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Adjustment in Indonesia's Exports to the United States: A Perspective from the Partial Adjustment Model

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ABSTRACT

Purpose: This study analyzes the short-run and long-run adjustment dynamics of Indonesia's export value to the United States by examining the effects of the exchange rate, Industrial Production Index (IPI), COVID-19, and geopolitical conflicts across several commodity groups.

Research Method: Monthly time-series data from 2018–2025 obtained from the International Trade Center (ITC), Bank Indonesia, and Badan Pusat Statistik (BPS) are analyzed using the Partial Adjustment Model (PAM) and Ordinary Least Squares (OLS). Lagged export variables are included to capture dynamic adjustment processes, supported by classical assumptions and diagnostic tests.

Results and Discussion: The findings show that the exchange rate has no significant short-run effect on export value, whereas IPI has a positive and significant effect on all commodity groups. COVID-19 and geopolitical conflicts also demonstrate positive effects with varying significance levels. The results further confirm the existence of partial adjustment mechanisms with different adjustment speeds across commodities.

Implications: The study suggests that export policies should prioritize industrial strengthening and adaptive sector-based trade strategies under global uncertainty.

Originality: This study integrates domestic macroeconomic factors and global shocks within a commodity-based PAM framework.

Keywords: exports; exchange rate; IPI; COVID-19; geopolitical conflict.

1. Introduction

International trade flows in recent years have exhibited increasingly complex dynamics. Indonesia's economic relationship with the United States, as one of its major trading partners, has led Indonesian export performance to fluctuate in response to changes in global macroeconomic and geopolitical conditions (Faradilla *et al.,* 2024). During this period, global trade dynamics were significantly influenced by the COVID-19 pandemic, which disrupted international supply chains and weakened global economic activity, as well as geopolitical conflicts such as the Russia–Ukraine war and tensions between Iran and the United States.

According to data from the International Trade Center, Indonesia's export patterns have changed considerably over the past two decades. As shown in Figure 1, Indonesia's exports to global markets have generally trended upward since the early 2000s, although several contraction periods have occurred due to economic shocks. A substantial increase was observed before the global slowdown

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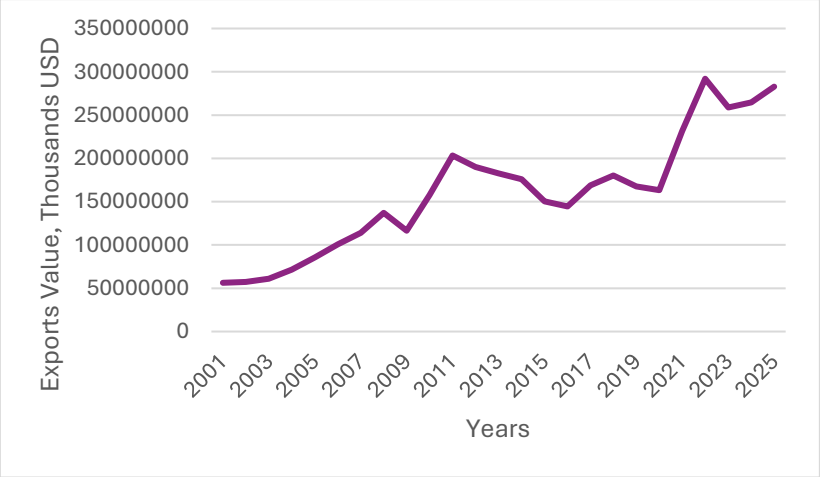
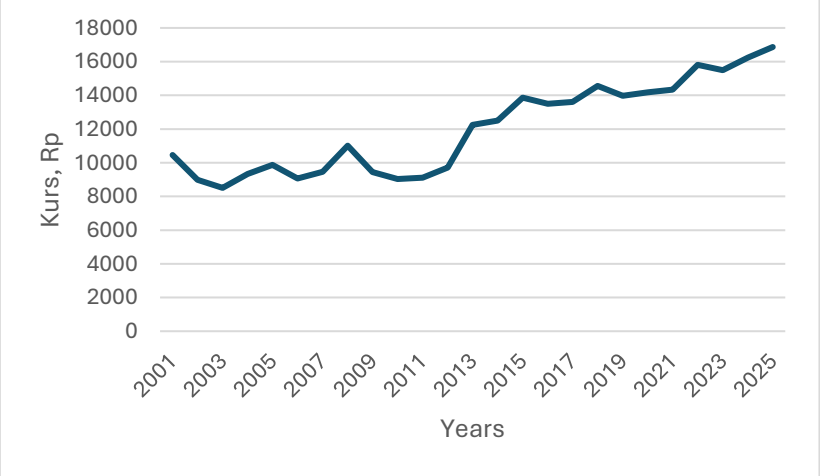
following the 2008 financial crisis, followed by fluctuations during 2011–2016 and a significant contraction during the COVID-19 pandemic in 2020, then a recovery in subsequent years.



Source: *International Trade Center (2026)*

Figure 1. The Total Value of Indonesia's Exports



Source: *Bank Indonesia*

Figure 2. Exchange Rate of the Indonesian Rupiah to USD

Furthermore, Figure 2 shows that the exchange rate of the Indonesian rupiah against the U.S. dollar exhibited a long-term depreciation trend during the 2001–2025 period, though with fluctuations in several periods. This depreciation was influenced by external pressures, including global economic uncertainty and the normalization of international monetary policy (Sugiharti *et al.,* 2020). Indrasto *et al.,* (2024) state that rupiah depreciation can increase the competitiveness of Indonesian exports through price advantages in international markets. However, depreciation may also increase production costs in industries that rely heavily on imported raw materials and intermediate inputs.

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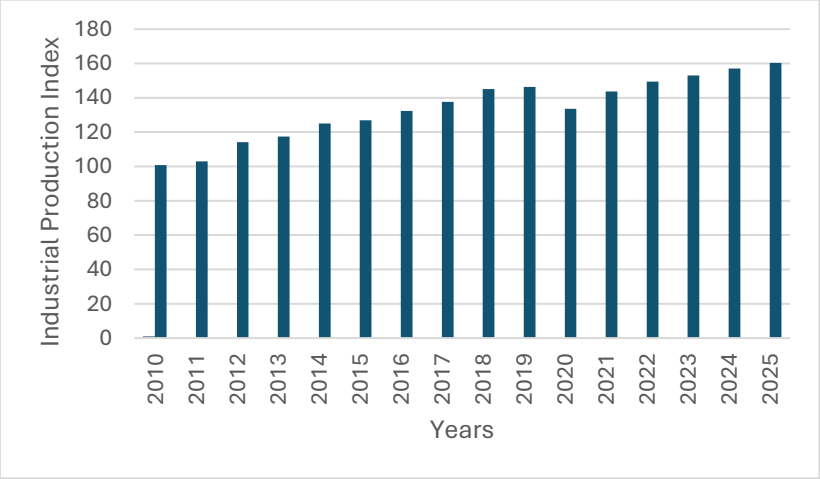

Source: *Badan Pusat Statistik*

Figure 3. Index of Industrial Production

The Industrial Production Index in Indonesia also shows a generally upward trend from 2010 to 2025, with a decline during the COVID-19 pandemic in 2020. This upward trend reflects the continuing expansion of domestic industrial production capacity, particularly in the manufacturing sector (Kozlovskyi *et al.,* 2025). However, the decline in 2020 indicates that the pandemic significantly disrupted production activities, labor mobility, and distribution systems.

At the same time, the Russia–Ukraine conflict that began in 2022 disrupted global energy markets, transportation systems, and international logistics networks, while tensions between Iran and the United States further increased uncertainty in global trade and financial markets (López *et al.,* 2025). These developments indicate that Indonesia's export value performance is influenced not only by domestic economic conditions but also by external geopolitical disturbances.

The theory of international trade elasticity explains that exchange rate depreciation tends to increase export competitiveness because domestically produced goods become relatively cheaper in foreign markets (Fitzgerald & Haller, 2014). In addition, export supply theory emphasizes the importance of domestic production capacity in supporting export growth, which in this study is represented by the Industrial Production Index (Chaldun *et al.,* 2024). Furthermore, the international political economy perspective highlights how geopolitical uncertainty can influence international trade flows through disruptions to global supply chains, energy price volatility, and shifts in global demand patterns (López *et al.,* 2025).

Several previous studies have examined the determinants of exports and highlighted the importance of exchange rates, industrial production, and external shocks. Indrasto *et al.,* (2025) found that exchange rate depreciation positively affects export performance. Sugiharti *et al.,* (2020) also demonstrated that exchange rates have both short-run and long-run effects on exports through dynamic adjustment mechanisms. Furthermore, Handoyo *et al.,* (2024) emphasized that domestic production capacity and industrial structure are important determinants of export competitiveness.

However, most previous studies still focus on aggregate export analysis, failing to distinguish among the characteristics of different commodity groups and to incorporate geopolitical shock variables into the empirical model explicitly. Different commodity groups may respond differently to exchange rate movements and global shocks because each sector has distinct production structures,

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dependence on imported inputs, and sensitivity to international demand conditions. For instance, the vegetable oil industry is closely tied to global commodity prices. In contrast, the footwear and electrical machinery industries are more dependent on manufacturing supply chains and imported intermediate goods. Furthermore, export adjustment does not occur instantaneously because exporters require time to respond to exchange rate changes, production capacity shifts, and global uncertainty. Therefore, a dynamic modeling approach is necessary to distinguish short-run responses from long-run equilibrium adjustments in export value performance.

Based on these considerations, this study aims to analyze the effects of the exchange rate, the Industrial Production Index, and global shocks represented by COVID-19 and geopolitical conflict variables on Indonesia's export value to the United States. The study employs the Partial Adjustment Model to identify short-run and long-run dynamics in the export adjustment process. Furthermore, the analysis is categorized into three major commodity groups, namely vegetable oils and animal or vegetable fats, footwear, and electrical machinery and equipment. This study is expected to contribute to the literature by integrating domestic macroeconomic factors and geopolitical shocks into a single empirical framework while accounting for commodity heterogeneity in Indonesia–United States trade relations.

The remainder of this paper is organized as follows. Section 2 provides a literature review and hypothesis development. Section 3 presents the research method and design. Section 4 provides a discussion; Section 5 is the Concluding Remarks and Recommendations.

2. Literature Review and Hypothesis Development

International trade is one of the main drivers of economic growth because it enables countries to expand market access, increase foreign exchange earnings, and strengthen integration into global markets. Comparative advantage theory explains that countries tend to export products that they can produce at relatively lower opportunity cost than other countries (Toraubally, 2023). In addition, modern trade theory developed by Krugman (1986) emphasizes the importance of economies of scale, industrial specialization, and market structure in determining international trade competitiveness. Countries with stronger industrial structures and higher production efficiency tend to achieve better export performance in international markets. Nguyen (2025) also states that increasing global market integration strengthens the relationship between domestic production capacity and export growth, as international trade increasingly relies on efficient production networks and global supply chains.

Export performance reflects the interaction between domestic economic conditions and changes in the international economic environment. A combination of primary commodities and manufactured goods still dominates Indonesia's export structure, indicating that the country continues to experience structural transformation in its economy (Jumiana, 2023). Wan *et al.,* (2022) demonstrate that developing countries that rely heavily on primary commodities are generally more vulnerable to fluctuations in global demand and international commodity prices. This condition implies that the responsiveness of exports to macroeconomic variables may differ across commodity groups because each sector possesses different production characteristics, market structures, and levels of dependence on imported inputs. According to Chen *et al.,* (2021), depreciation of the domestic currency tends to increase exports because exported products become relatively cheaper and more competitive in foreign markets.

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The relationship between exchange rates and exports is commonly explained through international trade elasticity theory, which argues that currency depreciation can stimulate export growth through price competitiveness effects. When the domestic currency depreciates, foreign buyers can purchase domestic goods at relatively lower prices, thereby increasing external demand. However, the impact of exchange rate depreciation may vary across industries depending on the import content of production activities. Export-oriented industries that rely heavily on imported raw materials may experience rising production costs following currency depreciation, partially offsetting gains in competitiveness. Sugiharti *et al.,* (2020) found that exchange rates have both short-run and long-run effects on export performance through dynamic adjustment mechanisms. Similarly, Indrasto *et al.,* (2025) concluded that rupiah depreciation positively affects Indonesia's exports, particularly in sectors with strong international market orientation. Based on these theoretical and empirical findings, exchange rate movements are expected to influence Indonesia's export value to the United States.
H1: *Exchange rate depreciation has a positive effect on Indonesia's export value to the United States.*

In addition to price factors, domestic production capacity is an important determinant of export performance. The Industrial Production Index (IPI) is commonly used to measure industrial activity and domestic production capacity. According to Nugroho *et al.,* (2024), increasing domestic production output contributes to larger production surpluses that can be allocated to export markets. Krugman (1986) emphasizes that economies of scale and industrial productivity are essential for improving international competitiveness. Furthermore, Wan *et al.,* (2022) found that industrial expansion significantly contributes to export growth and export diversification.

From the perspective of export supply theory, countries with stronger industrial production capacity tend to have higher export capabilities because firms can meet greater international demand more efficiently. Higher industrial output also indicates better utilization of production resources, technological capacity, and manufacturing performance, all of which support export expansion. In the Indonesian context, increasing industrial production may strengthen the export performance of manufacturing-based commodities such as footwear and electrical machinery products. Based on these arguments, the Industrial Production Index is expected to affect Indonesia's export value positively.
H2: *The Industrial Production Index has a positive effect on Indonesia's export value to the United States.*

Global non-economic shocks such as the COVID-19 pandemic have increasingly affected international trade dynamics. The COVID-19 pandemic caused major disruptions to global supply chains, reduced production, and restricted international distribution (Xu *et al.,* 2020). Restrictions on mobility, lockdown policies, and declining global economic activity significantly weakened the movement of goods and services across countries, thereby affecting export activities (Onyeaka *et al.,* 2021).

However, the impact of the COVID-19 pandemic on exports may differ across commodity groups. Certain export sectors experienced declining demand due to reduced international consumption and disruptions to logistics networks. In contrast, several commodity-based sectors benefited from shifts in global consumption patterns and supply shortages in competing countries. Consequently, the impact of COVID-19 on Indonesia's export value remains an empirical issue that requires further investigation, particularly at the commodity level.
H3: *The COVID-19 pandemic significantly affected Indonesia's export value to the United States.*

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In addition to the pandemic, geopolitical shocks, including international conflicts, have significantly influenced global trade dynamics (Yan & Piao, 2025). The Russia–Ukraine war increased uncertainty in international markets and affected global energy prices, transportation systems, and shipping costs (Sarwar & Rye, 2025). López *et al.,* (2025) emphasize that countries integrated into global supply chains are more vulnerable to external geopolitical disruptions, as disruptions to logistics, energy distribution, and international trade routes can affect production and export activities.

This study treats geopolitical conflict as a global uncertainty shock, represented by a dummy variable that captures the period of intensified geopolitical tensions after 2022, including the Russia–Ukraine conflict and escalating tensions between Iran and the United States. Although these conflicts differed in geographic location and transmission mechanisms, both contributed to increased global uncertainty, disrupted energy and logistics markets, and influenced international trade conditions during the observation period.

The impact of geopolitical conflict on exports may vary across commodity sectors depending on their dependence on energy prices, transportation systems, and international production networks. Manufacturing-based sectors are generally more vulnerable to increases in shipping costs and imported input prices, while commodity-based sectors may benefit from changes in global supply conditions. Based on these arguments, geopolitical conflict is expected to influence Indonesia's export value to the United States significantly.

H4: *Geopolitical conflict significantly affects Indonesia's export value to the United States.*

Overall, the literature indicates that exchange rates, domestic industrial production, and global shocks constitute important determinants of export performance. Nevertheless, previous studies tend to focus on aggregate exports and rarely integrate macroeconomic variables and geopolitical shocks into a unified dynamic framework that accounts for commodity heterogeneity. Therefore, this study contributes to the literature by examining the short- and long-run effects of exchange rates, industrial production, COVID-19, and geopolitical conflict on Indonesia's export value to the United States across commodity groups, using a dynamic adjustment approach.

3. Research Method

This study seeks to examine the dynamics of adjustments in Indonesia's exports to the United States by considering the influence of macroeconomic fundamentals and global shocks. The research examines the influence of the exchange rate, domestic production capacity, and external shocks—such as the COVID-19 pandemic and geopolitical conflicts—on Indonesia's export performance. In this study, export performance refers to Indonesia's export value to the United States, measured in billions of USD, to maintain consistency in interpreting the dependent variable throughout the analysis. This study also finds that different groups of goods exhibit distinct patterns of short- and long-term adjustment.

The data used are monthly time-series secondary data obtained from several official institutions. The study period covers January 2018 to December 2025. The research focuses on Indonesia's exports to the United States, one of its principal trading partners, which significantly influences the country's international trade performance.

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The Harmonized System (HS) code was used to classify commodities in this study to ensure consistency and comparability of international trade data. The three main commodity groups analyzed are summarized in Table 1.

Table 1. Commodity Classification

HS Code	Definition
15	Vegetable and animal fats and oils
64	Footwear
85	Electrical machinery and equipment

Source: *International Trade Center*

The analytical method used in this study is the Partial Adjustment Model (PAM) approach. This model illustrates the mechanism by which the dependent variable gradually adjusts to changes in the independent variables over time. This approach also accounts for differences between long-run equilibrium conditions and short-run adjustment processes occurring in the economy. The PAM approach is considered appropriate because export adjustment does not occur instantaneously, as exporters require time to respond to changes in exchange rates, industrial production capacity, and global economic shocks.

Prior to estimating the Partial Adjustment Model, several time-series diagnostic procedures were conducted to avoid spurious regression problems commonly found in time-series analysis. First, stationarity testing was conducted using the Augmented Dickey–Fuller (ADF) test to determine whether the variables were stationary in levels or first differences. Second, optimal lag selection was performed using information criteria to determine the most appropriate lag structure for the dynamic model. Third, cointegration testing was conducted to examine whether a long-run equilibrium relationship exists among the variables used in the study. These procedures are important because non-stationary variables may produce biased and misleading regression results if long-run relationships are not properly identified.

The short-run econometric model in this study is formulated by incorporating a lag of the dependent variable as a partial adjustment mechanism. The lagged dependent variable reflects the gradual adjustment of export value toward long-run equilibrium conditions. The short-run equation can be written as follows:

$$\boldsymbol{logEks_t = \delta\beta_0 + \delta\beta_1 logKurs_t + \delta\beta_2 IPI_t + \delta\beta_3 Covid_t + \delta\beta_4 War_t + (1-\delta) logEks_{t-1} + \varepsilon_{it}} \quad (1)$$

This model shows that export value in the current period is influenced by the model's determinant variables in the same period, as well as by export value in the previous period. The coefficient of the lagged dependent variable indicates the speed of adjustment of export value toward long-run equilibrium following short-run shocks.

Meanwhile, to obtain the long-run model in the Partial Adjustment Model (PAM), the coefficients of the lagged dependent variable are used to calculate the adjustment coefficient (\delta). The adjustment coefficient is obtained from the difference between one and the coefficient of the lagged dependent variable in the short-run model. To obtain the long-run parameters, each coefficient of the independent variables in the short-run model is divided by the value of (\delta). Thus, the long-run model in this study can be written as follows:

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$$logEks_t = \beta_0 + \beta_1 logKurs_t + \beta_2 IPI_t + \beta_3 Covid_t + \beta_4 War_t + \varepsilon_{it} \quad (2)$$

The long-run equation reflects the equilibrium relationship between export value and the explanatory variables over time. In this specification, the coefficients indicate the long-run responsiveness of Indonesia's export value to changes in the exchange rate, industrial production, COVID-19 shock, and geopolitical conflict.

The dependent variable in this study is the total value of Indonesia's exports to the United States, measured in USD billions. In contrast, the independent variables are the rupiah exchange rate, the Industrial Production Index, a dummy variable for the COVID-19 pandemic, and a dummy variable representing geopolitical conflict. The geopolitical conflict variable is treated as a global uncertainty indicator representing the period of intensified geopolitical tensions after 2022, including the Russia–Ukraine war and tensions between Iran and the United States. Although these geopolitical events differ in geographical scope and transmission channels, both generated disruptions in energy markets, global logistics systems, and international trade conditions during the observation period. All variables used in this study are summarized and presented in Table 2.

Table 2. Variable Definition

Variable	Definition	Measure	Source
Eks	Total value of Indonesia's exports to the United States	Billions of USD	ITC
Kurs	The exchange rate of the Indonesian rupiah against the USD	Rupiah	Bank Indonesia
IPI	Indonesia's Production Index	Index	Badan Pusat Statistik
Covid	Dummy variable to account for the impact of the COVID-19 pandemic 1 = pandemic period (March 2020–December 2022) 0 = outside the pandemic period	Dummy	Processed by Authors
War	Dummy variable to account for the role of the Russia-Ukraine war and the Iran-U.S. conflict 1 = war period (February 2022–December 2025) 0 = outside the war period	Dummy	Processed by Authors

The estimation process in this study begins with estimating the short-run model using the Ordinary Least Squares (OLS) method, incorporating a lagged dependent variable (\log Eks_{t-1}) in the regression equation. This lagged variable is intended to capture the gradual adjustment process of export value in response to changes in the explanatory variables over time. Next, the adjustment coefficient (\delta) is calculated from the transformation of the lagged dependent variable coefficient in the short-run model. This adjustment coefficient indicates the speed at which export value returns to the long-run equilibrium after experiencing short-run disturbances.

The short-run coefficients obtained from the dynamic model represent temporary responses of export value to changes in the explanatory variables. In contrast, the long-run coefficients are derived from the adjustment mechanism of the Partial Adjustment Model. The long-run coefficients are obtained by dividing the estimated short-run coefficients by the adjustment coefficient (\delta).

The next step is to test the classical assumptions to ensure that the regression model meets statistical requirements and yields unbiased, consistent estimates. The normality test in this study uses the Jarque-Bera test to determine whether the residuals are normally distributed. Furthermore, the

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Breusch-Pagan test is employed to detect heteroscedasticity by examining whether the residual variance differs across observations.

The multicollinearity test is conducted using the Variance Inflation Factor (VIF) method to identify whether strong correlations exist among the independent variables. If the VIF for each independent variable is below 10, the model is generally considered free of multicollinearity. Additionally, the autocorrelation is assessed using the Breusch-Godfrey test to determine whether residuals are correlated over time in the time-series regression model.

This study also employs the Ramsey RESET test as a model specification test. This test is used to evaluate whether the regression model has an appropriate functional form and to identify possible specification errors, such as omitted variables or inappropriate model forms. Overall, these diagnostic procedures are conducted to ensure the robustness, validity, and reliability of the estimated Partial Adjustment Model in explaining the dynamics of Indonesia's export value to the United States.

4. Results and Discussion

4.1 Analysis Results

Based on Table 3, the F-statistic values are 30.6649 for HS Code 15; 59.4874 for HS Code 64; and 186.5808 for HS Code 85, with respective p-values of 0.0000. These values are smaller than the α level of 0.05 (5%), indicating that all independent variables simultaneously influence export value across all commodity groups studied. Therefore, the regression model employed is considered appropriate for explaining the relationship among the examined variables.

The R^2 values for each commodity are 0.6327 for HS Code 15, 0.7696 for HS Code 64, and 0.9129 for HS Code 85. These values indicate that the model's explanatory variables account for 63.27% of the variation in HS 15 export value, while factors outside the model account for the remaining 36.73%. Meanwhile, the explanatory variables account for 76.96% of the variation in HS 64 exports and 91.29% of the variation in HS 85 exports.

The relatively high R^2 value for HS 85 indicates that exports of electrical machinery and equipment are more strongly associated with macroeconomic conditions and global shocks than those of other commodity groups. This finding suggests that the electrical machinery sector is highly integrated into global production networks and international supply chains, making it more sensitive to changes in external economic conditions.

Based on the t-test results, the exchange rate variable (logKurs) did not have a statistically significant effect on any commodity group, including HS 15, HS 64, and HS 85, as indicated by p-values above the 5% significance level. This finding indicates that exchange rate depreciation alone was insufficient to significantly improve Indonesia's export value to the United States during the observation period. One possible explanation is that several export-oriented industries rely heavily on imported intermediate inputs, thereby reducing the competitiveness gains resulting from rupiah depreciation. In addition, export contracts and global demand conditions may weaken the short-run responsiveness of exports to exchange rate fluctuations.

At the same time, the Industrial Production Index (IPI) variable showed a positive and statistically significant effect across all commodity groups. This result demonstrates that increases in domestic industrial production capacity contribute positively to Indonesia's export value. The strongest coefficient was observed in HS 64 commodities, indicating that the footwear industry is highly dependent on

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domestic manufacturing activity and labor-intensive production processes. Therefore, improvements in industrial productivity directly enhance export supply capacity in this sector.

Table 1. Short-Run Regression Results

Variable	Commodities					
	15		64		85	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
logKurs	-0.2546	0.7733	0.0144	0.9795	0.5219	0.4381
IPI	0.0090	0.0184	0.0147	0.0000	0.0048	0.0468
Covid	0.4355	0.0000	0.2146	0.0000	0.0979	0.0776
War	0.4817	0.0001	0.1165	0.0534	0.1810	0.0346
C	9.5668	0.2642	4.8573	0.2592	-2.9692	0.6218
logEks(-1)	0.2430	0.0045	0.3916	0.0000	0.7627	0.0000
R2	0.6327		0.7696		0.9129	
F-stat.	30.6649		59.4874		186.5808	
Prob. F-stat.	0.0000		0.0000		0.0000	

Source: *Author, 2026*

The COVID-19 dummy variable also showed a positive and significant effect on most commodity groups, except for HS 85, where significance was observed only at the 10% level. The positive coefficient on the COVID-19 variable indicates that Indonesia's exports to the United States remained relatively resilient during the pandemic. This condition may reflect shifts in global demand patterns, increasing demand for several Indonesian export products, and the recovery of international trade following the initial pandemic disruption. In the case of HS 15 commodities, the large positive coefficient suggests that vegetable oils and animal or vegetable fats experienced increased export demand during the pandemic period, particularly due to rising global demand for food and household consumption products.

Furthermore, the geopolitical conflict (War) dummy variable exhibits a positive effect with varying levels of significance across commodity groups. The variable is statistically significant for HS 15 and HS 85 commodities and nearly significant for HS 64 at the 5% significance level. This result suggests that geopolitical tensions after 2022 generated indirect opportunities for Indonesia's exports in certain sectors. Rising global energy prices, supply chain restructuring, and trade diversion effects may have increased demand for Indonesian products in international markets. The positive effect on HS 85 exports indicates that electrical machinery exports benefited from adjustments in global production networks and shifts in sourcing strategies among trading partners during periods of geopolitical uncertainty.

The export lag variable (logEks(-1)) also has a positive and significant effect on all commodity groups. The magnitude and direction of these coefficients indicate the presence of a partial adjustment mechanism, meaning that export value in the previous period influences export value in the current period. Thus, the significance of the lagged dependent variable confirms that the Partial Adjustment Model (PAM) approach used in this study is appropriate for capturing the dynamics of gradual export adjustment.

The coefficient on the lagged export variable is highest for HS 85 commodities (0.7627), indicating that the export adjustment process in the electrical machinery sector is relatively slower than in other sectors. This implies that export activities in the HS 85 sector are more dependent on previous trade contracts, production planning, and international supply chain commitments.

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Table 2. Test of Classical Assumptions

Commodities	JB	BP	BG	VIF	Ramsey
15	0.4520	0.1917	0.2212	1. LogKurs = 2.4308 2. IPI = 1.8166 3. Covid = 1.5696 4. War = 3.3090 5. LogEks(-1) = 1.8922	0.1564
64	0.1668	0.2519	0.4620	1. LogKurs = 2.3988 2. IPI = 1.8187 3. Covid = 1.4357 4. War = 3.2228 5. LogEks(-1) = 2.1100	0.0788
85	0.9040	0.3980	0.1050	1. LogKurs = 3.3589 2. IPI = 1.7708 3. Covid = 1.5658 4. War = 4.0269 5. LogEks(-1) = 5.4086	0.4870

Source: *Author, 2026*

Based on Table 4, the model used satisfies the statistical requirements of the classical assumption tests. The normality test, as indicated by the Jarque-Bera statistic, shows p-values above the significance level for all commodity groups, indicating that the residuals are normally distributed. The Breusch-Pagan test indicates the absence of heteroscedasticity because the p-values are statistically insignificant. The Breusch-Godfrey test also indicates that there is no autocorrelation problem in the regression model. Furthermore, the Variance Inflation Factor (VIF) values for all variables remain below the common threshold value of 10, indicating that multicollinearity is not present in the model. The Ramsey RESET test results further indicate that the model specification is appropriate and free of specification errors.

In addition to the classical assumption tests, the study also conducted stationarity and cointegration procedures before estimating the dynamic regression model. These procedures are important in time-series analysis because non-stationary variables may produce spurious regression results. The stationarity and cointegration results confirmed that the estimated model was appropriate for analyzing both short-run and long-run export dynamics. Overall, the model used in this study satisfies the classical assumptions and is suitable for further econometric analysis.

The long-run model is derived by transforming the Partial Adjustment Model (PAM) based on the short-run model's estimation results. In the short-run model, the coefficient of the lagged export variable ((\log Eks_{t-1})) for each commodity is used to calculate the adjustment coefficient ((\delta)), which reflects the speed of adjustment toward long-run equilibrium.

For HS 15 commodities, an adjustment coefficient of 0.757 indicates that approximately 75.7% of the adjustment toward long-run equilibrium occurs in each period, with an Adjustment Time (AT) of 1.32 periods, suggesting a relatively rapid adjustment process.

For HS 64 commodities, an adjustment coefficient of 0.6084 indicates that approximately 60.84% of the adjustment occurs in each period, with an Adjustment Time of 1.64 periods, indicating a moderate adjustment speed.

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Meanwhile, for HS 85 commodities, an adjustment coefficient of 0.2373 indicates that approximately 23.73% of the adjustment occurs in each period, with an Adjustment Time of 4.21 periods, indicating that the adjustment process is considerably slower than for the other commodity groups.

The slower adjustment process in HS 85 exports may reflect the characteristics of the electrical machinery industry, which is strongly connected to long-term production planning, imported intermediate inputs, and international supply chain arrangements. Consequently, export adjustments in this sector take longer to respond to changes in macroeconomic conditions and global shocks.

The adjustment coefficients obtained for each commodity are subsequently used to calculate the long-run coefficients by dividing each independent variable coefficient in the short-run model by the corresponding adjustment coefficient in order to derive the long-run equilibrium relationship.

Table 3. Adjustment Coefficient and Adjustment Time

Commodities	Adj. Coeff.	Adj. Time
15	75.7%	1.32
64	60.84%	1.64
85	23.73	4.21

Source: *Author, 2026*

Table 4. Results of Short-Run (SR) and Long-Run (LR) Regression

Variable	Commodities					
	15		64		85	
	SR	LR	SR	LR	SR	LR
logKurs	-0.2546	-0.3363	0.0114	0.0187	0.5219	2.1993
IPI	0.0090	0.0118	0.0147	0.0241	0.0048	0.0202
Covid	0.4355	0.5752	0.2146	0.3527	0.0979	0.4125
War	0.4817	0.6363	0.1165	0.1914	0.1810	0.7627
C	9.5668	12.6377	4.8573	7.9837	-2.9692	-12.5124

Source: *Author, 2026*

Based on Table 6, there are differences in coefficient values between the short-run (SR) and long-run (LR) estimations across all variables and commodity groups. In general, the long-run coefficients tend to be larger than the short-run coefficients, reflecting the accumulation of the effects of explanatory variables over time through dynamic adjustment.

For the exchange rate variable (logKurs), HS 15 commodities exhibit a stronger negative coefficient in the long run, while HS 64 and HS 85 show higher positive coefficients over time. However, because the exchange rate variable was not statistically significant in the short-run estimation, the long-run interpretation of the exchange rate effect should be treated cautiously. The results mainly indicate the direction and relative magnitude of long-run adjustment rather than strong statistical evidence of exchange rate effects.

For the Industrial Production Index (IPI), all commodity groups exhibit larger coefficients in the long run, indicating that domestic production capacity becomes increasingly important over time in supporting export growth. The long-run effect is particularly important for manufacturing-based commodities because industrial expansion gradually strengthens export competitiveness and production efficiency. A similar pattern is observed for the COVID-19 and geopolitical conflict variables,

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with long-run coefficients larger than short-run coefficients across all commodity groups. These findings indicate that global shocks generate persistent effects on Indonesia's export value beyond temporary short-run disturbances. The increasingly long-run coefficients suggest that exporters gradually adapt to global disruptions through market adjustments, supply chain reconfiguration, and changes in international demand patterns. Nevertheless, the long-run coefficients presented in Table 6 are derived from the Partial Adjustment Model transformation and are not estimated separately in an independent long-run regression equation. Therefore, the interpretation of long-run effects should focus on the magnitude and direction of adjustment rather than solely on statistical significance comparisons between short-run and long-run coefficients. Overall, the comparison between short-run and long-run coefficients confirms a gradual adjustment process in Indonesia's export value to the United States across commodity groups.

4.2 Discussion

The study's findings demonstrate that the exchange rate variable exerts no statistically significant influence on exports across all commodity groups in the short run. These findings suggest that the transmission mechanism by which exchange rate movements affect export value does not operate instantaneously. The trade elasticity approach posits that a depreciation of the domestic currency should improve export competitiveness by reducing relative export prices in international markets (Li *et al.,* 2020). However, in practice, this effect is often delayed due to international trade contracts, price rigidity, and production structures that remain dependent on imported intermediate inputs (Martínez García & Sposi, 2025).

The insignificant exchange rate effect found in this study also indicates that Indonesia's exports to the United States are not solely determined by price competitiveness. Several export-oriented industries, particularly manufacturing-based commodities, rely heavily on imported raw materials and intermediate goods. Consequently, rupiah depreciation may simultaneously increase production costs, thereby offsetting the potential gains from lower export prices. This condition is especially relevant for HS 85 commodities, where production activities are closely integrated with global supply chains and the use of imported technological components.

These findings align with the study by Indrasto *et al.,* (2025), which demonstrates that the exchange rate's influence on Indonesia's exports is more pronounced in the long term than in the short term. Conversely, Kartika *et al.,* (2025) found that the exchange rate had a significant effect on exports. This suggests that export sensitivity to exchange rate movements depends considerably on commodity characteristics, industrial structures, and the degree of import dependence in the production process. Furthermore, although the long-run coefficients of the exchange rate variable appear larger than the short-run coefficients, the interpretation of these long-run effects should be approached with caution because they are derived from the Partial Adjustment Model transformation rather than estimated in a separate long-run regression. Therefore, the results mainly indicate the persistence of dynamic adjustment rather than definitive statistical evidence of stronger exchange rate effects over time.

The Industrial Production Index (IPI) variable has a positive and significant effect on all commodities, in both the short and long term. This indicates that domestic production capacity is a key factor in determining Indonesia's export performance. This finding aligns with export supply theory, which posits that an increase in domestic output generates a production surplus suitable for international markets (Krugman, 1986). Moreover, the study by Yuliati *et al.,* (2024) demonstrates that

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industrial capacity and production structure are vital to enhancing a nation's export competitiveness. The strongest IPI effect was observed in HS 64 commodities, indicating that the footwear industry is highly dependent on domestic manufacturing activity and labor-intensive production capacity. This finding suggests that improvements in industrial productivity, labor utilization, and domestic manufacturing efficiency directly contribute to export expansion in the footwear sector. Meanwhile, although the IPI coefficient in HS 85 commodities is relatively smaller, the variable remains statistically significant, indicating that industrial production continues to play an important role in supporting technology-based exports. The positive long-run coefficients of the IPI variable across all commodity groups further indicate that industrial development generates cumulative effects on export growth over time. Improvements in industrial infrastructure, production efficiency, and domestic production capacity may gradually strengthen Indonesia's export competitiveness in international markets.

In this study, COVID-19 had a positive effect on most commodity groups, suggesting that the pandemic did not uniformly have a negative effect on international trade. A United Nations report (2022) states that although global trade contracted during the initial phase of the pandemic, several industries experienced increased demand due to shifts in consumption patterns and global market adjustments. The positive COVID-19 coefficient for HS 15 commodities indicates that vegetable oils and animal or vegetable fats experienced increased international demand during the pandemic period. Essential food and household goods remained in high demand despite global economic disruptions. This condition may explain why Indonesia's exports in this commodity group continued to perform well during the pandemic.

For HS 64 and HS 85 commodities, the positive COVID-19 effect suggests that the recovery of global manufacturing activity and changes in international sourcing patterns helped sustain export demand. In particular, the expansion of digital economic activities and electronic consumption during the pandemic may have indirectly supported demand for exports of electrical machinery and equipment. Nonetheless, these findings contradict the study by Rahmayani *et al.,* (2021), which found that the pandemic primarily hindered global trade due to supply chain disruptions and mobility restrictions. This difference demonstrates that the impact of the pandemic varied across sectors and depended heavily on commodity characteristics, production flexibility, and global demand structures.

Geopolitical conflict (War) also exerts a positive effect on most commodity groups, indicating that global uncertainty may simultaneously generate export opportunities for certain countries. Conflicts such as the Russia–Ukraine war disrupted global supply chains, particularly in energy, logistics, and food distribution systems, thereby creating opportunities for alternative exporting countries to fill market gaps (Sarwar & Rye, 2025).

The positive geopolitical conflict effect observed in HS 15 commodities may reflect increasing global demand for alternative food and commodity suppliers during periods of international instability. Indonesia, as a major producer of vegetable oils and related commodities, benefited from changes in global trade flows and supply chain disruptions in competing exporting countries. Meanwhile, the positive effect on HS 85 exports suggests that geopolitical tensions accelerated adjustments in global production networks and sourcing diversification strategies among importing countries. As multinational firms attempted to reduce dependence on certain regions affected by geopolitical instability, countries such as Indonesia gained opportunities to expand their participation in international manufacturing supply chains.

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This finding aligns with the international political economy perspective, which states that external shocks can alter global trade structures through mechanisms of market substitution and trade reallocation (Böschemeier & Mau, 2023). A report from the International Monetary Fund (IMF) (2023) also explains that geopolitical conflicts may contribute to trade fragmentation and encourage diversification of international suppliers. In certain circumstances, this condition may benefit developing countries by opening new export markets and production opportunities. However, research by Yan and Piao (2025) emphasizes that geopolitical conflicts tend to increase uncertainty, transportation costs, and trade barriers in the long run. Therefore, although the short-run impact of geopolitical conflict in this study appears positive, persistent geopolitical instability may ultimately undermine global trade efficiency and long-term export sustainability.

The estimation results further show that all commodity groups undergo adjustment toward long-run equilibrium, albeit at different rates. Natural resource-based commodities, such as HS 15, exhibit faster adjustment rates compared to manufacturing-based commodities, such as HS 85, which tend to adjust more slowly. The relatively rapid adjustment process in HS 15 exports indicates that commodity-based exports are more flexible in responding to changes in international demand and global market conditions. Commodity exports generally involve shorter production cycles and lower dependence on highly complex industrial supply chains. In contrast, the slower adjustment observed in HS 85 exports indicates that manufacturing industries require longer periods to adapt to changes in macroeconomic conditions and external shocks. This condition reflects the complexity of manufacturing production systems, dependence on imported intermediate inputs, and long-term contractual arrangements within international supply chains (Budiono *et al.,* 2021).

This finding is consistent with partial adjustment theory, which posits that structural rigidities within the economy influence the convergence process toward long-run equilibrium (Alemu *et al.,* 2025). Therefore, differences in adjustment speed across commodity groups demonstrate that commodity characteristics, production structures, and levels of integration into global trade networks strongly influence export dynamics.

5. Concluding Remarks and Recommendation

This study aims to analyze the effects of the exchange rate, the Industrial Production Index (IPI), the COVID-19 pandemic shock, and the geopolitical conflict shock on Indonesia's export value to the United States across several commodity groups, namely HS 15, HS 64, and HS 85. Using monthly time-series data from 2018 to 2025 and applying the Partial Adjustment Model (PAM), this study investigates both short-run and long-run export adjustment dynamics. The findings indicate that the exchange rate variable does not exert a statistically significant effect on export value in the short run across all commodity groups. In contrast, the Industrial Production Index consistently demonstrates a positive and significant effect, indicating that domestic production capacity constitutes one of the primary determinants of Indonesia's export performance. Furthermore, the COVID-19 pandemic and geopolitical conflict variables exhibit positive effects with varying levels of significance across commodity groups, suggesting that global shocks generate heterogeneous sectoral impacts depending on commodity characteristics and market structures. The results also confirm the existence of a partial adjustment mechanism in Indonesia's exports to the United States. The significance of the lagged export variable demonstrates that export adjustment toward long-run equilibrium occurs gradually rather than

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instantaneously. The adjustment process differs across commodity groups, with natural resource-based commodities, such as HS 15, adjusting more rapidly than manufacturing-based commodities, such as HS 85. This finding indicates that commodity structure, production complexity, and dependence on global supply chains influence the speed of export adjustment under changing macroeconomic and geopolitical conditions. In addition, although the long-run coefficients tend to be larger than the short-run coefficients, these long-run estimates should be interpreted cautiously because they are derived from the transformation process within the Partial Adjustment Model rather than from separate long-run significance testing procedures.

Theoretically, this study contributes to the literature on export dynamics by integrating domestic macroeconomic variables and external global shocks into a single dynamic econometric framework. Unlike previous studies that primarily focus on aggregate exports, this research emphasizes commodity heterogeneity by examining different export adjustment patterns across commodity groups. The study also enriches the application of the Partial Adjustment Model in international trade analysis by demonstrating that export responses to macroeconomic changes and geopolitical shocks vary according to industrial structure and commodity characteristics. Practically, the findings imply that export policies should not rely solely on exchange rate stabilization but should also prioritize strengthening domestic industrial capacity, improving production efficiency, and enhancing supply chain resilience. From a policy perspective, the results underscore the importance of adaptive, sector-specific export strategies for responding to global uncertainty, particularly during periods of geopolitical instability and international market disruption.

This study nevertheless has several limitations. First, the geopolitical conflict variable aggregates the Russia–Ukraine war and Iran–U.S. tensions into a single dummy variable, thereby limiting the ability to identify the specific transmission effects of each geopolitical event on Indonesia's exports. Second, although the study applies a dynamic Partial Adjustment Model, the analysis remains limited to selected macroeconomic variables and does not incorporate other potentially relevant determinants such as interest rates, international commodity prices, trade agreements, logistics costs, or foreign demand indicators. Third, while the study includes classical assumption testing, additional time-series procedures such as structural break analysis, seasonal adjustment, and more comprehensive cointegration approaches may further strengthen the robustness of the estimation results. Therefore, future studies are encouraged to incorporate broader macroeconomic indicators, more explicitly separate geopolitical shock variables, and employ alternative dynamic econometric approaches, such as ARDL, VECM, or panel-based methods, to obtain deeper insights into the long-run dynamics of Indonesia's export performance.

Statement of Use of Generative AI

During the preparation of this work, the author used generative artificial intelligence tools to support the scientific writing process. Grammarly was used to check grammar, refine writing style, and improve clarity in scientific writing. All interpretations, analyses, and conclusions presented in this study are the sole responsibility of the author.

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