewed the effect of exchange rate volatility on the bilateral trade performance of Indonesia-United States using data from 2001:Q1 to 2022:Q2. This study employed *Autoregressive Conditional Heteroskedasticity* (ARCH) to measure exchange rate volatility.

Meanwhile, the Autoregressive Distributed Lag-Error Correction Model (ARDL-ECM) was used to test the study variables' long- and short-term relationships. The analysis shows that real exchange rate volatility did not affect Indonesian export volume. Therefore, if Indonesia wishes to maintain the trade balance, it is recommended to keep a developed and controlled exchange rate policy.

Keywords: ARCH model · ARDL-ECM · Exchange rate volatility

1 Introduction

Exchange rate volatility is a critical issue continuously studied and criticized by economists and regulators, given its extensive effects on economic growth, international trade, and the security stability of a nation (Yunusa, 2020). The exchange rate is a reference of global economic activities to maintain the strength of the supply and demand rate. Liming, Ziqing, & Zhihao (2020) emphasized the effect of dynamic economic policies that might cause drastic exchange rate movements. Furthermore, active economic policies can be asymmetric. Thuy & Thuy (2018) mentioned that exchange rate volatility is a risk in exchange rate change, where the exchange rate volatility movement can be high, low, and stable. Khalighi & Fadaei (2017) stated that exchange rate volatility directly affects export since export is a prosperity indicator of a nation. Export plays a vital role in developed and developing countries. Several predecessor studies, such as Arize, Osang, & Slottje (2000) and Demez & Ustaoğlu (2012), discovered that exchange rate volatility could positively and negatively affect export performance.

The exchange rate standard determination history in Indonesia continues to experience adjustments according to domestic and global economic conditions. The global economy has started recovering from recession due to the COVID-19 pandemic. Indonesia was also affected by its macro and microeconomics. Bank of Indonesia (2020)

asserted that global economic performance increases following policy stimuli, particularly from the United States and China as countries of Indonesia's main export destination. In the national financial condition recovery, the Bank of Indonesia issues a combination of monetary and fiscal stimulus policies adjusted to the inflation decrease and the importance of maintaining Rupiah exchange rate stability.

This paper differs from previous studies, covering an empirical study of Indonesia and the United States trade. The study also employed the COVID-19 pandemic that causes uncertainty, where exchange rate volatility highly depends on the macroeconomic factor that fluctuates during the pandemic. This research has three objectives: First, it analyzes the volatility of the rupiah exchange rate as a soft currency that is reluctant to global economic shock, particularly due to the COVID-19 pandemic. Second, it aims to understand the phenomenon of exchange rate volatility to obtain the optimal policy for economic recovery during the COVID-19 pandemic. Third, it seeks to understand and anticipate exchange rate fluctuations which can harm the balance of trade, especially export volume, because exports are a major source of income for the country. This paper provides two primary contributions. First, examine the effect of exchange rate volatility on the export performance of Indonesia to the United States during the ongoing COVID-19 pandemic. The United States is the main export destination in Indonesia. During the COVID-19 pandemic, the Indonesian economy experienced delays; however, it could persist as an emerging market. The COVID-19 pandemic caused international trade disruption, both from the supply and demand aspects among countries worldwide. Second, this paper used the ARDL-ECM econometric approach to estimate long-term and short-term variables. From this explanation, the primary purpose of this study was to analyze the effect of volatility on export performance during the COVID-19 pandemic to observe the magnitude of the impact and implications on macroeconomic policies.

2 Literature Review

Goldstein & Khan (1985) provided an alternative for the incomplete substitution of two countries by assuming that export products and goods produced overseas cannot be replaced perfectly. The export size of a country is determined by the foreign trading partner's income, export price, and exchange rate. In such a condition, importers encounter uncertainty and relatively high exchange rate volatility risks. Therefore, export is highly determined by the exchange rate. The function is as follows:

$$ex_i = f(y^*, ep_i, fx, fxvol)$$

ex_i = export quantity, y^* = trading partner income, ep_i = price of export commodity i , fx = exchange rate, $fxvol$ = exchange rate volatility. Therefore, it can be formulated as follows:

$$ex_{it} = X_{it} \beta + \xi_{it}$$

ex_{it} = export commodity column vector i period t , X_{it} = matrix of independent variable exports of product i period t , ξ_{it} = disturbance variable.

Exchange rate volatility affects international market prices. It also affects the domestic market mechanism and institutional. It highly affects the export-import flow (Ma,

Wang, and Sun, 2018). According to De Grauwe (1998), there is an ambiguous relationship between exchange rate volatility and trade flow. This theory illustrates that companies can sell products at predetermined prices in domestic and international markets, giving an exchange rate risk. However, the exchange rate volatility risk increases revenue margin, supporting the company's productivity. De Grauwe (1998) also developed a simple export supply model, showing that increasing exchange rate risk can reduce prosperity.

In several precedent studies, there are pros and contras of exchange rate volatility's effect on the export volume. Yunusa (2020) stated that hedging absence would exacerbate the exchange rate volatility risk since there will be no economic condition projection in the future. In the long term, volatility can reduce international trade profit and increase transaction costs. Hooper and Steven (1978) argued that the higher the exchange rate volatility, the higher the price and the lower the international trade volume and profit. Exporters avoid this risk due to international trade and potential profit uncertainties. Relatively high exchange rate volatility increases trade profit potential. The assumption is that companies can select which market to be entered with adequate information on exchange rate volatility.

Agiomirgianakis, Serenis, & Tsounis (2015) used the ARDL method to test the effect of exchange rate volatility on tourist visits to Iceland. It revealed that exchange rate volatility caused a decrease in the number of tourist visits. Demez & Ustaoglu (2012) reviewed the effect of exchange rate volatility on Turkish export performance from 1992–2010, showing no impact of an exchange rate change or volatility on Turkish international trade. Ma, Wang, and Sun (2018) analyzed exchange rate volatility in Central Asia based on the VAR spillover index. It discovered that economic and political policy changes could affect the exchange rate movement. Senadza & Diaba (2017) studied the effect of exchange rate volatility on the export and import of Sub Sahara Africa member countries from 1993–2014. The findings showed no effect of exchange rate volatility on imports. However, it negatively affects the export in the short term and positively affects a long time.

Serenis and Tsounis (2021) analyze the effect of exchange rate volatility on Germany, England, and Swedish exports from 1973–2010. The results demonstrated that exchange rate volatility negatively affected export. Thuy & Thuy (2018) studied the effect of exchange rate volatility on Vietnamese export from 2000–2014 with the ARDL method, discovering a negative impact of exchange rate volatility on export volume in the long term in Vietnam. A study by Yunusa (2020) reviewed the effect of exchange rate volatility on Nigerian raw oil export to trade partners (England, the US, Italy, France, Spain, Canada, and Brazil) from 2006 to 2019. The GARCH method measured the volatility, and the study employed the ARDL method. The finding was that exchange rate volatility significantly affected oil export with different magnitudes in each destination country.

3 Method

Our study was motivated by two main reasons. The first reason is a review of volatility's effect on export performance during the COVID-19 pandemic to observe the magnitude of the impact and implications on macroeconomic policies. Secondly, the paper

was motivated by the severe and unique effects of the ongoing COVID-19 outbreak on international trade and capital flows, which might change the exchange rate structure and challenge prior research findings.

The study's primary purpose was to estimate and analyze the effect of exchange rate volatility on Indonesian export performance from 2001:Q1 – 2022:Q2. Study data were obtained from the International Monetary Fund. The dependent variable was export volume, while the regressors included national income, IDR-USD exchange rate, and exchange rate volatility of Rupiah to US Dollar. The study model is a development of previous studies by Ardiyanti (2015), Senadza & Diaba (2017), and Thuy & Thuy (2018):

$$\ln X_t = \lambda_0 + \lambda_1 \ln Y_t^f + \lambda_2 \ln P_t + \lambda_3 \ln V_t + \mu_t.$$

X_t is the export volume in period t ; Y_t^f is the nominal value of economic activity in period t ; P_t is the exchange rate in period t ; V_t exchange rate volatility and μ_t is the disturbance variable. High national income tends to increase international trade transactions. An increase in the currency (nominal exchange rate) can also increase exports due to the normative price effect. Thus, it is expected that hypotheses λ_1 and $\lambda_2 > 0$ and $\lambda_3 < 0$ or > 0 .

The study utilized the ARDL-ECM (*Autoregressive Distributed - Lag Error Correction Model*) method developed by Pesaran & Shin (1995) to observe the effect of Rupiah exchange rate volatility on five main destination countries. This model was used as follows based on Pesaran, Shin, & Smith (2001):

$$\Delta \ln X_t = \lambda_0 + \lambda_1 \ln Y_t^f + \lambda_2 \ln P_t + \lambda_3 \ln V_t + \sum_{i=1}^n b_i \Delta Y_{t-1} + \sum_{i=1}^n c_i \Delta P_{t-1} + \sum_{i=1}^n d_i \Delta V_{t-1} + \mu_t$$

Coefficients $\beta_1, \beta_2, \beta_3,$ and β_4 show long-term relationships. Hypothesis H_0 shows no cointegration relationship between exchange rate volatility and export, while H_1 shows a cointegration relationship between variables in the study model. The subsequent step was testing the short-term coefficients using the *error correction model* (ECM):

$$\Delta \ln X_t = \lambda_0 + \sum_{i=1}^n \gamma_{1i} \Delta Y_{t-1} + \sum_{i=1}^n \gamma_{2i} \Delta P_{t-1} + \sum_{i=1}^n \gamma_{3i} \Delta V_{t-1} + \gamma_4 ECT_{t-1} + \mu_t$$

Exchange rate volatility in this study employed the ARCH-GARCH method as applied in precedent studies (Table 1). The variable operational description used in this study is presented in Table 2.

4 Result and Discussion

The first testing step was conducting the data stationarity test. The stationarity test results are presented in Table 3.

Based on the data stationarity test results, all variables were stationary on the first difference level. The next step was selecting the best ARDL order. The chosen model is presented in Table 4.

Table 1. Exchange Rate Volatility Calculation

No.	Exchange Rate Volatility Calculation	Author
1.	The average absolute difference (over 13 weeks) between the previous forward and the current spot rate.	Hooper and Kohlhagen (1978)
2.	Gini means differentiation (non-parametric).	Rana (1981)
3.	Real exchange rate standard deviation $V_t =$ $[\frac{1}{m} \sum_{i=1}^m (ER_{t+i-1} - ER_{t+i-2})]^{i-2}$	IMF (1984), Kenen and Rodrik (1986), Bailey, Tavlas, and Ulan (1987), Cushman (1988), Koray and Lastrapes (1989), Lastrapes and Koray (1990), Klein (1990), Bini-Smaghi (1991), Chowdhury (1993), Daly (1998), Wei (1998), Aristotelous (2001)
4.	Autoregressive Integrated Moving Average (ARIMA) model.	Asseery and Peel (1991)
5.	Autoregressive Conditional Heteroskedasticity (ARCH) models	Kroner and Lastrapes (1993), Caporale and Doroodian (1994), Mckenzie and Brooks (1997), Mckenzie (1998), and Chou (2000).

Source: Siregar and Rajan, 2002

Table 2. Variable Operational Description

Variables	Description	Mean	Minimum	Maximum
Export volume	Exports of Goods and Services, Real, Seasonally Adjusted, Domestic Currency	19.812	19.088	20.435
GDP	Gross Domestic Product, Real, Seasonally Adjusted, Domestic Currency	21.321	20.785	21.793
Exchange rate	Domestic Currency per US Dollar, End of Period	9.304	9.022	9.703
Exchange rate volatility	Rupiah volatility against the USD Dollar using the ARCH-GARCH method	4639.530	1207.473	7546.576

Source: IMF, 2022

Table 3. Variable Stationarity

Variable	Augmented Dickey-Fuller (ADF) test		
	Level		1st difference
	Intercept	Intercept and Trend	Intercept
Export	-0.535	-7.530***	-7.530***
GDP	-1.238	-0.957	-9.088***
Exc. Rate	-0.772	-3.712**	-10.764***
Exc. Rate	-0.772	-3.712**	-10.764***

Source: Author's calculation

Table 4. ARDL Model Estimates (1, 3, 2, 0)

Variables	Coefficient	Std. Error	t-Statistic
LX(-1)	0.790	0.047	16.71***
LY	2.037	0.318	6.400***
LY(-1)	-1.726	0.413	-4.180***
LY(-2)	0.126	0.393	0.322
LY(-3)	-0.817	0.308	-2.649***
LKURS	-0.062	0.063	-0.978
LP(-1)	0.069	0.0863	0.798
LP(-2)	-0.123	0.068476	-1.804*
V	0.000	2.310	5.282***
C	12.718	2.606	4.878***
Adjusted R-squared	0.994	F-statistic	1636.772***

Source: Author's calculation

Export lag affected export during the study period. GDP and GDP lag significantly affected Indonesian export volume, while the exchange rate had an insignificant effect. The main thing from this ARDL model finding was that exchange rate lag and volatility significantly affected export volume. The Adj. The R^2 value was high, indicating a combination of all independent variables on export. The Bound test was used to discover the cointegration level among variables. Table 5 shows that F -stat values were over $I(0)$ and $I(1)$. Hence, all variables were co-integrated.

The long-term analysis is presented in Table 6. GDP negatively affected export. It shows that Indonesia must export activities without being affected by national income. The Rupiah exchange rate also had a negative effect. It indicates that Rupiah needs to be a stronger currency with high competitiveness. Volatility positively impacted the long term, where such a condition must be considered to apply the Rupiah strengthening policy formulation. For the short-term analysis, GDP was the only one with a significant

Table 5. Bound Testing

Test Statistic	Value	Sig.	I(0)	I(1)
F-Statistic	8.317531	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Source: Author's calculation

Table 6. Long-Term Estimates

Variable	Coefficient	Std. Error	t-Statistic
LY	-1.807	0.884	-2.043**
LP	-0.556	0.156	-3.542***
V	0.000	0.000	3.761***
C	60.647	17.75	3.416***

Source: Author's calculation

effect on export. However, the error correction probability was significant on alpha 5% and negative coefficients. Therefore, the ECM model used is valid for the estimators. The final step was the robust model test using Cusum and Cusum-Q tests in Fig. 1.

Hung, Nguyen, and Vo (2022) asserted that the COVID-19 pandemic has greatly affected exchange rate volatility across countries. Their findings demonstrated a strong influence of volatility on macroeconomic stability, especially in financial markets. Therefore, policies from investors, business people, and the government are urgently needed to maintain exchange rate stability. Current conditions are similar to van Horen et al. (2006) findings, which found the effect of the 1997–1998 crisis on exchange rate shocks. Similar results were also discovered by Shahrier (2022) that the COVID-19 pandemic caused financial market imbalances in ASEAN-5. Indonesia, Malaysia, and Singapore experienced the highest volatility, while the Philippines faced mild short-term volatility without long-term fluctuations. Thailand also faced mild short-term volatility and long-term high volatility.

The estimation results of this research indicate a strong influence of volatility on long-term Indonesian exports. However, volatility does not affect exports in the short term.

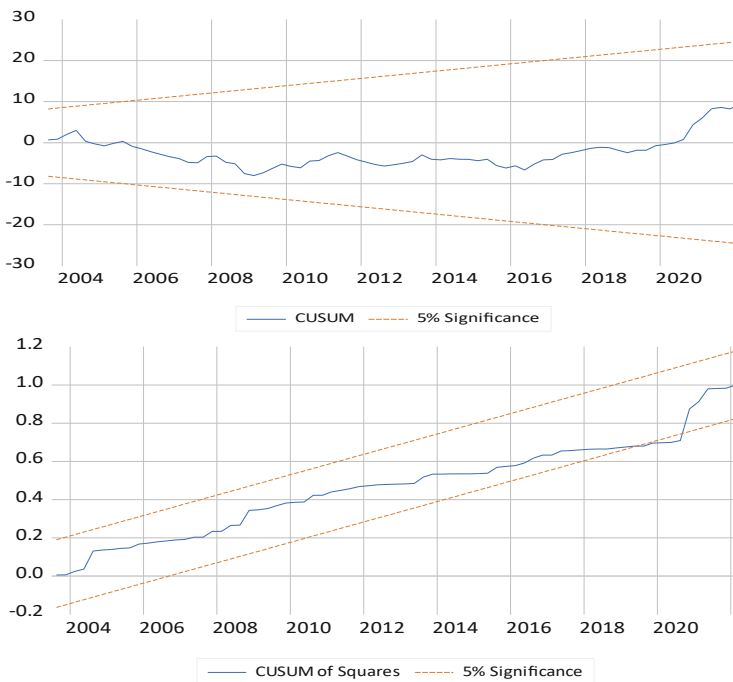
These results are related to volatility affecting Turkish exports significantly. In volatility, there is the possibility of asymmetric information, then low volatility caused Turkish exports to increase, but high volatility caused Turkish exports to decrease. According to Senadza and Diaba (2018), volatility harms international trade, as found in Sub-Saharan Africa, where volatility hurts exports in the short term but has a positive impact in a long time. Ardiyanti (2015) mentioned the vital role of the exchange rate in Indonesian trade, which demonstrates the Indonesian trade position and relates to the demand for export

Table 7. Long-Term Estimates

Variable	Coefficient	Std. Error	t-Statistic
D(LY)	1.942	0.321	6.041***
D(LP)	-0.082	0.071	-1.149
V	-1.650	2.070	-0.079
ECT(-1)	-9.860	3.920	-2.517**
C	-0.005	0.011	-0.494
Adjusted R-squared	0.312		
F-statistic	9.995***		

Source: Author's calculation

goods. Strategic policies are urgently needed to improve Indonesia's trade performance. Thuy and Thuy (2018) estimated that exchange rate volatility harms Vietnamese exports in the long term and has a positive impact in a long time (Table 7).

**Fig. 1.** Cusum and Cusum-Q Robust Tests

5 Conclusion

The main finding of this study is that exchange rate volatility is significantly positive in the long term. However, it does not substantially impact Indonesia's export to the US. This result shows that Indonesia's exports to the US are inelastic to the real exchange rate volatility. At the same time, Indonesia's imports from the US are elastic to the real exchange rate volatility. The recommendation is the importance of monetary and fiscal policy balance to maintain Rupiah stability and remain strong and balanced in international trade, particularly during the COVID-19 pandemic. Structural reforms are needed to improve Indonesia's trade competitiveness and increase cooperation with major trading partners.

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