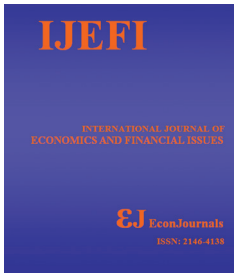

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How Does Ores and Metal Exports, Fuel Exports and Inflation Affect Economic Growth in Indonesia? An Autoregressive Distributed Lag Approach

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ABSTRACT

The study investigates the impact of ores and metal exports, fuel exports, and inflation on economic growth using the autoregressive distributed lag (ARDL) approach in Indonesia. Indonesia's economy, significantly dependent on its inflation and natural resources, particularly ores and metals, and fuels, has experienced varied impacts on growth due to these factors. This research aims to analyze the long-term and short-term dynamics between these variables and economic growth. The analysis employs annual time series data from 1990 to 2022, focusing on GDP growth, inflation rates, ore and metal exports, and fuel exports. The ARDL approach is chosen for its ability to handle small sample sizes and mixed integration orders of variables. This method provides a comprehensive examination of both long-term equilibrium relationships and short-term adjustments. The findings reveal a positive but statistically insignificant long-term impact of ores and metal exports on GDP growth. In contrast, fuel exports show a significant positive long-term effect on economic growth. However, the potential for negative long-term impacts due to over-reliance on fuel exports is noted. Inflation demonstrates a complex relationship with economic growth in the long-term. Short-term analysis indicates that both ore and metal exports and fuel exports positively affect GDP growth. The short-term negative impact of inflation is significant. This study contributes to the literature by providing empirical evidence on the critical roles of natural resource exports and inflation in shaping Indonesia's economic growth. The findings offer valuable insights for policymakers aiming to develop sustainable economic strategies that mitigate risks associated with resource dependency and inflation, thereby fostering long-term economic stability and growth.

Keywords: Ores and Metal Exports, Fuel Exports, Inflation, Economic Growth, Autoregressive Distributed Lag Approach
JEL Classifications: C22, E31, F10, F62, Q43

1. INTRODUCTION

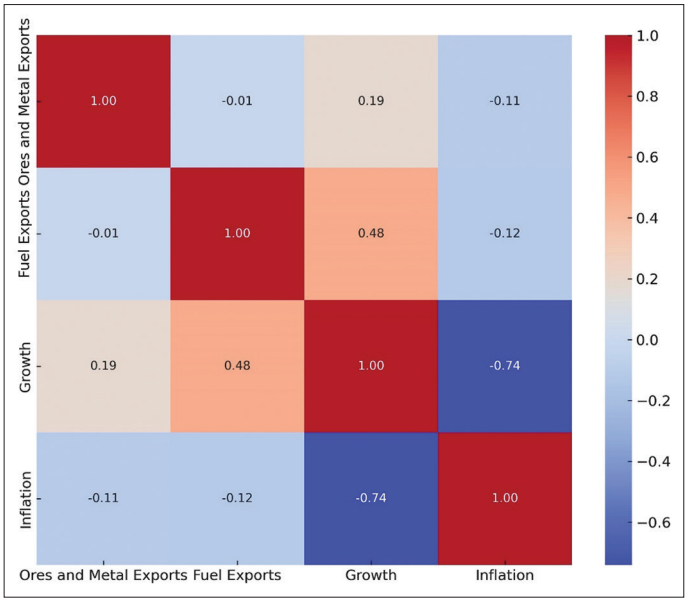
Indonesia, as one of the largest economies in Southeast Asia, has experienced significant economic transformations over the past few decades. Its growth trajectory has been influenced by various factors, among which the exports of ores, metals, and fuels, along with inflation rates, play pivotal roles. The Indonesian economy is highly dependent on its natural resources. Ores and metals, such as nickel, tin, and bauxite, constitute a substantial portion of its export portfolio. These commodities are critical not only for the country's export revenues but also for the global supply chain, given Indonesia's significant share in the production of these minerals. Similarly, fuel exports, primarily consisting of oil and natural gas, are vital to the nation's economic framework. The energy sector has been a cornerstone of Indonesia's economic development, providing both employment and substantial foreign exchange earnings. Inflation, on the other hand, is a crucial macroeconomic variable that affects economic stability

and growth. High inflation can erode purchasing power, distort spending and saving behavior, and create uncertainties that deter investment. Conversely, moderate and stable inflation is often associated with healthy economic growth, as it encourages spending and investment.

Figure 1 clearly displays the relationships between Ores and Metal Exports, Fuel Exports, Inflation, and GDP Growth. Each cell shows the correlation coefficient between two variables, with the color gradient from blue (negative correlation) to red (positive correlation) indicating the strength and direction of these correlations. The heatmap reveals a strong positive correlation between Ores and Metal Exports and Growth, as well as between Fuel Exports and Growth. This indicates that higher exports in these categories are associated with higher economic growth. On the other hand, the negative correlation between Inflation and Growth suggests that higher inflation rates are linked to lower economic growth. This visualization effectively highlights the key interactions among these variables, providing valuable insights for a Scopus journal article by illustrating the significant impact of exports and inflation on economic growth.

Understanding the impact of ores, metal exports, fuel exports, and inflation on economic growth is essential for formulating effective economic policies. While exports of natural resources can drive economic growth through increased revenues and investment, they can also lead to volatility and dependency on global commodity prices. Inflation, depending on its level and volatility, can either hinder or stimulate economic activities. Therefore, examining the interplay between these factors and economic growth is critical for Indonesia's sustainable development. This study aims to investigate the intricate dynamics between these variables and their collective impact on Indonesia's economic growth, employing the Autoregressive Distributed Lag (ARDL) approach. The findings of this research will contribute to the existing literature on economic growth determinants, particularly in the context of a resource-rich developing country like Indonesia. By utilizing the ARDL approach, which allows for the examination of both long-term and short-term relationships, this study offers a comprehensive understanding of how key export sectors and inflation influence economic growth. Policymakers, economists, and stakeholders can leverage these insights to devise strategies that mitigate risks associated with resource dependency and inflation, thereby fostering sustainable economic development.

Figure 1: Correlation Heatmap



2. LITERATURE REVIEW

The information on the combined impact of ore and metal exports, fuel exports, and inflation on economic growth is still limited from various studies since 2013. Therefore, this section will individually examine the impact of ore and metal exports, fuel exports, and inflation on economic growth.

2.1. Relationship between Ore and Metal Exports and GDP Growth

There is a significant relationship between ore and metal exports and gross domestic product (GDP) growth in various countries. Ore and metal exports play a crucial role in increasing national income through their contribution to foreign exchange earnings. Countries rich in mineral resources often make the mining sector one of the main sectors in their economy. For example, countries like Australia, Brazil, Chile, and Indonesia have experienced significant GDP growth due to iron ore and metal exports, which are among their largest revenue sources. The positive relationship between these exports and GDP is also supported by a study conducted by Kristjanpoller et al. (2016), which states that there was a positive impact on Latin American and Caribbean (LAC) countries during the commodity boom in the 2000s, contributing to higher growth. However, in the long term, fuel-mining exports were found to have a negative impact on economic growth in the UAE (Kalaitzi and Chamberlain, 2020). The relationship between ore and metal exports and GDP growth can also have indirect connections through several variables such as labor productivity (Csordas, 2018), resource scarcity (Zheng et al., 2017), and the uncertain sustainability of mineral resources (Patino Douce, 2016).

2.2. Relationship between Fuel Exports and GDP Growth

The relationship between fuel exports and GDP growth has been a significant topic in international economic studies. Countries with abundant fuel reserves, such as oil and gas, often experience significant increases in their GDP due to the export of these commodities. Fuel exports can provide a substantial boost to national income through increased foreign exchange earnings. For instance, fuel exports had a positive impact on Latin American and non-Latin American countries with large oil reserves during the commodity boom in the 2000s, contributing to strong economic growth as their export volumes and prices increased (Kristjanpoller et al., 2016). However, in the UAE, fuel-mining exports were found to have a negative impact on economic growth both in the short and long term (Kalaitzi and Chamberlain, 2020). For countries with oil reserves like Indonesia, fuel export activities will have a direct impact on economic growth through increased foreign exchange reserves and direct investment. Khayati (2019) mentioned a

positive impact of fuel exports on economic growth both in the short and long term, indicating that further encouragement of the non-fuel sector and higher export diversification will have a positive impact on the economy.

2.3. Relationship between Inflation and GDP Growth

The relationship between inflation and GDP growth is one of the most analyzed topics in economic literature (De Gregorio, 1992; Fischer, 1993; Barro, 1995; Bruno and Easterly, 1998). Inflation, measured through the general rise in prices of goods and services, can directly and indirectly affect economic growth. Moderate inflation is often considered a sign of a healthy economy as it reflects strong demand and dynamic economic activity. Several studies show that low to moderate inflation can stimulate economic growth by encouraging consumption and investment. For instance, in the context of developing countries, controlled inflation often coincides with periods of strong GDP growth. However, excessively high or uncontrolled inflation can negatively impact GDP growth (Baglan and Yoldas, 2014; Behera and Mishra, 2017; Balcilar et al., 2017; Ngoc, 2020; Karahan and Colak, 2020; Kusumatrisna et al., 2022; Azam and Khan, 2022). High inflation can lead to economic uncertainty, which in turn can reduce levels of investment and consumption. When the prices of goods and services rise rapidly, people's purchasing power declines, thereby reducing domestic consumption. Additionally, rising production costs due to higher prices for raw materials and labor can reduce company profits, potentially decreasing long-term investment.

3. DATA AND METHODS

3.1. Data

This section describes the variables used, units of measure, and data sources. GDP growth (annual %), inflation (GDP deflator, annual %), Ore and metal exports (% of merchandise exports), and fuel exports (% of merchandise exports) for Indonesia are the variables used in this study. The annual time series data used covers the period from 1990 to 2022, as per data availability. The data source is the World Development Indicators (WDI) from the World Bank.

3.2. Econometric Model

GDP Growth is the dependent variable, while Inflation, Ore and Metal Exports, and Fuel Exports are the independent variables. The data, as sourced, fits the following model:

$$Growth = f(OME, FE, Inflation) \quad (1)$$

The functional form of the model will be:

$$Growth_t = \beta_0 + \beta_1 OME_t + \beta_2 FE_t + \beta_3 Inflation_t + \mu_t \quad (2)$$

Here "t" is the time period and μ is the error term. "*Growth*" is GDP Growth (annual %), "*OME*" is Ores and Metal Exports (% of merchandise exports), "*FE*" is Fuel Exports (% of merchandise exports) and "*Inflation*" is Inflation (GDP deflator, annual %). "β_0" is a constant where "β_1, β_2, β_3" are the coefficients of the independent variables.

Table 1 shows summary statistics that provide a comprehensive overview of the four variables: Growth, ores and metal exports (OME), fuel exports (FE), and Inflation. On average, the Growth rate is 4.69, with a median of 5.17, but it exhibits high variability, evidenced by a standard deviation of 3.71 and extreme values ranging from −13.12 to 8.22. OME and FE have average values of 6.22 and 26.58, respectively, with moderate standard deviations, indicating less volatility compared to Growth. Inflation has a mean of 10.96, but a notably high maximum of 75.27 and a standard deviation of 12.63, suggesting significant fluctuations. The skewness and kurtosis values for Growth and Inflation indicate non-normal distributions, with high skewness and kurtosis pointing to outliers and a heavy-tailed distribution. The Jarque-Bera test results, particularly for Growth and Inflation, confirm these distributions' departure from normality with a high level of significance (P = 0.00).

3.3. ARDL Estimation Procedure

This study uses the autoregressive distributed lag (ARDL) model to prove the relationship between GDP growth, inflation, ore and metal exports, and fuel exports. The ARDL model is a linear time series model where the dependent and independent variables are related not only contemporaneously but also historically (lagged). The ARDL bounds test, provided by Pesaran et al. (2001), is an advancement over techniques like the Engle and Granger (1987) model for two variables, the Johansen Cointegration (1988) model for more than two variables, and the Johansen and Juselius (1990) model, which is an extension of the VAR model. However, VAR is only suitable under certain conditions, such as large sample sizes and the prerequisite for all variables to be cointegrated to the same order, for example, I(1). The ARDL model not only addresses these issues but also offers several other advantages. First, the ARDL model is more suitable than Johansen-Juselius Cointegration for small sample sizes (Pesaran and Shin, 1999). Second, the ARDL model can be used whether all variables are cointegrated I(0), I(1), or a mixture of both (Pesaran and Pesaran, 1997). Third, the ARDL model can capture the appropriate number of lags in the data generating process (DGP), especially from the general to specific process as reported by Laurenceson and Chai (2003). Fourth, the Error Correction Model (ECM) can be obtained from a simple OLS transformation approach. The ECM shows the short-term adjustment mechanism to the long-term without losing long-term information (Pesaran and Shin, 1999). Fifth, in cases of several endogenous regressors, the ARDL model provides unbiased long-term estimates (Narayan, 2005). To avoid endogeneity issues, Borensztein et al. (1998) introduced instrumental variables. However, there is no ideal instrumental variable, so the best

Table 1: Descriptive statistics

Parameter	Growth	OME	FE	Inflation
Mean	4.69	6.22	26.58	10.96
Median	5.17	5.69	25.73	8.55
Maximum	8.22	10.65	43.77	75.27
Minimum	−13.12	3.52	15.63	−0.40
SD	3.71	1.85	5.66	12.63
Skewness	−3.63	0.81	0.86	4.13
Kurtosis	17.47	2.75	4.37	21.73
Jarque-Bera	360.63	3.71	6.71	576.55
Probability	0.00	0.16	0.03	0.00

SD: Standard deviation

approach is to include variable lags, making the model dynamic. The ARDL approach makes the model dynamic.

The ARDL model can be used when all variables are stationary at the level order I(0) or the first difference order I(1), or it can be a mixture of both orders (Pesaran et al., 2001 and Pesaran and Pesaran, 1997). However, Ouattara (2004) states that we cannot use the ARDL model when there are variables stationary at the second difference order I(2) since bound testing is based on orders I(0), I(1), or a mixture of both. For this reason, unit root tests are performed on each research variable to ensure that no variables are stationary at the second difference order. The unit root tests used are ADF (Dickey and Fuller, 1979), ADF-GLS (Dickey and Fuller, 1981) (Elliott, Rothenberg, and Stock, 1996), PP (Phillips and Perron, 1988), KPSS (Kwiatkowski et al., 1992), and Ng-Perron (Ng and Perron, 2001). The KPSS test is generally used to verify the results of the ADF and PP tests due to its stronger power. The null hypothesis.

$$Growth_t = \lambda_0 + \sum_{i=1}^{n} \lambda_{1i} Growth_{t-i} + \sum_{i=1}^{n} \lambda_{2i} OME_t + \sum_{i=1}^{n} \lambda_{3i} OME_{t-i} + \sum_{i=1}^{n} \lambda_{4i} FE_t + \sum_{i=1}^{n} \lambda_{5i} FE_{t-i} + \sum_{i=1}^{n} \lambda_{6i} Inflation_i + \sum_{i=1}^{n} \lambda_{7i} Inflation_{t-i} + \mu_t \quad (3)$$

The error correction model of the ARDL approach used in this study is estimated and mathematically represented as follows:

$$\Delta Growth_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta Growth_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta OME_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta FE_{t-i} + \sum_{i=1}^{n} \beta_{4i} \Delta Inflation_{t-i} + \delta_0 Growth_{t-1} + \delta_1 OME_{t-1} + \delta_2 FE_{t-1} + \delta_3 Inflation_{t-1} + \mu_t \quad (4)$$

In equation(4), Δ is the 1st difference operator, β_0 ia a constant, μ_t is the error term, β_1- β_4 are error correction dynamics, δ_0- δ_3 indicate the long-term relationship between variables.

$$\Delta Growth_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta Growth_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta OME_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta FE_{t-i} + \sum_{i=1}^{n} \beta_{4i} \Delta Inflation_{t-i} + \eta_1 ECT_{t-1} + \mu_t \quad (5)$$

Table 2 displays the outcomes of unit root tests performed on four primary variables: Growth, OME, FE, and Inflation. These tests, including ADF (Augmented Dickey-Fuller), ADF-GLS (Generalized Least Squares), PP (Phillips-Perron), KPSS (Kwiatkowski-Phillips-Schmidt-Shin), and Ng-Perron, aim to identify whether the variables are stationary at level (I(0)) or at first difference (I(1)). This step is critical as the Autoregressive Distributed Lag (ARDL) model used in the study requires that none of the variables be stationary at the second difference (I(2)). The findings reveal that all variables exhibit stationarity either at level (I(0)) or at first difference (I(1)), with no evidence of integration at the second difference. These results validate the suitability of the ARDL model, as it is capable of managing variables integrated at mixed orders (I(0) and I(1)). This ensures the robustness of the subsequent analysis, allowing the model to effectively capture both long-term and short-term relationships among the variables.

4. RESULTS AND DISCUSSION

4.1. Criteria for Selecting Lag Length

The ARDL analysis technique determines the lag length based on (P+1)k, where P is the maximum number of lags and k indicates the number of variables in the equation.

Bahmani-Oskooee and Brooks (2003) stated that to estimate the F-statistic, which is sensitive to the number of lags in the ARDL model, selecting an appropriate lag length is crucial, which means finding the optimal lag length. Lütkepohl (2006) showed that the Akaike Information Criterion (AIC) outperforms other lag selection tests such as LR, FPE, HQ, and SIC. The selection results indicate that the optimal lag length is (3,4,4,4) with the smallest AIC value of 3.162, as shown in Figure 2.

4.2. Bound Test F-Statistic

After obtaining the optimum lag length, we conducted the Bound Test F-statistic, as shown in Table 3. It can be seen that the F-statistic value is 7.71, which is higher than the upper bound at the 1% significance level. This means we reject the null hypothesis of no long-term cointegration relationship, concluding that there is a long-term relationship among the research variables.

4.3. Long-term and Short-term Coefficients

After confirming the long-term cointegration relationship, we examined the long-term and short-term coefficients of the research variables, as shown in Table 4. When GDP Growth is the dependent variable, the long-term coefficient for Ore and Metal Exports is positive but not significant, indicating that in the long term, ore and metal exports do not significantly impact GDP growth in Indonesia. This insignificant positive impact can be associated with factors such as lower labor productivity (Csordas, 2018), resource scarcity (Zheng et al., 2017), and the uncertain sustainability of mineral resources (Patino Douce, 2016). However, it is important to note that despite these factors contributing to the insignificance,

Figure 2: Result AIC

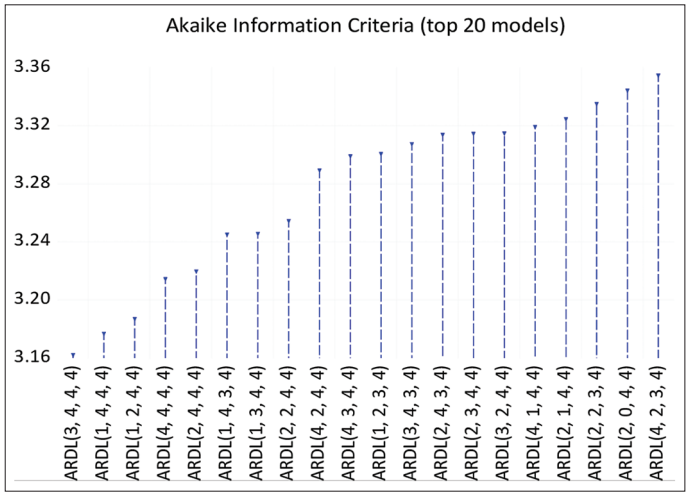


Table 2: Root test

Variable	ADF		ADF-GLS		PP		KPSS		Ng-Perron	
	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
Growth	−4.16*		−4.02*		−4.09*		0.11*		−2.67*	
OME		−5.24*		−5.33*		−5.22*		0.07*		−2.71*
FE	−3.57*			−3.28*	−3.44*		0.27*			−2.24*
Inflation		−9.39*	−2.96*		−4.65*		0.35*		−2.42*	

*denotes prob. <0.05 1st time

Table 3: Bound F-statistic cointegration test

Test	Value	Signif. (%)	I (0)	I (1)
F-Bound	7.71	10	2.37	3.20
		5	2.79	3.67
		2.5	3.15	4.08
		1	3.65	4.66

The null hypothesis are "no levels relationship"

Table 4: Long term coefficients

Variable	Coefficient	Std. error	t-statistic	Prob.
OME	0.28	0.19	1.40	0.19
FE*	0.50	0.06	8.25	0.00
Inflation*	−0.13	0.03	−3.87	0.00
C*	−9.61	2.06	−4.65	0.00

*denotes prob. <0.05

Table 5: Short term coefficients

Variable	Coefficient	Std. error	t-statistic	Prob.
ΔGrowth(−1)	−0.07	0.12	−0.59	0.56
ΔGrowth(−2)**	−0.25	0.12	−2.02	0.07
ΔInflation*	−0.20	0.01	−14.38	0.00
ΔInflation(−1)*	−0.13	0.03	−4.17	0.00
ΔInflation(−2)*	−0.13	0.04	−3.04	0.01
ΔInflation(−3)*	−0.05	0.02	−3.13	0.01
ΔOME*	0.43	0.15	2.83	0.01
ΔOME(−1)*	1.03	0.19	5.21	0.00
ΔOME(−2)*	0.69	0.24	2.80	0.01
ΔOME(−3)**	0.39	0.20	1.93	0.08
ΔFE*	0.29	0.09	3.00	0.01
ΔFE(−1)*	−0.35	0.11	−3.06	0.01
ΔFE(−2)*	−0.27	0.11	−2.44	0.03
ΔFE(−3)*	−0.51	0.10	−4.73	0.00
ECT(−1)*	−1.29	0.17	−7.34	0.00

*denotes prob. <0.05. **denotes prob. <0.10. ECT: Error correction term

the direct impact of ore and metal exports on economic growth remains complex and diverse. Wiedmann et al. (2015) showed that the global extraction rates of iron ore and bauxite have increased faster than global GDP, indicating that increased mineral extraction may not directly correlate with economic growth. Supporting this finding, Kristjanpoller et al. (2016) noted a positive impact of commodity exports, including agricultural raw materials, fuel, food, ore, and minerals, on economic growth.

The long-term coefficient for Fuel Exports is positive and significant at 5%, indicating that a 1% increase in fuel exports leads to a 0.5% increase in GDP growth. Fuel exports provide not only direct financial benefits but also broader economic growth through various interconnected economic mechanisms. These findings align with Khayati (2019), who noted a positive impact of fuel exports on economic growth both in the short and long term, suggesting that further encouragement of the non-fuel sector and higher export diversification will positively impact the economy. In contrast, Kalaitzi and Chamberlain (2020) found that fuel-mining exports in the UAE had a negative long-term impact on economic growth. The long-term coefficient for Inflation is negative and significant at 5%, indicating that a 1% increase in inflation leads to a 0.13% decrease in GDP growth. This finding aligns with studies (De Gregorio, 1992; Fischer, 1993; Barro, 1995) that found a negative relationship between inflation and economic growth using pooled cross-section, time series regression for a set of many countries. Bruno and Easterly (1998) also found a long-term negative relationship between inflation and economic growth. Several studies (Klachkova, 2017; Runganga, 2020; Sadok et al., 2022) also show an inflation threshold beyond which economic growth is significantly and negatively affected. The relationship between inflation and economic growth is often nonlinear, with the impact of inflation on growth varying based on the inflation level. Studies (Baglan and Yoldas, 2014; Behera and Mishra, 2017; Balcilar et al., 2017; Ngoc, 2020; Karahan and Colak, 2020; Kusumatrisna et al., 2022; Azam and Khan, 2022) reveal that inflation negatively impacts economic growth only after surpassing a certain threshold, indicating a nonlinear negative relationship.

The short-term coefficients of the research variables are obtained along with the error correction term (ECT), which is expected to be negative and significant to indicate the time required to reach equilibrium when a disturbance occurs in the research model (Pesaran and Pesaran, 2009). From Table 5, the error correction term (ECT) is negative and significant (−1.29), indicating that disturbances in the research variables are quickly (approximately 129%) corrected to reach long-term equilibrium. In the short term, changes in GDP Growth have a negative and significant impact on achieving GDP Growth in Indonesia in the current period. This condition suggests that GDP Growth in the previous period burdens current period GDP Growth in Indonesia. Factors such as income inequality (Topuz, 2022), financial development (Delic and Rogic Dumancic, 2016), globalization (Raisova, 2015), and income concentration (Vaca, 2020) influence the impact of previous economic growth on current economic growth.

Short-term changes in Inflation have a significant negative impact on GDP Growth in Indonesia in the current period. A 1% increase in inflation in the previous period leads to a 0.13% contraction in economic growth. Studies (Ngoc, 2020; Kusumatrisna et al., 2022; Runganga, 2020; Azam and Khan, 2022) support the claim that inflation has a significant negative impact on economic growth in the short term, with implications for policy-making in various countries and regions. Short-term changes in Ore and Metal Exports have a significant positive impact on GDP Growth in

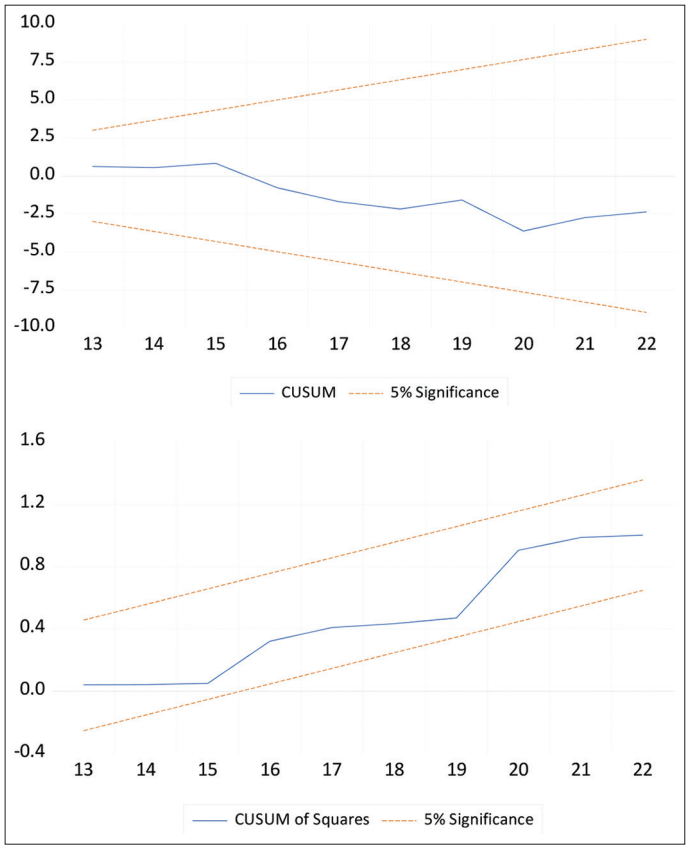
Indonesia in the current period. Liu et al. (2024) confirmed the positive impact of iron ore mining efficiency on economic growth in East Asian and Pacific countries, indicating a short-term increase of 0.39% and a long-term increase of 0.51% for every 1% increase in efficiency. Liu and Lin (2024) showed that economic uncertainty related to declining iron ore trade in developing countries emphasizes the need for sustainable production and consumption practices. These studies suggest that metal exports, particularly iron ore, can positively impact economic growth in the short term, especially when accompanied by human development and environmentally friendly power generation. However, challenges related to economic uncertainty and environmental issues must be considered when assessing the short-term impact of metal exports on economic growth.

Short-term changes in Fuel Exports have a significant negative impact on GDP Growth in Indonesia in the current period. Kalaitzi and Chamberlain (2020) found that fuel-mining exports in the UAE had a negative short-term impact on economic growth. Kpodar et al. (2022) revealed that rising domestic fuel prices adversely affect real non-fuel export growth, especially in countries with high energy dependence ratios. Evidence from these studies shows that short-term changes in fuel exports can significantly negatively impact economic growth, while non-fuel exports, particularly oil exports, can have a positive impact. Additionally, the long-term relationship between fuel exports and economic growth indicates a "resource curse" effect in some regions.

Table 6: Diagnostic examination: Model assumptions

Test	Value	Prob.
Jarque-Berra normality	0.28	0.86
Breusch-Godfrey serial correlation LM	1.93	0.20
Breusch-Pagan-Godfrey heteroskedasticity	2.65	0.05

Figure 3: Stability test



4.4. Robustness Analysis

Diagnostic tests for normality, serial correlation, and heteroscedasticity were conducted, and the results are presented in Table 6. As shown, the model has desirable econometric properties, being normally distributed, serially uncorrelated, and homoscedastic. Therefore, the results of the research model are valid for meaningful interpretation.

The null hypothesis for the Jarque-Bera Normality Test is that the residuals are normally distributed. With a test value of 0.2873 and a probability of 0.8662, we fail to reject the null hypothesis, indicating that the residuals are normally distributed. The null hypothesis for the Breusch-Godfrey Serial Correlation LM test is that the residuals are not serially correlated. With a test value of 1.9303 and a probability of 0.2070, we fail to reject the null hypothesis, indicating no serial correlation. The null hypothesis for the Breusch-Pagan-Godfrey Heteroskedasticity test is that the residuals are homoscedastic. With a test value of 2.6572 and a probability of 0.0587, we fail to reject the null hypothesis, indicating that the residuals are homoscedastic.

The cumulative sum (CUSUM) of recursive residuals and the cumulative sum of squares (CUSUMSQ) tests were used to assess parameter stability as developed by Brown et al. (1975). The CUSUM test identifies systematic changes in regression coefficients, while the CUSUMSQ test detects sudden changes in the stability of regression coefficients. Figure 3 shows the results of the CUSUM and CUSUMSQ tests, indicating no instability in the coefficients as the CUSUM and CUSUMSQ statistic plots lie within the 5% critical confidence interval. Therefore, the coefficients are stable over the sample period for the research model.

5. FINDINGS

Based on the results of the analysis, a number of interesting findings were found, namely based on the results of the ARDL analysis, it shows that ore and metal exports and fuel exports have a positive effect on economic growth in the short and long term. This explains that ore and metal exports are proven to be the main driver of economic growth due to their significant contribution to the country's foreign exchange earnings. It can also be seen from the case in Australia reported by Fortescue Metals Group (2022) that the iron ore industry in Australia contributes significantly to the country's economy, with a gross value added (GVA) of A$58.7 billion in FY19, representing 32% of the total resources industry GVA. The industry directly employs around 37,000 people and indirectly creates nearly 80,000 additional roles, contributing to a strong multiplier effect. Then in India, although ore and mineral exports have declined over time, the sector still contributes significantly to the country's export earnings. In 2018-19, ores and minerals accounted for 1.8% of total export earnings (Reddy and Lakshmi, 2020). This is also supported by research from Davis (2010) which explains that exporting ores and metals contributes

to economic diversification by reducing dependence on a single sector or commodity. This diversification helps stabilize the economy and reduces the impact of fluctuations in one market. Similarly, as reported by the Coordinating Ministry for Economic Affairs of the Republic of Indonesia (2023), exporting ores and metals generates significant foreign exchange earnings, which can be used to finance imports, invest in infrastructure, and support domestic economic activities. This influx of foreign capital can boost economic growth by increasing domestic consumption and investment.

Furthermore, mining and extraction industries create direct and indirect employment, contributing to economic growth through multiplier effects. As these industries grow, they also stimulate demand for goods and services from other sectors, thereby further increasing economic activity (Coordinating Ministry For Economic Affairs Republic of Indonesia, 2023). The extraction and processing of ores and metals also often require large infrastructure investments, such as transportation networks and processing facilities. These investments can provide long-term benefits to the economy by improving the overall business environment and increasing productivity (Pitt, 2021). In addition, the demand for high-tech goods and services, such as those used in the mining and extraction industries, drives technological innovation and investment. This can lead to long-term economic growth as new technologies and processes are developed and adopted (Davis, 2010). So, it can be concluded that the positive impact of ore and metal exports on economic growth comes from economic diversification, increased foreign exchange earnings, job creation, infrastructure development, and technological advancement. These factors collectively contribute to a strong and resilient economy that is able to sustain growth in both the short and long term.

However, mineral-rich countries, especially Indonesia, face several challenges in transforming mineral wealth into sustainable economic growth, including the phenomenon of natural resource abundance hampering economic growth due to factors such as corruption, mismanagement and lack of diversification (World Bank, 2014; International Institute for Environment and Development, 2022). The World Bank (2022a) and United Nations Development Programme (2022) explain that mining activities can have significant environmental and social impacts, including pollution, land degradation and community displacement. Therefore, a number of targeted strategies and policies are needed to address these challenges so that they can have an impact on economic growth.

The World Bank (2014) and the International Institute for Environment and Development (2022) describe a number of strategies that can be undertaken, including good governance and transparency, which are essential to ensure that mineral wealth is managed effectively and the benefits are shared equitably among stakeholders, including the implementation of a strong regulatory framework and monitoring system. In addition, it is important to encourage technological innovation and investment. This can lead to long-term economic growth as new technologies and processes are developed and adopted. Then, managing these fluctuations through fiscal policy and commodity lending can help mitigate the impact on public finances. Countries also need to plan for the transition to a post-mining economy, ensuring that the economic benefits of mineral extraction are not concentrated in the extractive sector. Balancing the economic benefits of this growth with the need to mitigate environmental impacts and ensure sustainable development is also an important solution.

Furthermore, inflation has a more complex impact on economic growth. Moderate inflation supports economic growth by increasing domestic demand and dynamic economic activity. However, high inflation tends to undermine economic stability, reduce purchasing power, and lower investment levels. This dichotomy is important to understand the impact of inflation on economic performance. Moderate inflation, usually defined as an annual rate of 2-3%, can stimulate economic growth by encouraging spending and investment as people are motivated to consume goods and services before prices rise further, and through dynamic economic activity. Moderate inflation can lead to a dynamic economy where businesses are incentivized to invest and expand. This increased economic activity encourages job creation, innovation and productivity growth. Conversely, high inflation can have a negative impact on economic stability. This is explained by Widya et al. (2023) where, high inflation erodes consumer purchasing power, leading to reduced consumption and decreased economic activity to slow economic growth. In addition, high inflation can lead to reduced investment levels as businesses and individuals become less confident in the economy. In addition, high inflation can disrupt the financial system by lowering the value of money and increasing uncertainty. For example, in recent times, Indonesia has experienced a slowdown in the decline of inflation which has slowed economic growth. This highlights the importance of maintaining a stable and moderate inflation rate to support economic stability and growth (Widya et al., 2023).

Furthermore, rising inflation can cause losses to the banking sector due to a mismatch between assets and liabilities, which can reduce lending and impact economic activity. Similarly, research by the World Bank (2023) explains that rising inflation can depress GDP by causing losses to the banking sector, which in turn reduces lending and economic activity. This highlights the importance of stable inflation in maintaining the health of the banking sector. To keep inflation stable, central banks and governments can use monetary and fiscal policies to control inflation and maintain economic stability. This includes adjustments to interest rates, money supply, and taxation to manage inflationary pressures. In addition, continuous monitoring of market prices helps identify and address potential inflationary trends early, thus preventing significant disruptions to economic stability (Widya et al., 2023). Stable prices allow people and businesses to plan more reliably, which in turn supports economic growth and employment (European Central Bank, n.d).

6. CONCLUSION

This study aimed to identify the impact of ore and metal exports, fuel exports, and inflation on economic growth in Indonesia using the ARDL (Autoregressive Distributed Lag) approach. The results indicate that there are significant short-term and long-term

relationships between these variables and Indonesia's GDP growth. Specifically, both ore and metal exports and fuel exports positively influence economic growth in the short and long term. Ore and metal exports have proven to be a key driver of economic growth due to their significant contribution to the country's foreign exchange earnings. These findings support the view that the mining sector can be a primary engine of Indonesia's economy, provided there is good management and supportive policies for sustainable resource utilization. On the other hand, fuel exports also contribute positively but with a caveat: there is a potential negative impact in the long term if there is excessive dependence on this sector. Inflation has a more complex impact on economic growth. In this study, moderate inflation supports economic growth by boosting domestic demand and dynamic economic activity. However, high inflation tends to undermine economic stability, reducing purchasing power and lowering investment levels. Therefore, controlling inflation is critical to ensuring sustainable economic growth in Indonesia.

Overall, this study provides strong empirical evidence on the importance of ore and metal exports, as well as fuel exports, in driving Indonesia's economic growth, while highlighting the need for effective inflation management. These findings are expected to guide policymakers in formulating more effective and sustainable economic strategies, focusing on economic diversification and optimal inflation control.

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