

# Natural Resource Commodity Prices Volatility Determined By Macroeconomic Indicators: A Case of A Developing Nation

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## -RESEARCH ARTICLE-

## MACROECONOMIC INDICATORS AS DETERMINANTS OF FLUCTUATING NATURAL RESOURCE COMMODITY PRICES: A CASE OF AN EMERGING ECONOMY

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### —Abstract—

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The volatility of natural resource commodity prices is a global issue that has gained attention from researchers and academ<sup>22</sup> due to its importance in a nation's socioeconomic development. Considering the significan<sup>22</sup> of natural resources for the sustainable development of a nation and investigating the impact of macroeconomic indicators on natural resource commodity price volatility in Indonesia, this study was conducted using economic theory and empirical analysis. The study used secondary data sources from 2001 to 2020, including the Goldman Sachs Commodity<sup>43</sup> dex and the World Bank Index, and applied Autoregressive Distribution Lags tests to examine the relationship among the study variables. The findings revealed that foreign direct investment, gross domestic product growth, human capital index, exports, expected inflation, industry conditio<sup>33</sup>s, and economic conditions all positively impact natural resource commodity prices in the short and long term, with varying degrees of impact in the short term. Policymakers and practitioners can use these results to implement effective policies related to natural resource commodity price volatility that benefit the people in developing economies.

**Keywords:** Macroeconomic Indicators; Foreign Direct Investment; Human Capital Index; Expected Inflation; Industry Conditions; Natural Resource Price Volatility.

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## 1. INTRODUCTION

The universe is enriched with different natural resources distributed in different countries (Wang & Wang, 2021). Natural resources are conceptualized as services or goods that exist in an area providing economic gain. They include genetic varieties, raw materials, the place itself, water, air, soil etc. (Jiang et al., 2022). They are also classified as renewable or non-renewable resources. The resources available for a limited time are categorized as non-renewable resources, the use of which for unprecedented time results in unavailability for the next generations (Usman et al., 2022). In contrast, the resources that can be generated over time and stock are known as renewable resources (Zhao et al., 2023). Both renewable and non-renewable resources play an essential role in the economic development of a country. However, countries pay more attention towards non-renewable resources based on their scarcity and limited nature (Liu et al., 2022). Hence the countries with abundant non-renewable resources like oil, coal, and gases have an advantage over the others. Therefore, it is appropriate to say that the availability of resources in a country determines its economic status globally. Previously, researchers have highlighted the significance of natural resources in terms of the economic development of the nations (Liang et al., 2021; Zhang et al., 2022). However, research is limited in terms of presenting the importance of natural resources to determine the commodity prices in a country (Ekananda, 2022). Also, very few researchers have highlighted the importance of macroeconomic indicators in determining the price volatility of natural resource commodities (Chien et al., 2022). By addressing this literature gap, the current study aims to assess the role of macroeconomic indicators in determining natural resource commodity prices, more specifically in a developing nation, i.e., the Indonesian context.

Depending upon the enormous surface area and geological position, many natural resources are available in Indonesia. These natural resources, including oil, gas, coal, etc., are used to develop Indonesia's economy (Yamazaki, 2022). In 2019 oil resources in Indonesia were 2.5 billion barrels compared to 2018, which were 0.3 billion barrels (Anand & Mitra, 2022). It further depicts a tremendous increase in crude oil in Indonesia. However, despite this greater availability of natural resources, Indonesia is facing challenges in using those natural resources (Ekananda, 2022). Simultaneously, Indonesia is facing the same situation in terms of natural gas resources. These statistics depict the enormous increase in natural resources and their extraction in Indonesia in the last 20 years. As Lestari et al. (2022) asserted in 2007 that different commodities in Indonesia generated approximately one-fourth of its government income and GDP, making it one of the significant natural resources commodities exported. Likewise, in terms of producing palm oil, it is among the world's largest producers. Research also shows that Malaysia and Indonesia produce more than 85% of the world's palm oil (Ahmad Hamidi et al., 2022).

Based on the abundant availability of natural resources like gas and oil, their prices have decreased in recent years in Indonesia. Similar are the results in terms of rubber

plantation, as by 2020, approximately 3.8 million tons of rubber as a natural resource had been extracted in Indonesia. Additionally, Indonesia is the world's third-largest producer of coca worldwide (Phuang et al., 2022). The production of these natural resource commodities in Indonesia reflects its global dominance in terms of production. Simultaneously, the other countries, consumers are constantly involved in keeping the natural resources prices in Indonesia unchanged because of the benefits of extracting in global commodity trading (Yamazaki, 2022). It also reflects Indonesia's limited capacity to keep the domestic price stable at its own end. In this context, the World Bank report shows that the rise in natural commodity prices in past years favoured Indonesia's economy (Duha & Saputro, 2022). Furthermore, considering Indonesia among the most prominent natural resource commodity producers, the ministry of trade plays its role in keeping the prices stable (Pramananda, Rifin, & Naully, 2022).

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Research also shows that natural resource commodity prices significantly affect the economic situation of a country (Guo et al., 2022). On the contrary, stable natural resource commodity prices play an important role in natural resource commodities' production, extraction, processing and economic activities in a nation (Guo et al., 2022). Although the Indonesian government's ministry of trade continuously plays its part in keeping the prices stable for natural resource commodities. However, considering these potential issues, there is a need to work on policymaking along with several other factors that affect this situation in the prices of raw commodities (Ekananda, 2022; Yamazaki, 2022). Hence, the main aim of the current study is to identify the factors that significantly help to control natural resources commodity prices. Since natural resource commodity prices are among the hottest and most debated topic for researchers nowadays, therefore, the current study will be a valuable addition to the macroeconomic literature by determining the factors affecting those prices.

Simultaneously previously, the researchers primarily focused on the quality of natural resources and their importance in developed nations' context (Ahmad & Wu, 2022; Xu et al., 2022). In contrast, the current study deals with natural resource commodity prices in developing nations available with an abundance of natural resources. Also, most researchers have primarily focused on the influence of economic development or growth on the commodity prices of natural resources (Yong et al., 2022). In contrast, the current study considered the macroeconomic factors, including Foreign Direct Investment FDI, Gross Domestic Product GDP growth, human capital exports, expected inflation, industry conditions and economic conditions to determine the natural resources commodity prices. In addition to that, regardless of the existing issues of imbalance in terms of natural resources commodity prices, very few studies have highlighted this problem (Wang, Li, & Altuntaş, 2022). Therefore, the current study attempted to bridge this literature gap using economic theory to examine the impact of macroeconomic factors on natural resources commodity prices.

## 2. LITERATURE REVIEW

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Natural resources play a vital role in shifting the status of a country from an emerging economy to a developed nation. Likewise, the sustainable economic growth of a nation is highly dependent upon the availability of natural resources, which reflects the parallel nature of economic growth with the availability of natural resources (Razzaq et al., 2022). Previously, the researchers have highlighted the significance of natural resources promoting sustainable growth in developed nations (Khan et al., 2022). Likewise, commodity prices are considered the outcome of the nation's amount or number of exports (Gupta & Varshney, 2022). Besides, researchers use various statistical approaches to determine the relationship between different macroeconomic factors with commodity prices for which exports play an important role. Recently in terms of natural resource commodity prices, government organizations have introduced various programs to determine the unbiased and fair nature of commodity prices to facilitate the masses (Meng, Iqbal, & Zhao, 2022). This association between natural resource commodity prices and macroeconomic factors is not so simple. Instead, it requires various econometric and statistical approaches to calculate empirically. Moreover, the current study investigated the influence of macroeconomic indicators, including foreign direct investment, GDP growth, human capital, exports, expected inflation, industry conditions, and economic conditions on natural resources commodity prices.

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### 2.1 Foreign Direct Investment

Foreign direct investment became stagnant to engage natural resources commodity prices for the short and long term (Wei, Mohsin, & Zhang, 2022). Research supports foreign direct investment addressing several important issues of economic development of nations, including commodity prices. Fan, He, and Kwan (2019) demonstrated the association between FDI and the spillover production of natural resources in China. Most nations worldwide focus on foreign direct investments not only to enhance economic productivity but also to sustain the level of natural resources and their prices in the long run (Yasuda & Kotabe, 2021). Scholars have also highlighted the significant association between foreign direct investment and environmental pollution. In this context, Khan and Ozturk (2020) studied Asian countries from 1980 to 2014. They applied the panel cointegration test to assess the association between the study constructs and postulated the significance of foreign direct investments in controlling environmental pollution in Asian countries. For that purpose, sustainable use of natural resources was considered the prerequisite. Moreover, effective use of natural resources enhances their importance, influencing the prices of the natural resource commodities to keep the quality stable (Zhang & Dilanchiev, 2022). The current study has extended the previous findings in terms of developed nations to examine the role of foreign direct investment on natural resources commodity prices in a developing nation context.

### 2.2 GDP Growth

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GDP growth rate plays a vital role in the economic prosperity of a nation. Mostly, low-

income countries face issues with commodity prices due to low GDP (Zhang & Dilanchiev, 2022). Besides, investments from different organizations, individuals, and foreign actors play an important part in stabilizing the GDP growth rate in a country (Jamil, 2022). Simultaneously, statistical tools play a vital role in assessing the association of GDP with natural resources and the price volatility of natural resource commodities. Previous research conducted in developed nations' context clearly indicates the significance of GDP growth in enhancing natural resource commodity prices (Mou & Ma, 2022). Scholars have also examined the association between foreign direct investments and GDP growth on natural resource extraction and found positive results (Gyamfi, Agozie, & Bekun, 2022). Singh and Kumar (2020) conducted a study in terms of natural gas prices by assessing the role of different economic indicators. They reported the positive impact of situated GDP growth rate on natural gas prices. Rehman et al. (2021) evaluated the role of GDP growth and non-renewable energy in determining natural resource commodity price volatility in Pakistan from 1985 to 2017 and found positive results. Extending the same line of research on data from 2001 to 2020 in Indonesia, the current study expects that the GDP growth rate positively influences the natural resource commodity prices, ultimately affecting the region's economic growth.

### 2.3 Human Capital Index

Human and social capital play an important role in the context of natural innovations and the use of natural resources (Nguyen, 2020). Several factors affect human capital that ultimately leads to changes in natural resource commodity prices in the business and societal context (Wen et al., 2022). Chien et al. (2022) explained the association of political institutions and human capital to determine the prices of natural resource commodities using various statistical and theoretical approaches. Likewise, Caliskan and Zhu (2020) empirically tested the association of human capital economic growth and digital intrusion in the production of natural resources in the Asia context. Their findings suggested the human capital index as a potential determinant of natural resources commodity prices, leading to the area's economic stability over the past few years. It further reflects the human capital index's significance in sustaining natural resources by deciding their prices at a certain level. Therefore it can also be stated that based on the originating nature of non-renewable resources, there are tools that are continuously affecting the natural environment. Hence, it is crucial for individuals to play their part in the effect of using those natural resources (Mahaputra & Saputra, 2021). This effective use of natural resources will further maintain a natural order of things for which it is important to stabilize or keep the prices at a certain rate to avoid exploiting natural resources.

### 2.4 Exports

Research shows that exports help interact the commodity price with natural resource availability (Han et al., 2022). A more recent study by Sun and Wang (2021) demonstrates the natural resources commodity prices as an outcome of various global

economic factors, out of which exports are considered the most significant indicators. Exports are dependent upon the global economic sector, which significantly determines the natural resource commodity prices (Li, Mehmood, & Iqbal, 2022). The interaction and trade between different countries significantly impact a nation's economic conditions and socioeconomic development. When there are more exports, there is more exploitation of natural resources. It further increases the demand for natural resources (Ekananda, 2022). This increase in demand results in higher natural resource commodity prices. Previously several studies have been conducted in developed nations' contexts where the influence of exports on different natural resource commodities like oil, gas, crude coal etc., has been assessed (Chien et al., 2022). The results revealed the significant impact of exports on the increase in commodity prices for natural resources. Relying upon these previous findings, the current study also postulates the importance of exports in enhancing natural resources commodity prices in Indonesia.

## 2.5 Expected Inflation

Following the assumptions of the monetary theory of inflation, inflation is the result of money growth. The fluctuations in the rate of money growth cause changes in the inflation rate (Leasiwal, 2021). The country facing the issues of devaluation of the money ultimately faces the problem of inflation (Zenchenko et al., 2022). Most of the developing nations are the victims of inflation based on the devaluation of their money compared to their dollar rates and terms and conditions decided by the International Monetary Fund (IMF) (Madani & Widiastuti, 2021). Research shows that it decreases the purchasing power of individuals and increases the prices of the commodities based on the high cost of production and extraction of those commodities (Leasiwal, 2021). Research also shows that commodity prices quickly responded to general economic shocks like increased demand and decreased purchasing power (Guo et al., 2022). Previously, researchers have assessed the role of expected inflation in organizational studies to determine the firms' productivity and profitability, GDP growth and capital structure (Shahzad et al., 2022). In contrast, the current study aims to assess expected inflation in determining the natural resource commodity prices.

## 2.6 Industry Conditions

The industry presents a group of productive organizations or enterprises producing or supplying services and goods or generating income sources (Yang & Zhu, 2022). Industries can be classified based on their nature and goods and services. Besides, the state of an industry reflects the industry conditions in a market (Liu et al., 2020). Research shows that when the industry conditions are favourable, businesses accelerate the production and sales of different commodities resulting in economic stability and prosperity in the region (Haron et al., 2021). The industry conditions also help businesses and governments to take important decisions regarding the production and supply of certain commodities. The industry conditions can be assessed based on several indicators, including the overall attractiveness of the industry and the underlying forces

that work for the industry (Lugovoi, Andritsos, & Senot, 2022). Previously, researchers as focused on the role of industry conditions in determining the capital structure of organizations and commodity prices in developed nations (Haron et al., 2021; Jaworski & Czerwonka, 2021). However, research in terms of determining the role of industry conditions for natural resources commodity prices in developing nations' contexts is scarce and needs to be elaborated further.

## 2.7 Economic Conditions

Economic conditions reflect the macroeconomic status of a country depending upon the fiscal and monetary policies and unemployment rate (Rachas et al., 2022). The success of a market depends upon the production and consumption of more goods and services over time (Limaho, Pramono, & Christiawan, 2022). Research reports that in terms of favourable market conditions, there is more demand for natural source commodities (Khomiuk et al., 2020). As a result, their production increases. This high demand for natural resources results in high community prices (Zhao et al., 2023). Economic conditions also help stabilize the commodities' natural order and maintain sustainable production of natural resource consumption (Usman et al., 2022). Developed nations have more stable economic conditions. Therefore, the prices of natural resource commodities are also sturdy and high, further enhancing the nation's socioeconomic development (Liang et al., 2022). In contrast, developing nations' economic conditions frequently fluctuate. As a result, the prices of natural resource commodities also fluctuate (Pramananda et al., 2022). Hence it can be asserted that economic conditions play an important role in terms of natural resources commodity price volatility.

## 3. METHODOLOGY

The current study empirically investigates the influence of macroeconomic factors on the natural resources' prices volatility. It examines the influence of Foreign Direct Investment (FDI), Gross Domestic Product (GDP) growth, human capital, exports, expected inflation, industry conditions, and economic conditions on the price volatility of natural resources in Indonesia. Using secondary sources by extracting data from Goldman Sachs Commodity Index (GSCI) and World Bank Indicators (WDI) databases from 2001 to 2020, the Autoregressive Distributed Lag (ARDL) was applied to test the associations among the study variables. Simultaneously, the assumptions of economic theory are followed by the researchers, which display the economic factors influencing the commodities prices. Moreover, the equation for the current study is as follows;

$$NRCP_t = \alpha_0 + \beta_1 FDI_t + \beta_2 GDPG_t + \beta_3 HCI_t + \beta_4 EXP_t + \beta_5 EI_t + \beta_6 IC_t + \beta_7 EC_t + e_t \quad (1)$$

Where NRCP presents the prices of natural resources commodities, t reflects the time, FDI is equivalent to foreign direct investment. At the same time, GDP growth is abbreviated as GDPG, human capital index as HCI, exports as Exp, expected inflation as EI, industry conditions as IC and economic conditions as EC.



In this equation, natural resources commodity price has been considered as the outcome variable and is measured using the commodity index. Besides, FDI was calculated as the percentage of GDP, and GDP growth was measured as the annual percentage of GDP growth. To measure the human capital, the authors used the human capital index, and exports were calculated as an annual growth percentage. Moreover, expected inflation was estimated based on economists' forecasts, and to measure the industry conditions, we consider industry sales growth and median leverage.

Descriptive statistics were performed to assess the constructs, mean, standard deviations, and minimum and maximum values. Followed by descriptive statistics, a correlation among the study constructs was extracted. These correlation values further reflect the discriminant validity among the study variables and help determine the multicollinearity issues if they exist among the study constructs. Additionally, the "Variance Inflation Factor (VIF)" was executed to investigate the multicollinearity issues in study variables. Moreover, the equations of VIF are as follows;

$$R_Y^2 \Rightarrow Y_{it} = \alpha_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \beta_6 X_{6it} + \beta_7 X_{7it} + e_{it} \quad (2)$$

$$j = R_Y^2 + R_{X1}^2 + R_{X2}^2 + R_{X3}^2 + R_{X4}^2 + R_{X5}^2 + R_{X6}^2 + R_{X7}^2 \quad (3)$$

$$\text{Tolerance} = 1 - R_j^2 \quad \text{VIF} = \frac{1}{\text{Tolerance}} \quad (4)$$

"Augmented Dickey-Fuller Test (ADF)" test was also performed to investigate the overall fitness of the model to assist the stationarity of the study constructs. This also reflects the overall appropriateness of the study model. the ADF equation is given as follows;

$$\Delta Y_t = \alpha_0 + \beta t + \gamma Y_{t-1} + \theta(\Delta Y_{t-1}) + \varepsilon_t \quad (5)$$

The scholars can also assess the stationarity in the separate equations by relying on individual estimation equations as presented below;

$$\Delta \text{NRCP}_t = \alpha_0 + \beta t + \gamma \text{NRCP}_{t-1} + \theta(\Delta \text{NRCP}_{t-1}) + \varepsilon_t \quad (6)$$

Foreign Direct Investment

$$\Delta \text{FDI}_t = \alpha_0 + \beta t + \gamma \text{FDI}_{t-1} + \theta(\Delta \text{FDI}_{t-1}) + \varepsilon_t \quad (7)$$

GDP growth

$$\Delta \text{GDPG}_t = \alpha_0 + \beta t + \gamma \text{GDPG}_{t-1} + \theta(\Delta \text{GDPG}_{t-1}) + \varepsilon_t \quad (8)$$

Human Capital Index

$$\Delta \text{HCI}_t = \alpha_0 + \beta t + \gamma \text{HCI}_{t-1} + \theta(\Delta \text{HCI}_{t-1}) + \varepsilon_t \quad (9)$$

Exports

$$\Delta \text{EXP}_t = \alpha_0 + \beta t + \text{YEXP}_{t-1} + \theta(\Delta \text{EXP}_{t-1}) + \varepsilon_t \quad (10)$$

Expected Inflation

$$\Delta \text{EI}_t = \alpha_0 + \beta t + \text{YEI}_{t-1} + \theta(\Delta \text{EI}_{t-1}) + \varepsilon_t \quad (11)$$

Industry Conditions

$$\Delta \text{IC}_t = \alpha_0 + \beta t + \text{YIC}_{t-1} + \theta(\Delta \text{IC}_{t-1}) + \varepsilon_t \quad (12)$$

Economic Conditions

$$\Delta \text{EC}_t = \alpha_0 + \beta t + \text{YEC}_{t-1} + \theta(\Delta \text{EC}_{t-1}) + \varepsilon_t \quad (13)$$

The results of stationarity analysis depict that the ARDL model best fits the study constructs. Several assumptions of the ARDL model need to be satisfied for the model's fitness. For instance, constructs must be stationary at I (0) or at I (1). Simultaneously, the ARDL model also relies on the assumptions of cointegration among the study variables (Ekananda, 2022). The results fulfilled both assumptions. Therefore, the authors adapted the ARDL model based on the following equation;

$$\begin{aligned} \Delta \text{NRCP}_t = & \alpha_0 + \sum_{i=1}^p \delta_{1i} \Delta \text{NRCP}_{t-1} + \sum_{j=1}^q \delta_{2j} \Delta \text{FDI}_{t-j} + \sum_{k=1}^r \delta_{3k} \Delta \text{GDPG}_{t-K} + \\ & \sum_{l=1}^s \delta_{4l} \Delta \text{HCL}_{t-1} + \sum_{m=1}^u \delta_{5m} \Delta \text{EXP}_{t-m} + \sum_{n=1}^v \delta_{6n} \Delta \text{EI}_{t-n} + \sum_{o=1}^w \delta_{7o} \Delta \text{IC}_{t-o} + \\ & + \sum_{p=1}^x \delta_{8p} \Delta \text{EC}_{t-p} + \varphi_1 \text{NRCP}_{t-1} + \varphi_2 \text{FDI}_{t-1} + \varphi_3 \text{GDPG}_{t-1} + \varphi_4 \text{HCL}_{t-1} + \\ & \varphi_5 \text{EXP}_{t-1} + \varphi_6 \text{EI}_{t-1} + \varphi_7 \text{IC}_{t-1} + \varphi_8 \text{EC}_{t-1} + e_t \end{aligned} \quad (14)$$

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Additionally, the coefficients of short-term and long-term nexus are represented in the ARDL equation along with the error term.

#### 4. RESULTS

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The findings regarding the descriptive statistics of study variables, as presented in table one, shows that the total number of observations in the study was 67. Besides, the mean value for natural reserve commodity price was 47.092% with Std. 4.375 and maximum and minimum values 31.210 and 56.391, respectively. Likewise, the values for all the study constructs are presented in detail (see Table 1).

**Table 1. Descriptive Statistics**

Variable	Obs.	Mean	Std.	Min	Max
NRCP	67	47.092	4.375	31.210	56.391
FDI	67	5.431	0.591	2.308	7.384
GDPG	67	0.419	0.404	1.192	4.030
HCI	67	3.006	0.124	0.109	0.670
EXP	67	4.643	0.624	2.492	6.992
EI	67	0.311	0.060	0.180	1.207
IC	67	0.486	0.046	0.198	1.292
EC	67	0.521	0.057	0.241	1.079

**Where:** FDI=Foreign Direct Investment; GDPG=Gross Domestic Product Growth; HCI=Human Capital; EXP= Exports; EI=Expected Inflation; IC=Industry Conditions; EC=Economic Conditions.

Moreover, [Table 2](#) illustrates the correlation matrix presenting associations among the study variables. Results showed that all the correlation values among the study variables are less than 0.70 hence establishing the discriminant validity among their study variables.

**Table 2. Matrix of Correlation**

Variable	NRCP	FDI	GDPG	HCI	EXP	EI	IC	EC
NRCP	1.000							
FDI	0.590	1.000						
GDPG	0.602	0.387	1.000					
HCI	0.395	0.610	0.550	1.000				
EXP	0.408	0.400	0.230	0.960	1.000			
EI	0.346	0.542	0.454	0.356	0.656	1.000		
IC	0.230	0.633	0.239	0.434	0.532	0.460	1.000	
EC	0.287	0.403	0.582	0.654	0.451	0.349	0.574	1.000

The values of VIF present that all the values are less than 3. Results further show that all the study variables are distinct from each other, and there is no issue of multicollinearity among them ([See Table 3](#)).

To check the appropriateness of the model ADF test was executed where the constructs' stationarity reflected the overall model fitness of the study. Besides, the results show that natural resources commodity prices, human capital index, exports, expected inflation and economic conditions were stationary at the first level. In comparison, the FDI, GDP growth, and industry conditions were stationary at a zero level. Hence, the results present the appropriateness of the ARDL model as presented in [Table 4](#).

**Table 3. Variance Inflation Factor**

	VIF	1/VIF
NRCP	2.015	0.496
FDI	2.224	0.449
GDPG	3.002	0.333
HCI	1.620	0.617
EXP	2.518	0.397
EI	2.200	0.454
IC	3.108	0.321
EC	2.110	0.473
Mean VIF	2.349	-

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**Table 4. Unit Root Test**

Augmented Dickey-Fuller Test (ADF)	Level	t-statistics	p-values
NRCP	I (1)	-7.008	0.000
FDI	I (0)	-7.911	0.000
GDPG	I (0)	-4.710	0.001
HCI	I (1)	-7.901	0.000
EXP	I (1)	-4.252	0.001
EI	I (1)	-5.236	0.003
IC	I (0)	-2.675	0.011
EC	I (1)	-3.444	0.009

Besides assessing the ARDL model's second assumption regarding the cointegration among the study variables, "ARDL bound test" was used. The findings showed the highest values of f-statistics (7.018) compared to critical values at a 5% level of significance. The findings are presented in Table 5.

**Table 5. ARDL Bound Test**

Model	F-stat	Lag	Level of Significance	Bound test critical values	
				I (0)	I (0)
NRCP/ (FDI, GDPG, HCI, EXP, EI, IC, EC)	7.018	3.249	1%	7.21	7.21
			5%	6.19	6.19
			10%	5.65	5.65

The results also showed that in the short run, there is a positive association of all the predictor variables with natural resources prices volatility in Indonesia. The results show that with one unit increase in all the macroeconomic indicators, the resultant natural resource commodity prices increase significantly. The detailed results are presented in

Table 6.

Table 6. Short Run Coefficients

Variables	Coefficient	Std. Error	t-Statistic
$\Delta FDI$	1.342***	0.089	4.287
$\Delta GDPG$	4.762***	0.943	6.872
$\Delta HCI$	0.928***	0.643	3.988
$\Delta EXP$	2.056***	1.160	5.287
$\Delta EI$	0.456***	0.241	2.012
$\Delta IC$	0.688***	0.353	2.155
$\Delta EC$	1.442***	0.134	4.546
ConstantEq (-1)	0.597***	0.205	2.220
R-squared	0.507	Mean Dependent construct	
Adjusted R-squared	0.498	STD Dependent construct	

“Note: \*\*\*, \*\* for 1% and 5% significance”.

Likewise, the ARDL model results, in the long run, showed that macroeconomic indicators, including FDI, GDP growth, human capital, exports, expected inflation, economic conditions, and industry conditions, positively influence Indonesia's natural resources price volatility. The detailed results of long-run price volatility are presented in Table 7.

Table 7. Long Term Coefficients

Variables	Coefficient	Std. Error	t-Statistic
FDI	3.945***	1.112	5.087
GDPG	2.007***	0.687	3.950
HCI	3.998***	1.272	5.245
EXP	2.836***	0.982	4.133
EI	1.973***	0.411	3.219
IC	3.234***	1.328	4.655
EC	1.987***	0.997	3.087
C	0.497***	0.101	2.020

“Note: \*\*\*, \*\* for 1% and 5% significance”.

Simultaneously, regression analysis results revealed an optimal order where  $v=1$ ,  $u=1$ ,  $S=1$ ,  $r=1$ ,  $q=1$ . And  $p=1$ . Hence after substituting the parameters (significant at 1% level) of Tables 6 and 7, equation 15 is presented as;

$$\begin{aligned} \Delta NRCP_t = & \alpha_0 + 1.342\Delta FDI_{t-1} + 4.763\Delta DGP_{t-1} + 0.928\Delta HCI_{t-1} + \\ & 2.056\Delta EXP_{t-1} + 0.456\Delta EI_{t-1} + 0.688\Delta IC_{t-1} + 1.442\Delta EC_{t-1} + 3.945FDI_{t-1} + \\ & 2.007DGP_{t-1} + 3.998HCI_{t-1} + 2.836EXP_{t-1} + 1.973EI_{t-1} + 3.234IC_{t-1} + \\ & 1.987EC_{t-1} + e_t \end{aligned} \quad (15)$$

## 5. DISCUSSION

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The current study examines the influence of seven different macroeconomic indicators in predicting natural resources commodity price volatility in a developing nation context. Results show that foreign direct investment positively influences the natural resources commodity prices. As in the current study context, the increase of FDI in a developing nation significantly affects economic activities like tourism, transportation, construction, manufacturing, infrastructure development, and public services. These economic activities ultimately affect the natural resources' commodity prices. The current study results are in line with the previous researchers, citing FDI as an essential source of funding to support different economic projects in the private and public sectors and facilitate the functioning of various financial enterprises (Gyamfi et al., 2022; Khan & Ozturk, 2020; Rehman et al., 2021). These activities also result in the continuous use of natural resources, ultimately increasing prices (Gyamfi et al., 2022). In this context, Wei et al. (2022) also reported the keen interest of foreign entities while investing in domestic enterprises and projects to make those projects successful, which results in additional progressive activities leading to higher natural resource prices in a country.

Findings also showed that GDP growth positively affects the natural resources commodity prices. These results can be related to the fact that there is a proportionate change in natural resources commodity prices with GDP growth in Indonesia. Natural resources use increases the GDP growth in social and economic activities, resulting in high demand for those natural resources, which further results in higher prices. Previous research conducted by Wang et al. (2022) also supports these study findings by presenting the significance of GDP growth in determining the price volatility of natural resource commodities. The research also affiliates GDP growth with natural resource production (Meng et al., 2022). Besides, the high rate of GDP growth depicts a country's socioeconomic development and enhanced level of infrastructure, tourism, and transportation resulting in the high demand for natural resources that causes significant volatility in the prices. Researchers have also affiliated the increase in GDP growth with higher employment opportunities and improved living standards of people with high incomes (Liu et al., 2022). These rises in income and living standards further depict that when people have more purchasing power to afford natural resource commodities, they are in a better position to utilize those, causing the shortage of natural resources and increased prices.

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The human capital index is also an important predictor of natural resource commodity price change. Indonesia is among the most highly populated countries in the world, with abundant human capital. This enhanced level of human capital is linked with the rise in natural resources commodity prices. Previously researchers have also asserted the human capital index's significance in determining a nation's prosperity based on the economic activities performed with the availability of physical resources (Nguyen, 2020). It can also be related to the fact that the availability of more skilled personnel results in enhanced productivity of the organizations. When specifically talking about

manufacturing organizations, the highly skilled professionals will result in higher production that will ultimately utilize more natural resources leading to their change in prices in the long and short run (AlQershi, 2021). Simultaneously, human capital is progressively trained to utilize modern technologies nowadays. Hence, the adoption of digital technologies in most manufacturing organizations can enhance the productivity of human capital by using more resources, resulting in higher prices.

Results also showed that more exports are important predictors of increased prices of natural resource commodities. This is based on the fact that when exports are increased, the production of different commodities increases and this high production of commodities results in high utilization of natural resources, consequently increasing the prices of those resources. These findings of the current study can also be linked with the previous research, which asserted the increase of exports in a country with more production of goods and services (Liu & Yu, 2023). High production of goods and services results in the utilization of more energy and other natural resources, ultimately resulting in high demand for such resources (Wang et al., 2022). High demand also depicts higher prices reflecting the proportionate relationship between the two. Previous research also supported the current study findings as linked use of natural resources result in more economic activities (Ekananda, 2022). These activities may include the infrastructure development and provision of services to the masses, which requires continuous use of natural resources, resulting in increased prices.

As inflation increases the prices of everything, it also positively affects the use of natural resources and their prices. Previously researchers have also affiliated inflation as a source of increase in the prices of different commodities (Leasiwal, 2021). At the same time, the current study has considered the expected inflation in the future based on the economists' views and its determinantal effect on the commodity prices of natural resources. Additionally, results also revealed the importance of industry conditions in determining price volatility in a developing nation. Industry conditions depict the state of an economy or industry. When the industry conditions are suitable with high production and selling capabilities, they play a positive role in the development of a society (Lugovoi et al., 2022). Whereas developed societies always have more purchasing power. The people want to exploit different opportunities to enjoy high standards of living (Haron et al., 2021). This willingness of the people to enjoy everything with higher standards of life dissolves into more utilization of natural resources, ultimately increasing their prices based on increased demand.

## 6. CONCLUSION

Finally, the findings also suggest that the economic conditions of a country are not only based on the prices of the commodities but also significantly affect those prices. Hence, a correlation between the two exist, where an increase in one results in an increase in the other. Thus, when the economic condition of a country is stable, they want to achieve sustainable development of the society. This development results in the continuous use

of natural resources, which may also produce the threats of depletion of those resources (Khomiuik et al., 2020). To limit the use of those resources or to effectively utilize them for the benefit of the masses, their prices are increased. This reflects the linear relationship between the economic conditions of a country with enhanced commodity prices of natural resource commodities.

## 7. RESEARCH IMPLICATIONS

### 7.1 Theoretical Implications

The current study adds value to the practice and theory in macroeconomics literature in terms of presenting the macroeconomic determinants of price volatility for natural resources commodities. Previously, most studies have considered limited factors as determinants of economic development, natural resource productivity, and countries' sustainable growth (Meng et al., 2022; Mou & Ma, 2022; Razzaq et al., 2022; Usman et al., 2022). Whereas, the current research has not only considered a wide range of macroeconomic factors (i.e., foreign direct investment, GDP growth, human capital index, exports, expected inflation, industry conditions, and economic conditions) but also has assessed those factors' role in determining price volatility of natural resources commodities. As different parts of the world have diverse natural resources in variable quantities, to utilize those natural resources productively, many scholars report examining the various factors that affect the price volatility of natural resources (Ekananda, 2022; Khan et al., 2022; Yating et al., 2022). Thus bridging this literature gap, the current study is valuable to the macroeconomic field. Also, instead of relying on the existing inflation rate, the current study has assessed the expected inflation in the future and its effect on a country's economy by directly affecting the natural resources commodity price fluctuations, especially in developing nations where purchasing power for people is not high.

### 7.2 Practical Implications

In addition to theoretical implications, the current study also adds several practical significances in macroeconomic literature for practitioners, government organizations, academicians, and policymakers. The results of the current study reflect that multiple macroeconomic factors influence the natural resource price change. Along with the advantages of the direct influence of several macroeconomic indicators in terms of natural resources commodity prices, the continuous use of those resources can also result in the depletion of those resources affecting the natural order of things. Hence, presenting the significance of the seven macroeconomic indicators, the current study offers the policymakers to actively engage in the sustainable use of natural resources. Also, after finding the factors and their differential effects on natural resource commodity prices, the practitioners can focus on the factors that highly affect the changes in prices for natural commodities. Considering these results, policymakers can devise policies to increase the prices of commodities to such levels that can ensure the safety of those commodities.



On the other hand, the resources available in independence should be moderately presented to the socially disadvantaged groups and the people with low purchasing power. This balanced presentation of natural sources to the masses can result in the sustainable development of those resources and a good initiative for the product production of those resources following the United Nation's sustainable development goals for 2030. Moreover, the significance of using natural resources and their change in prices can also be utilized by practitioners. They can attract foreign investors to invest in projects which use renewable natural resources sustainably, applying modern technologies to protect the environment in the long run. Likewise, the study findings can be utilized by manufacturing and other organizations to facilitate the process of production, distribution, and evaluation to improve their productivity with efficiency and effectiveness using human capital as well as modern technologies.

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## 8. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

There are a few limitations of the current study that need to be overcome in future research. Although, the current study has assessed the role of a diverse set of macroeconomic indicators to determine the price volatility of natural resources commodities. However, it has only relied on secondary data for analysis over 20 years. In contrast, future researchers can also collect the primary data in specifying the different natural resource commodities. For that purpose, the individuals or organizations dealing with those commodities can be contacted to assess the statistics of price change over time for those commodities. Also, the views and concerns of those individuals and organizations can be recorded to determine the price volatility of natural resource commodities. Secondly, the current study has been conducted in a developing nation context with secondary data regarding the macroeconomic indicators by assessing their impact on natural resource commodities prices in Indonesia. In contrast, future researchers can conduct a comparative study by collecting data from different developed and developing nations to generalize results and confirm the current study findings. Finally, in addition to macroeconomic indicators, future researchers can also set the role of microeconomic indicators like demand and supply, market conditions, rivalry among the competitors, supply chain actors etc., to assess the natural resources commodity price volatility.

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