

Research article

The Effect of Exchange Rate Volatility on Indonesia's Top 5 Export Countries in 2015-2022

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Abstract: Using quarterly panel data, this research examines the effects of the Industrial Production Index (IIP), the Real Effective Exchange Rate (REER), and REER volatility on Indonesia's non-oil and gas exports to its five major trade partners between 2015 and 2022. The findings of panel data regression using the Fixed Effect Model show that exports are significantly positively impacted by both the IIP and the CPI (Consumer Price Index). Nevertheless, REER shows a positive but insignificant effect, while REER volatility negatively impacts exports. It is recommended that Bank Indonesia maintains a free-floating exchange rate system to support international trade stability and growth.

Keywords: Export, Index Industrial Production (IIP), Real Effective Exchange Rate (REER) and Volatility of REER.

INTRODUCTION

Nowadays globalization become stimulation for a country to be open and doing international trade to exchange not only goods and services, but also involve the foreign exchange transaction and become the engine of a country's economic growth. But struggling to revive its economy because of high consumption, Indonesia is once again facing the challenge of a global economic slowdown. According to the World Trade Organization (2023), Indonesia is feeling the impact of the global economic slowdown, as evidenced by a decline in annual exports in the second quarter. Goods trade volumes are expected to slow through 2023 due to weak trade.

Based on data from International Monetary Fund 2022, the Indonesian economy grew by 5.17%, which is actually good news, although it is far from the predicted growth of 17%. However, this is inversely proportional to the status of international trade. The international trade surplus in August 2023 was only \$25 billion, while it may reach a surplus of as high as \$35 billion in 2022. In this regard, the Ministry of Foreign Affairs has made various efforts, especially to develop markets in densely populated areas has huge potential for exports to Indonesia.

Worrisomely, exchange rate swings under a floating exchange rate regime set by market forces to account for a portion of the export reduction by the end of 2023. Lately, the importance of exchange rate movements has increased as misalignment in currencies is considered a source of global imbalances (Auboin & Ruta, 2011). Some of these aspects have the potential to cause uncertainty in the market, volatility of traders' profits, negative enhancement of social economic risk, uncertainty of inflation, and impact on production and transaction costs which traders basically try to reduce risk in the trading system (Obstfeld & Rogoff, 1998; Phan & Juhro, 2018).

According to Sugiharti et al., (2020) the depreciation of Indonesia's real effective exchange rate in 2006-2018 against China (CNY, 34%), America (USD, 5%) and Japan (YEN, 10%) didn't make Indonesia's exports recover in accordance with production theory (Poon et al., 2005). This is due to strong exchange rate hedging by developed countries such as the US, Singapore and Japan, which is able to suppress volatility and ultimately maintain exports, but the opposite happens to developing countries such as the Philippines and China (Nishimura & Hirayama, 2013). In November 2018, the Indonesian government began to adopt a more intensive hedging strategy in an effort to protect exporters amidst the volatility of Rupiah fluctuations. Therefore, this study focuses on exports, as the impact of exchange rate volatility is more significant for developing countries and tends to have less impact on developed countries.

According to De Vita & Abbott (2004), empirical research, Arize et al. (2000) and Asteriou et al. (2016) suggest that exchange rate volatility has a negative influence on exports, whereas Nishimura & Hirayama (2013) show that there is no evidence of this impact. In contrast, findings from other research indicate that a number of factors, including national finances (Aghion et al., 2009), industry (Aftab et al., 2017), importer risk behavior (De Vita & Abbott, 2004), unique occurrences (Fitrianti, 2017), and a number of other characteristics, influence the impact of exports. Not only that, some of these things certainly occur due to differences in phenomena, time, methodological approaches and countries allowing different research results.

Given the strain on the trade balance, an understanding of the effects of exchange rate volatility can help in the explanation of the possible reasons for the sudden drop in exports. Only a small number of studies have examined the connection between Indonesian exports and exchange rate volatility, particularly when comparing industrialized and developing nations (Hall et al., 2010). This analysis differs from others in that it takes into account the pandemic era and the export fall in 2023, which is expected to have a major effect on export outcomes. Furthermore, there are several other variables that may impact Indonesia's export performance, including IIP and REER (Sugiharti et al., 2020).

The difference between our research and previous research can be seen from several empirical studies. First, the object of this research uses 5 countries with the largest non-oil and gas export contribution in Indonesia with complete data availability. Second, the period uses 2015-2022 where there is a pandemic phenomenon which is new and has not been covered in previous studies. Hopefully this studies can help the government to analyze and optimazitation of non-oil and gas export goods in the area or provience in Indonesia.

LITERATURE REVIEW

Trade Volatility

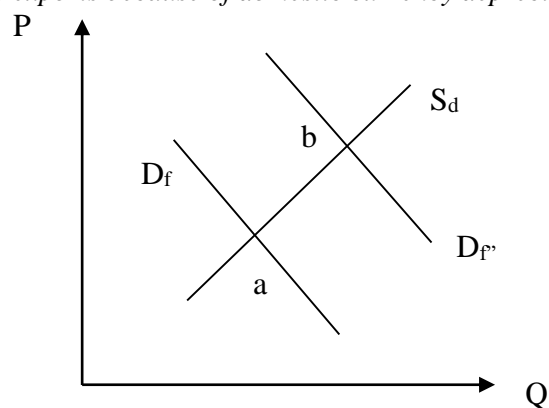
Currency depreciation stimulates the production of import substitutes and export goods, leading to higher domestic prices. As a result of these items' inclusion in the national general price index, this depreciation also causes inflation. Higher inflation results from more substantial depreciation. As domestic prices for import substitutes and export goods rise, production resources shift towards these goods and away from non-tradable commodities produced for domestic consumption. This shift reduces the price benefit gained from depreciation (Samuelson & Nordhaus, 2010). A country's demand and supply elasticity determine how easily it can redirect production resources from non-

tradable domestic goods to import and export substitutes and how much this shift can cause inflation.

Figure 1. illustrates the domestic export market. In this figure, D_f represents foreign demand for domestic exports, and S_d represents the domestic supply of exports, both measured in domestic currency. Initially, equilibrium (a) occurs at the intersection of D_f and S_d . When the domestic currency depreciates, the D_f curve shifts upward to D_f' , making exports cheaper for foreign markets. As a result, demand is increased when the foreign currency's value rises in relation to the home currency. As a result, the economy reaches a new equilibrium (b) where export volume (Q) increases and D_f' overlaps S_d .

Figure 1.

The Impact on domestic exports because of domestic currency depreciation.



Source: (Salvatore, 2013)

Marshall-Lerner Condition

Darwanto (2014) emphasizes that the Marshall-Lerner condition is crucial in the elasticity approach to balancing payments. This condition helps ascertain whether a real devaluation or depreciation will enhance a country's current account balance. It stipulates that the foreign exchange market remains stable if the combined price elasticities of import and export demand are greater than 1, suggesting that a depreciation can rectify a balance of payments deficit (Salvatore, 2013).

To evaluate the foreign currency market's stability, apply the Marshall-Lerner criteria. Given that it is difficult to pinpoint the exact forms of the supply and demand curves in the foreign currency market, evaluating market stability is difficult. However, if the supply curve can be identified, it becomes easier to address current account deficits by devaluing the currency (Salvatore, 2013)

Competitive Advantage

The principle of comparative advantage suggests that countries gain by focusing on producing and exporting goods that they can create at a relatively low cost, and by importing goods that are more costly for them to produce. Ricardo demonstrated that both regions benefit from such specialization. Under free trade, when countries focus on their comparative advantages, each country improves its overall well-being. Workers in each region can obtain more consumer goods for the same amount of work compared to a situation with no trade. The law of comparative advantage not only explains the geographic pattern of specialization and trade but also shows that trade improves countries' welfare and real wages by increasing global production (Samuelson & Nordhaus, 2010; Afrizal, 2021).

Volatility Exchange Rate

The exchange rate represents the value of one currency compared to another currency. It is measured by how much foreign currency can be bought with one unit of domestic currency (Salvatore, 2013). Volatility refers to the fluctuations in exchange rate movements, which are unpredictable and cannot be directly observed (Salvatore, 2013).

Exchange rate movements are based on several economic variables such as demand and supply of goods, investment and inflation from various countries. Exchange rates will move steadily if the underlying variables are stable, otherwise this will affect the profitability of international trade. No one can predict the future pattern of exchange rate movements (Hacker & Dzansi, 2006). Therefore, volatility is a risk for companies in international trade (Peter B. Kenen, 1984).

Determining exchange rate volatility is a key concern for policymakers and economic actors in financial markets. Companies use volatility models to calculate risk and as a price evaluation tool. Meanwhile, policymakers use information about factors affecting exchange rate volatility to design appropriate policies (Bauwens & Sucarrat, 2006).

Impact of exchange rate volatility on exports

The function of exchange rate is also as a trading tool in international trade. Exchange rate conditions depend on a country's economic conditions. If the exchange rate rises, domestic raw material prices will be high and relatively more expensive, resulting in a decline in exports (Samuelson & Nordhaus, 2010). Another rationale is that a significant decline in the value of the currency will lead to inflation within the economy (Hacker & Dzansi, 2006). This happens when there is a greater demand for overseas exports when the price of foreign currency is higher than the price of local currency. (Salvatore, 2013).

Exchange rate volatility affects world trade both positively and negatively, depending on the variables and instruments analyzed. It negatively impacts global trade by increasing the risks associated with international transactions. When payment contracts are made in the exporter's currency, the importing company bears more risk. If the exporter assumes the risk, prices will rise due to a higher risk premium being charged. Consequently, higher exchange rate volatility leads to reduced imports and lower market prices (Hooper & Kohlhagen, 1978).

Exporters are exposed to two kinds of risks as a result of exchange rate fluctuations: first, the exporter's profit margin is unknown; second, the price is set in the exporter's or importer's currency during the sales process. Second, when prices are fixed in the currency of the importer, there are transaction risks involved in changing foreign cash into local currency. Therefore, changes in actual exchange rates are seen as a source of uncertainty by risk-averse exporters. Changes in exchange rates may have an impact on exporters' export choices, such as through hedging, and risk-averse exporters may choose to export less when volatility increases (Gonzaga & Terra, 1997).

METHOD

Research Design, Source of Data and Method of Data Collection

Using secondary data for the IIP and REER from the International Monetary Fund (IMF) as well as total export data from trade map, this study employs a quantitative research methodology. The five largest non-oil and gas exporting nations in Indonesia are the subject of this study, which uses quarterly data from 2015 to 2022 that was collected

from the Indonesian Ministry of Trade's website, namely China, America, Japan, the Philippines, and Singapore totaling 160 observational data and use pooled data (Gujarati, 2003).

Sampling and data collection techniques

Based on the data available in the Indonesian Ministry of Trade, the population of countries carried out as a research target is all countries that are used as export destinations for Indonesian countries totaling 216 countries. The samples used in this study are the top 5 countries, namely China, America, Sepang, Philippines and Singapore whose data are available in full in the 2015-2022 quarterly data with a total of 160 data observations. Table 1 explain how the measurement of dependent and independent variables.

Table. 1
Definition of Variables

	Variables	Measurement	Conception	Expected sign
Dependent Variables	Export	Total export – Total Import	EXP	NA
	Index Industrial Production	$\left(\frac{\text{Output of current year}}{\text{Output of based year}} \right) \times 100$	IIP	+
Independent Variables	Real Effective Exchange Rate	$\sum_i W_i \times \left(\frac{\text{NER} \times \text{Price (domesti)}}{\text{Price (foreign countr)}} \right)$	REER	+
	Volatility	$\text{REER}_t - \text{REER}_{t-1}$	VOL	-
	Consumer Price Index	$\left(\frac{\text{Cost of Market Basket in Current Year}}{\text{Cost of Market in Base year}} \right) \times 100$	CPI	+

Source: Researcher's formulation, 2024

Analysis Technique

E-views software version 12 was used for data processing and analysis. Prior to using the panel data regression approach, researchers must choose the optimal model among the Fixed Effect Model, Random Effect Model, and Common Effect Model. We have several steps to decide which model is best: The probability value determines the Chow test. The best model is CEM if Probability > 0.05; if the outcome is the opposite, the best model is FEM. The second test is the Hausman Test, where the optimal model is REM when the probability is greater than 0.05 and FEM when the converse is true. Gujarati (2003) states that the Hausman Test may be used to choose between FEM and REM as the best model. The Lagrange Multiplier test should be performed if the chosen model is REM. The best model is CEM if the Prob value is greater than 0.05; if the inverse is true, the best model is REM. Not only that, determining the FEM or CEM model can be seen from the amount of data used if the amount of cross section data is smaller than the period used, the best model is FEM Gujarati (2003).

Following the selection of the optimal model, panel data is subjected to a Classical Assumption Test, which includes the normality, heteroscedacity, multicollinearity, and

autocorrelation tests. Should multiple classical assumption test problems arise afterward, they must be addressed (Gujarati, 2003). First, the Jarque-Bera test is used to perform the normalcy test. Second, compare the probability value of the dependent variable to perform a heteroscedacity test using the Gletsjer Test technique. Third, examine the correlation coefficient between the dependent variables to perform the Multicollinearity Test. Fourth, the Durbin-Wastons value in the study results table is examined in order to perform the autocorrelation test.

In accordance with (Sugiharti et al., 2020), the volatility variable in this study is calculated using the volatility difference between the current year and the previous year, which is expressed as follows:

$$\text{Volatility REER}_t = \text{REER}_t + \text{REER}_{t-1} \tag{1}$$

Following Bahmani-Oskooee & Aftab (2017), the panel data regression model in this study:

$$EX^{IND}_{l,i} = \beta_0 + \beta_1 IIP_t^* + \beta_2 REER_t + \beta_3 VOL_t + \Sigma_t \tag{2}$$

Robustness Test

When variables are added or removed from the regression model, a statistical technique called the robustness test is used to assess how stable the estimates of the core regression coefficient are (Lu & White, 2014). If the estimates remain robust and statistically significant, it generally indicates structural validity.

RESULTS

Model Selection Test Results

Three approaches are used in panel data regression analysis: FEM, CEM, and REM. A portion of these tests are employed to choose the optimal model for examining the panel data regression outcomes presented in Table 1. Ferdinand (2014) states that the goal of multiple linear regression analysis is to determine the direction and impact of numerous independent variables on a single dependent variable. Upon satisfying the traditional presumptions, BLUE (Best Linear Unbiased Estimator) parameters are found. A fixed effect model is employed in the study's final regression model. The study's final regression model uses a fixed effects model (FEM) and is based on table 1.

Table 1.
Panel Data Regression Model Selection Test Results

	Testing Methods	Value	Result
Fixed Effect	Uji Chow / Prob. Cross-Section Chi-Square	0.0000 < 0.05	Fixed Effect Model
Hausman Test	Hausman Test/ Prob. Cross-Section Random	0.0000 < 0.05	Fixed Effect Model
Larger Multiplier	Cross-Section Breusch Pagan	0.0000 < 0.05	Random Effect Model

Source: Researcher’s formulation, 2024

Classical Assumption Test Result

Based on the research results in table 2. shows that the data is free from normality problems because the data used is more than 100 and does not contain Multicollinearity

because the correlation is less than 0.85 (Gujarati, 2003). However, in the research results there is a heteroscedacity problem because Prob. less than 0.05 Significance and Autocorrelation of 2.29.

Table 2.

Classical Assumption Test Results IIP, REER and Volatility Variables

	Testing Methods	Value	Result
Normality	Jarque-bera	0.000 > 0.05	Data is not normally distributed
Heteroskedacity	Glestjer Test	Prob. < 0.05	Data contains Heteroskedacity
Multicollinearity	Correlations	Correlation < 0.80	no multicollinearity
Autocorrelation	Durbin Waston	0.290 (DW) < 2.296 (dL) The value of Durbin Waston among dU and 4-dU	Data contains autocorrelation

Source: Researcher's computation with E-Viwes, 2024

Robustness Test Result

Before conducting a panel data analysis test, one of the requirements that must be met is to go through classical assumption testing in regression analysis (Gujarati, 2003). Based on the results of the above research, the data used contains Autocorrelation, to overcome this, this study uses a robustness test as an alternative so that the data used is normal.

This study conducted robustness test in which variables were added or subtracted to avoid autocorrelation. The purpose of the robustness test in this study is intended so that the variables used are able to interpret how much influence they have on exports. Based on research conducted by Oo et al., (2019) adding the Consumer Price Index to the research in order to exclude it from the Classical Assumption Test. Table 4 displays the findings of the panel data regression test study, which is devoid of traditional assumption test issues and allows for further analysis to determine which model is best suited for panel data regression analysis.

Table. 3

Classical Assumption Test Results after Robustness Test

	Testing Methods	Value	Result
Normality	Jarque-bera	2.938324 > 0.05	Data is normally distributed
Heteroskedacity	Glestjer Test	Prob. > 0.05	No Heteroskedacity
Multicollinearity	Correlations	Correlations < 0.80	No Multicollinearity
Autocorrelation	Durbin Waston	1.77 (dU) < 2.15 (DW) < 2.22 (4-dU) The value of Durbin Waston among dU and 4-dU	No Autocorrelation

Source: Researcher's computation with E-Viwes, 2024

Panel Data Regression Analysis Results

Table 4.

Panel Data Regression Analysis Results

Variables	FEM	CEM	REM
Constanta	-18467217	-1388464	-1388346
	-6.762538	-0.907511	-0.619557
IIP	33888.44**	43612.87**	43612.87**
	6.914667	13.90089	9.490133
REER	23822.21	-33691.56**	-33691.56**
	1.499780	-3.573343	-2.439519
VOL	-105383.4*	-114528.3*	-114528.3
	-1.742516	-1.948385	-1.330161
CPI	140682.5**	34942.64*	34942.64
	7.012919	2.328206	1.589465
R Squared	0.740113	0.427625	0.427625
Adjusted. R. Squared	0.726344	0.412854	0.412854
F-Statistic	53.75263	28.95035	28.95035

Notes:

Numbers in parentheses are standard errors and numbers in brackets are t-statistics

* significant at 10% significance level

** significant at 5% significance level

Source: Researcher's computation with E-Views, 2024

The panel data regression analysis findings using the fixed effect model technique are displayed in Table 4. The regression equation may be found in the above table as follows:

$$\text{Export} = -18467217 + 33888,44\text{IIP} + 23822,21\text{REER} - 105383,4\text{VOL} + 140682,5\text{CPI}$$

T Test Analysis Results (Partial)

This is the research result based on panel data regression analysis using fixed effect model in table 4. It is as follows:

1. 6.914667 (t-count) > 1.655 (t-table) was the result of the t-test on the IIP variable, with a sig value of 0.00 < 0.05. This indicates that in Indonesia, the export variable is impacted by the IIP variable.
2. The REER variable's t-count was 1.4997 (t-count) < 1.655 (t-table) in the t-test findings, and the sig value was 0.1358 > 0.05. This indicates that in Indonesia, the export variable is unaffected by the REER variable.
3. With a sig value of 0.0835 > 0.05, the t-test findings on the REER Volatility variable were -1.7425 (t-count) < 1.655 (t-table). This indicates that the export variable in Indonesia is unaffected by the REER Volatility variable.
4. The CPI variable's t-count was 7.0129 (t-count) > 1.655 (t-table) in the t-test findings, with a sig value of 0.000 < 0.05. This indicates that in Indonesia, the export variable is impacted by the CPI variable.

F Test Analysis Results (Simultaneous)

Based on table 4, the F-count value is 53.75263 > F-table of 2.66 and sig value. 0.0000 < 0.05. This means that the IIP, REER, REER Volatility and CPI variables affect the Export variable in Indonesia.

Results of Adjusted R-Squared Analysis

72% of the variance in Indonesia's export variable can be explained by the independent variables taken together, as indicated by the Adjusted R-Square value of 0.726344. Other factors not included in the model account for the remaining 28%.

DISCUSSION

The results of Fitriani's (2017) research, which demonstrates that the IIP regression coefficient value has a considerable beneficial impact on exports in Indonesia, are in line with the findings of this study. This is consistent with the principle of comparative advantage, which postulates that nations would often manufacture and export items utilizing relatively inexpensive and plentiful domestic production resources. Furthermore, as one of the factors used to determine how much of a nation's output is sufficient for export, the study's findings are consistent with the concept of IIP. Sugiharti et al. (2020) corroborate this claim, stating that because IIP has a strong and favorable long-term influence on exports, it is highly demanded throughout Asia. This finding also supports the findings of research conducted by Safuan (2017) which proves that major trading partner countries such as China, America and Japan have a significant positive impact on Indonesian exports.

The significant positive effect on IIP should be able to encourage the Indonesian Ministry of Trade to continue to export other resource wealth or the uniqueness of UMKM (Micro, Small and Medium Enterprises) in order to increase state revenues.

Similar to study findings by Aslan et al. (2021), the positive and negative impact of REER on exports in Indonesia is contingent upon the sample object of the commodities exporting nation. Furthermore, research by Baek (2014) bolsters this by claiming that, over time, the actual exchange rate has little impact on Korea's exports. This is because lower Korean export prices result from the won's depreciation as a unit of currency, which increases Korean exports to the US. The existence of nation-specific rules that obstruct price and quantity changes is one reason for the shaky correlation between trade and exchange rates. To put it briefly, nations that experience exchange rate losses often use trade policies like increased tariff rates to offset their losses from trade (Aslan et al., 2021). Tran (2022) corroborates this, stating that reduced manufacturing costs in the Asian area result from an increase in the actual effective exchange rate.

The positive but insignificant effect of REER on exports found in this study is because 3 of the 5 sample countries in this study are developed countries, namely the United States, Japan and Singapore, which have a slightly decreased and insignificant REER strength to conduct international trade, one of which is exports. Although the results are not significant from the positive effect, Bank Indonesia should maintain REER fluctuations in order to play a role in increasing exports.

Based on the research findings presented in Table 4, it is evident that REER volatility significantly hurts Indonesian exports. This conclusion is corroborated by Ardiyanti (2015), who looks at how REER volatility affects Indonesian exports to the United States and finds that because primary products make up the majority of Indonesian exports, exports are not sensitive to fluctuations in exchange rates. In order to preserve the performance of international commerce, Indonesia must thus continue to have a free floating exchange rate regime and minimize excessive exchange rate volatility. De Grauwe (1988), however, took a different tack and claimed that producers' level of risk aversion determines how detrimental exchange rate fluctuation is. However, this is in

direct opposition to the findings of Tran's (2022) research, which found no correlation between export volume and volatility. Instead, exporters were advised to concentrate more on building their brands and strengthening their competitive advantage.

This is also consistent with the opinions of Sharma (2019), who found that real exchange rate volatility was more harmful than nominal exchange rate volatility and that it would have a long-term negative impact on exports. Furthermore, exports are often harmed by the short-term negative impacts of exchange rate uncertainty or when it crosses a particular threshold (Bouoiyour & Selmi, 2014). In order to lessen the effects of currency rate volatility, importers might choose to hedge against changes in exchange rates.

Based on research conducted by Mordecki & Miranda (2019) implies the idea that higher volatility could reduce exports in Uruguay, a small open economy due to the lack of capital market infrastructure and futures markets that could be used to hedge against sudden exchange rate fluctuations. However, Situ (2015) argues that exporters in developed countries tend to avoid exchange rate risk, while exporters in developing countries are starting to build more flexible distribution networks to reduce dependence on exports. Therefore, improving currency risk protection systems such as futures markets becomes relevant for developing countries.

The results of the study on the impact of the Consumer Price Index (CPI) show a significant positive impact on Indonesia's exports, which is consistent with the study of (Oo et al., 2019). As one of the indicators for calculating inflation, CPI will reduce people's purchasing power or reduce exports, thus producing significant effects. Is not about it, the positive relationship can help Indonesia to know the impact overall economy by Choudhry et al., (2015). The government should continue to implement the ITF (Inflation Targeting Framework) in coordination with the Ministry of Finance to maintain the inflation rate in Indonesia.

CONCLUSION

The analysis shows that the main five non-oil and gas export destinations for Indonesia, namely China, the US, Japan, the Philippines, and Singapore, suffer greatly from exchange rate volatility. The pandemic was a factor throughout the 2015–2022 research period, which is why this negative effect occurred. It was decided that the fixed effect model was the most effective method for panel data regression analysis. Furthermore, there is a notable positive influence on Indonesia's exports from the IIP and CPI variables, a positive but negligible effect from REER, and a fairly negative impact from REER volatility.

Exporters should consider hedging their sales growth when exporting their goods abroad. Bank Indonesia as the central bank should maintain a free-floating exchange rate determined by the market to stabilize and even increase international trade, higher sales growth will lead to higher REER volatility. Risk-averse exporters should avoid companies with fast sales growth as they tend to have higher volatility levels compared to companies with slow sales growth.

This study uses panel data regression analysis with aim of knowing how influential the IIP, REER, CPI, and REER volatility variables are on exports in Indonesia, but the countries used as the top 5 export destinations in Indonesia are not available so it is hoped that in the future the IMF will provide more complete data. In addition, to measure the volatility used in this study can use ARCH and GARCH methods in order to

further measure the effect of exchange rate volatility on exports in Indonesia.

This study has several limitations. Previous research rarely uses panel data regression analysis to calculate exchange rate volatility. Instead, many studies prefer ARCH and GARCH methods with symmetric or asymmetric approaches to assess short-term and long-term impacts. They often utilize specific product classifications like HS codes to help exporters identify promising products. In contrast, this study only employs panel data regression analysis to examine the impact of exchange rate volatility in Indonesia.

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