Journal of Economics, Management and Trade

Volume 30, Issue 5, Page 33-47, 2024; Article no.JEMT.115820
ISSN: 2456-9216
(Past name: British Journal of Economics, Management & Trade, Past ISSN: 2278-098X)

Understanding Global Commodity Price Shocks on Exchange Rates and Inflation in Emerging Economies: ARDL Perspective

Seth Acquah Boateng [a*], Frank Agyemang Karikari [b], Michael Provide Fumey [c], Emmanuel Ekow Asmah [a] and Stephen Antwi Winful [d]

[a] Department of Data Science and Economic Policy, University of Cape Coast, PMB, Cape Coast, Ghana.
[b] Department of Accounting, University of Cape Coast, University of Cape Coast, PMB, Cape Coast, Ghana.
[c] School of Public Policy and Administration, Northwestern Polytechnical University, Xi'an, 710072, P.R.C., China.
[d] Department of Finance, University of Cape Coast, PMB, Cape Coast, Ghana.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEMT/2024/v30i51208

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/115820

Original Research Article

Received: 01/04/2024
Accepted: 10/04/2024
Published: 13/04/2024

ABSTRACT

Aims: To analyze the changing relationship between commodity prices (cocoa, diesel, gold, oil, petrol) and macroeconomic factors (exchange rate and inflation) in Ghana and differentiate between long-term and short-term effects.
Study Design: Quantitative Design with Time series analysis using the Autoregressive Distributed Lag (ARDL) technique.

**Corresponding author: E-mail: sethboatengacquah36@gmail.com, sboateng013@stu.ucc.edu.gh;*

Methodology: The study utilized cointegration and Error Correction Model in econometric estimation. Time series data for commodity prices and macroeconomic factors were collected for the period 2003M01 to 2023M10. The ARDL technique was applied to differentiate between long-term and short-term effects of inflation and exchange rates.
Results: The short-run and long-run results indicate a positive relationship between commodity prices and inflation and exchange rates. A 1% increase in diesel prices is associated with a 0.23% appreciation in Ghana's currency in the short run (p=0.019) and a 1.76% rise in inflation in the long run (p=0.012). Past inflation has a dominant influence on current inflation, with a 1 percentage point increase in the previous year's inflation leading to a 0.45 percentage point increase in the current inflation rate.
Conclusion: Policymakers should prioritize stabilizing diesel prices, invest in storage facilities, promote alternative energy sources, strengthen domestic production and distribution of essential commodities, and adopt targeted monetary and fiscal policies to anchor inflationary expectations and address inflation inertia in Ghana.

Keywords: Commodity prices; inflation; exchange rate; inflation inertia; autoregressive distributed lag (ARDL).

JEL CLASSIFICATION: E31, F31, O13

1. INTRODUCTION

Recent debates on commodity price movements have focused on their impact on macroeconomic indicators such as inflation and exchange rates. There is a belief that commodity prices tend to rise and fall together, influenced by common macroeconomic factors such as interest rates, industrial production, exchange rates, and inflation [1-2]. Commodity price shocks, particularly in strategic commodities like oil, gold, silver, and copper, can lead to expectations of higher inflation and subsequent monetary policy tightening [1]. The choice between targeting the headline consumer price index or a measure of core prices in monetary policy response to commodity price shocks is also a topic in today's world [3-5, 2]. Likewise, the behaviour of the U.S. dollar relative to major currencies in the presence of precious metals and copper prices, as well as interest rates, is of interest [6]. Global commodity price shocks have a significant impact on inflation and exchange rate movements in emerging economies.

These shocks can increase inflation rates, as seen in the case of Iran where global commodity prices were found to positively and significantly affect inflation [7]. The impact of globalization on inflation dynamics is also evident, with increased integration between developed economies and emerging countries leading to a direct impact on domestic inflation in emerging countries [8] Inflation in these countries can be influenced by disruptions in global trade channels, highlighting the structural nature of global inflation [9]. At the same time, commodity price shocks have been identified as major drivers of business cycles in emerging economies, such as Brazil, Chile, Colombia, and Peru [10]. Adopting inflation-targeting regimes in these economies has shown to be effective in coping with commodity price shocks, particularly in managing inflation and output gaps [11]. Therefore, understanding the relationship between global commodity price shocks, exchange rates, and inflation is crucial for policymakers in emerging economies. Studies have shown that positive oil price shocks lead to devaluations in domestic currencies and tight monetary policies in some economies [12]. On the other hand, shocks in agricultural prices cause appreciations in domestic currencies [9].

The relationship between commodity prices and exchange rates varies across countries, with evidence suggesting that changes in commodity prices can better predict exchange rates in export-dependent developed countries, while the random walk model performs better in export-dependent emerging and import-dependent countries [13]. The research by Souza et al. [14] shows that the link between commodity prices and real exchange rates is not consistently positive, but rather depends on the specific country being analyzed. The effects of commodity price shocks on the economy also depend on factors such as global financial variables, global demand shocks, and global economic uncertainty shocks. The impact of copper price shocks on the economy of Chile varies depending on the source of the shock, with demand shocks positively affecting GDP

and supply-side events or specific copper demand having different effects [15].

1.1 Research Gaps, Motivation, and Contribution of the Research

Previous studies about global commodity price shocks and exchange rates in emerging economies include the need for further analysis of the specific impacts of different types of commodity price shocks on domestic financial markets [12]. Mauro [9] identified insufficient studies in understanding the role of global financial variables in influencing commodity prices and their subsequent effects on emerging economies' business cycles. This current study builds on the same notion in assessing the impact of global commodity prices on the Ghanaian economy, within the lens of its inflator factor and exchange rates. According to the research by Shahrazi et al. [7] there is mixed evidence regarding the relationship between global commodity prices and inflation. Some studies have found a positive and significant impact, while others have found no significant effect [9]. In addition, the role of macro-finance linkages and global financial variables in influencing commodity prices and their impact on inflation has not been fully explored [16].

Furthermore, the specific channels through which commodity price shocks affect inflation in emerging economies are not well understood [10]. There is a need for more studies that examine the impact of commodity price fluctuations on a holistic measure of development, such as inflation, exchange rates, and general human development Index, in emerging economies. The motivation for studying the influence of global commodity prices on inflation in a developing country like Ghana stems from the need to understand the factors driving inflation and exchange rates in the country. Although several studies have shown that commodity, prices, such as oil, cocoa, and petroleum products, can have a significant impact on inflation [17-18], this present study seeks to study both the influence on inflation and exchange rates interactions. In Ghana, fluctuations in these commodity prices can lead to changes in the overall price level, affecting the cost of living for the population.

Understanding the relationship between global commodity prices to exchange rates and inflation can help policymakers develop effective strategies to manage inflation and mitigate its negative effects on the economy. This study aims to provide additional and new insights that cover broader and current ways to address and control inflation and exchange rate impacts and increases. For example, an upsurge in the price of crude oil corresponds to an appreciation of the Ghana Cedi during turbulent conditions, while cocoa price tends to appreciate the Ghana Cedi for both normal and extreme market conditions. The current study highlights the impacts of both inflation and exchange rate in the dynamic co-movement of commodity prices, indicating that exchange rate and inflation drive commodity interdependence. Studying the extent of the pass-through of international commodity price changes to the domestic market can provide insights into the transmission mechanism of global price shocks to the local economy, investigating the influence of global commodity prices on inflation and exchange rates as adopted in this research, in Ghana is crucial for informing policy decisions and promoting economic stability.

This research also makes several contributions to existing literary works (1) This research looks at the unique interplay between Commodity Price (Oil Price, Cocoa Price, Petrol price, Diesel price), Exchange Rate, and Inflation in the Ghanaian economy. (2) The authors of this study are optimistic that this study is a pioneer in investigating variables Oil Prices, Cocoa Prices, Petrol prices, and Diesel prices in determining both inflation and exchange rates in a single study in emerging economies like Ghana. (3) The Augmented autoregressive distributed lag (ARDL) developed by Chudik and Pesaran [19] to estimate short and long-term estimators was employed in this study. (4) The theoretical contribution of this study is that we advance the Commodity terms of trade theory and the Inflation and exchange rates hypothesis in the context of the developing economy of Ghana. Since Ghana is an emerging country, we analyzed the presence of this hypothesis in this region. An emerging economy starts to expand, and a rise in economic growth and income may improve because of the inflation and exchange rates interplay. Premised on the afore introduction, the rest of the paper is arranged as follows: Part two covers the literature review, Part three focuses on the methodology, data, and empirical model, part four outlines the empirical results and discussion, and lastly the last part five illustrates the conclusion and policy implications.

2. LITERATURE REVIEW

This part of the study delves into the details of prior literary works on the association between commodity prices (Cocoa, Oil, Gold, Petrol, and Diesel), inflation rate and exchange rate.

2.1 Theoretical Literature

The Commodity Terms of Trade Theory serves as the theoretical basis of the current study as proposed by Berka and Crucini [20] in their model that emphasizes the role of productivity movements in understanding business cycle fluctuations, trade balance dynamics, and economic welfare. The Commodity Terms of Trade Theory explains the relationship between the volatility of commodity prices and various economic factors. It suggests that when commodity prices are volatile, it leads to higher sovereign credit spreads and a higher cost of capital for producers in commodity-dependent countries. This, in turn, affects the growth performance of industries in these countries, particularly in manufacturing sectors that are more vulnerable to financial constraints. The adverse effects of commodity price volatility on growth operate through lower total factor productivity and lower physical capital accumulation in industries that rely heavily on external finance.

The theory also suggests that commodity terms of trade can explain the non-stationarity of real exchange rates in certain countries, such as the Mediterranean or MENA countries. Additionally, relative international commodity prices can have effects on political transitions, with decreases in growth rates increasing the probability of democratic transitions [21-23]. Thus, this research provides empirical evidence on the role of commodity prices in shaping inflation and exchange rate dynamics. Financial l economists and scientists have identified important advancements such as ICT infrastructure development, and technological advances in the use and processing of commodities indicating the efficiency and stability of macroeconomic indicators. Therefore, in this research, we expect a positive association between Commodity Prices (Cocoa, Oil, Gold, Petrol, and Diesel) on Inflation Rate and Exchange rates in Ghana.

2.2 Empirical Literature

2.2.1 Commodity prices (cocoa, oil, gold, petrol, diesel) and inflation rate nexus

Commodity prices, such as cocoa, oil, gold, petrol, and diesel, have a significant impact on inflation. Previous studies by Abaidoo & Agyapong [10], Shahrazi et al. [7] showed that the fluctuations in the prices of these commodities can lead to an increase or decrease in consumer price inflation. The relationship between commodity prices and inflation is complex and varies across different countries and periods. In Nigeria, fluctuations in oil prices asymmetrically influence domestic inflation, with both increases and decreases in oil prices leading to a decline in inflation [24]. In Saudi Arabia, there is a dynamic nexus between oil prices, the Saudi/US dollar exchange rate, inflation, and output growth rate [25]. In Brazil, Russia, India, Indonesia, China, and South Africa, global commodity prices, particularly oil and energy prices, cause inflationary pressures, conversely in Russia where they cause deflationary pressures [26]. Comparatively, in the Organization of Oil Exporting Countries (OPEC), the oil price-inflation nexus is stronger compared to oil-importing countries, and the relationship tends to change over short periods [27,26].

In the UK, world food commodity prices, exchange rates, and oil prices have substantial and significant long-term effects on domestic food price inflation [28]. For example, fluctuations in the forex-adjusted price of crude oil, gold, and cocoa significantly influence inflation [10]. Similarly, a study by Shahrazi et al. [7] assessed global commodity prices, including oil, have a positive and statistically significant impact on inflation in Iran. Commodity price information, including convenience yields, enhances the ability to predict and assess inflation risk [29].

Commodity prices, such as cocoa, oil, gold, petrol, and diesel, have a significant impact on various aspects of the economy and development. Research in this field has focused on factors influencing commodity prices, the impact of price fluctuations on the macroeconomy, commodity price forecasting, and the financialization of commodities [30]. In Sub-Saharan Africa, commodity price changes, including crude oil, cocoa, and gold, have been found to have a positive influence on development, while cotton and coffee price changes have a negative effect [31]. Additionally, oil shocks and inflation have differential impacts on various commodity prices, both in the short and long run [32]. Therefore, changes in commodity prices, particularly those of cocoa, oil, gold, petrol, and diesel, play a crucial role in shaping inflation dynamics.

2.2.2 Commodity prices (cocoa, oil, gold, petrol, diesel) and exchange rate nexus

Commodity prices, including cocoa, oil, gold, petrol, and diesel, have a significant impact on exchange rates in various developing countries. The relationship between commodity prices and exchange rates is examined in several studies. The findings suggest that changes in oil prices can lead to fluctuations in exchange rates, both in oil-producing and exporting countries [33]. In Malaysia, there is evidence of a unidirectional causal relationship running from the nominal exchange rate to oil prices in both the long and short run [34]. Similarly, in Ghana, variations in commodity prices, such as cocoa and crude oil, have a significant influence on the nominal exchange rate [35]. The synchronization between international commodity prices and capital inflows to developing countries has also been observed, leading to double boom-bust cycles and increased vulnerability for commodity-dependent economies [18].

Zou et al. [36] find a strong and robust relationship between commodity prices and exchange rates in Australia and New Zealand, with the commodity price improving the forecast ability of the exchange rate. Cui [37] shows that gold and crude oil are positively correlated with Chinese stock market indices, while the USD CNY exchange rate is negatively correlated. Devereux and Smith [38] propose a monetary model that explains the correlation between commodity prices and currency values in commodity-exporting countries. Jiménez-Rodríguez and Morales-Zumaquero's [39] study suggests that the effect of commodity prices on real exchange rates varies across countries and is not consistently positive. Overall, these studies highlight the interplay between commodity prices and exchange rates, emphasizing the importance of understanding these dynamics for economic stability and policymaking.

3. METHODOLOGY

This chapter captures relevant data collection methods and data analysis technique

3.1 Data Collection Method

The study employed a quantitative research design to investigate the relationship between Commodity Prices (Cocoa, Oil, Gold, Petrol, and Diesel) on Inflation Rate and Exchange Rate in Ghana. Time series secondary data was obtained from the Ghana Statistical Service data bank, covering the period from 2005 to 2023. The dataset consists of monthly observations spanning from January 2005 to October 2023, resulting in a total of 244 observations. The data includes monthly price information for various commodities such as cocoa, diesel, gold, oil, and petrol, as well as macroeconomic indicators like the exchange rate (EXC_RATE) and the inflation rate (INF_OCPI). This comprehensive dataset from an official government source provides a reliable foundation for conducting economic research and trend analysis. Table 1 provides a detailed description of the study variables.

3.2 Estimation Approach

The Augmented Dicky Fuller unit root test was employed to check stationarity in the series. The f-bounds co-integration test was applied to confirm the presence of a long-run relationship between study variables. Before the estimation lag, the length best model estimator was identified. ARDL estimation method was used to analyze the relationship among the variables. ARDL is highly robust regardless of stationarity and endogeneity of study variables [40-42]]. The ARDL estimation method was used to estimate the relationship between Commodity prices and inflation and exchange rate. Robust methods such as diagnostic tests like autocorrelation (Breusch-Godfrey test) and heteroscedasticity (Breusch-Pagan test) were applied and corrected accordingly.

3.3 Model Specification

The research employed the following model to investigate the role of commodity prices on inflation and exchange rates.

$$\mathbf{EXER}_t = f(OIL_t, COCOA_t, GOLD_t, PETROL_t, DIESEL_t, \quad (1)$$

$$\mathbf{INFL}_t = f(OIL_t, COCOA_t, GOLD_t, PETROL_t, DIESEL_t, \quad (2)$$

Table 1. Measurements and variable definitions

Variables	Unit of Measurement	Definition	Data source	Expected sign
Dependent variable				
Inflation rate	CPI	Measures changes in the price of a fixed basket of goods and services purchased by households across the country.	Ghana Statistical Service	No prediction S. Alimia et al., [24]
Exchange rate	US Dollar and Ghana Cedi	Measures the average monthly interbank exchange rate between the US Dollar and Ghana Cedi		No prediction Umoru et al. [33]
Independent variables				
Commodity Prices Cocoa, Oil, Gold, Petrol, and Diesel	US Dollar	OIL_PRICE: Average International Brent crude oil price per barrel. COCOA_PRICE: Average world market price of cocoa per ton GOLD_PRICE: Average world market price of Gold per ounce PETROL_PRICE: Average indicative price of petrol as set by NPA DIESEL_PRICE: Average indicative price of diesel as set by NPA	Ghana Statistical Service	Positive prediction Abaidoo & Agyapong, [10] Butt et al. [34] Zou et al. [36]

To eliminate skewness problems the data variables were transformed into natural logs. Hence, we can re-write the above equation as follows:

$$\ln\mathbf{EXER}_t = \beta_0 + \beta_1 \ln\mathrm{OIL}_t + \beta_2 \ln\mathrm{COCOA}_t + \beta_3 \ln\mathrm{GOLD}_t + \beta_4 \ln\mathrm{PETROL}_t + \beta_5 \ln\mathrm{DIESEL}_t + \varepsilon_t \quad (3)$$

$$\ln\mathbf{INFL}_t = \beta_0 + \beta_1 \ln\mathrm{OIL}_t + \beta_2 \ln\mathrm{COCOA}_t + \beta_3 \ln\mathrm{GOLD}_t + \beta_4 \ln\mathrm{PETROL}_t + \beta_5 \ln\mathrm{DIESEL}_t + \varepsilon_t \quad (4)$$

Where ε_t– represents the error term, t represents time dimensions, $shows$ the constant term, and $\beta_1\ to\ \beta_5$– are coefficients variables.

ARDL estimation model was applied as shown in Equations 5 and 6

$$\Delta\ln\mathrm{EXER}_t = \alpha_{01} + \sum_{i=1}^{p} \alpha_{1i} \Delta\ln\mathrm{EXER}_{t-i} + \sum_{i=0}^{w} \alpha_{2i} \Delta\ln\mathrm{COAP}_{t-i} + \sum_{i=0}^{w} \alpha_{3i} \Delta\ln\mathrm{DIEP}_{t-i} + \sum_{i=0}^{w} \alpha_{4i} \Delta\ln\mathrm{GOLP}_{t-i} + \sum_{i=0}^{w} \alpha_{5i} \Delta\ln\mathrm{OILP}_{t-i} + \sum_{i=0}^{w} \alpha_{6i} \Delta\ln\mathrm{PETP}_{t-i} + \varepsilon_{1t} \quad (5)$$

$$\Delta\ln\mathrm{INFL}_t = \alpha_{01} + \sum_{i=1}^{p} \alpha_{1i} \Delta\ln\mathrm{INFL}_{t-i} + \sum_{i=0}^{w} \alpha_{2i} \Delta\ln\mathrm{COAP}_{t-i} + \sum_{i=0}^{w} \alpha_{3i} \Delta\ln\mathrm{DIEP}_{t-i} + \sum_{i=0}^{w} \alpha_{4i} \Delta\ln\mathrm{GOLP}_{t-i} + \sum_{i=0}^{w} \alpha_{5i} \Delta\ln\mathrm{OILP}_{t-i} + \sum_{i=0}^{w} \alpha_{6i} \Delta\ln\mathrm{PETP}_{t-i} + \varepsilon_{1t} \quad (6)$$

To check for causality association error correction term equations 7 and 8 were used.

$$\Delta lnEXER_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta lnEXER_{t-i} + \sum_{i=0}^{w} \alpha_{2i} \Delta lnCOAP_{t-i} + \sum_{i=0}^{w} \alpha_{3i} \Delta lnDIEP_{t-i} + \sum_{i=0}^{w} \alpha_{4i} \Delta lnGOLP_{t-i} + \sum_{i=0}^{w} \alpha_{5i} \Delta lnOILP_{t-i} + \sum_{i=0}^{w} \alpha_{6i} \Delta lnPETP + \emptyset_1 ECT_{t-1} + \varepsilon_{1t} \quad (7)$$

$$\Delta lnINFL_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta lnEXER_{t-i} + \sum_{i=0}^{w} \alpha_{2i} \Delta lnCOAP_{t-i} + \sum_{i=0}^{w} \alpha_{3i} \Delta lnDIEP_{t-i} + \sum_{i=0}^{w} \alpha_{4i} \Delta lnGOLP_{t-i} + \sum_{i=0}^{w} \alpha_{5i} \Delta lnOILP_{t-i} + \sum_{i=0}^{w} \alpha_{6i} \Delta lnPETP + \emptyset_1 ECT_{t-1} + \varepsilon_{1t} \quad (8)$$

The lagged error correction term ECT_{t-1} , in equations 7 and 8 measures the speed of adjustment to the long-run equilibrium. ECT_{t-1} Is the error correction term.

3. RESULTS AND DISCUSSION

This chapter reports the analysis, results, and discussion.

3.1 Descriptive Statistics

Table 2 shows the summary statistics for the economic variables studied. The mean price of cocoa for the period under consideration is $2447 per ton, with a standard variation of around $500. On the other hand, the mean prices of diesel and petrol in Ghanaian cedis (GHC) are notably lower, around GHC 3.40 each, with comparatively low variability, indicating little price fluctuations. Gold has an average price of $1258 per ounce, with a standard deviation higher than $410. This indicates a broader spectrum of gold prices seen in the dataset. The average inflation rate, as measured by the Consumer Price Index (OCPI), is 55.97, with a standard deviation of 35.22, showing notable fluctuation in inflation levels throughout the studied period. The average currency rate is 3.26 USD per GHC, with a standard deviation of 2.37, indicating variability in the exchange rate. This descriptive study offers an initial insight into the primary patterns and variability of key economic indicators, setting the stage for further in-depth research and analysis [43-45].

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Cocoa_price	220	2447.089	498.8751	1367.6	3430.4
Diesel_price	220	3.429091	3.412971	0.4	22.6
Gold_price	220	1258.41	410.1943	422.7	2000.7
Oil_price	220	76.09909	24.52343	26.6	134.8
Petrol_price	220	3.318182	2.974693	0.4	17.4
Exc_rate	220	3.260909	2.370812	0.9	13.1
Inf_ocpi	220	55.97227	35.21621	15.5	170.6

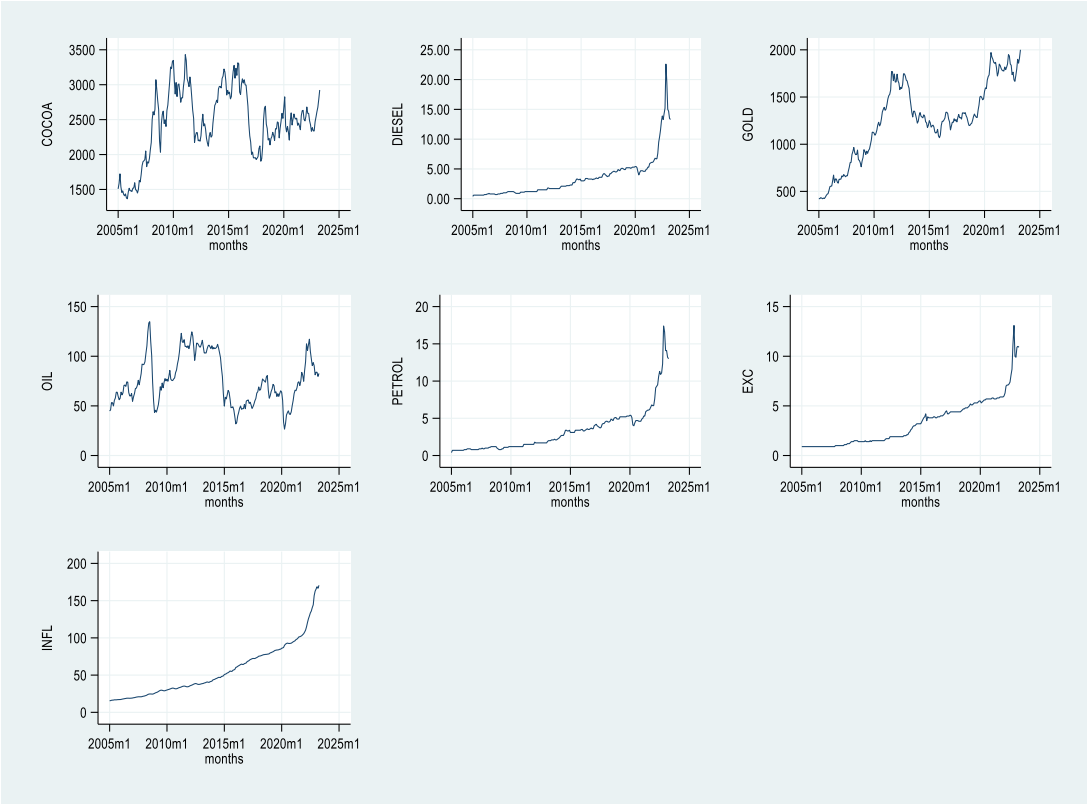

Fig. 1. Trend analysis of key variables

Fig. 1 shows the trend analysis of the key variables studied. Cocoa prices exhibited an overall upward trajectory from 2005 until around 2016-2017, after which they generally declined with occasional spikes. This trend could be influenced by factors such as global demand, supply disruptions, and weather conditions affecting cocoa production. Crude oil and gold prices display cyclical patterns, with periods of increases and decreases. However, both commodities exhibit an overall upward trend, with more pronounced increases in recent years, particularly from 2019 onwards for gold. Also, prices of petrol and diesel have steadily increased throughout the period, with the rate of increase becoming more pronounced in recent years, especially from around 2020 onwards. The exchange rate exhibits a consistent upward trend, indicating a depreciation of the local currency over time. The inflation rate displays an overall upward trend, with the rate of increase accelerating in recent years, particularly from around 2022 onwards. This trend could be attributed to factors such as changes in commodity prices, exchange rate fluctuations, and domestic economic conditions.

3.2 Stationary Test

Table 3 presents Augmented Dickey-Fuller unit root test results examining the order of integration for the time series variables. Tests were conducted on the levels and first differences both with and without trend.

The Augmented Dickey-Fuller (ADF) unit root test was conducted to examine the stationarity of the time series data. The results indicate that the logs of cocoa price (LNCOAP), gold price (LNGOLP), and oil price (LNOILP) are stationary at levels, while the logs of diesel price (LNDIEP), petrol price (LNPETP), exchange rate (LNEXER) and inflation rate (LNINFL) are non-stationary at levels. The ADF test statistics for LCOAP, LGOLP and LOILP are lower than the 1%, 5%, and 10% critical values in absolute terms, indicating rejection of the null hypothesis of a unit root. This means these three variables are integrated of order zero, I(0), and do not require differencing to become stationary. On the other hand, LNDIEP, LNPETP, LNEXER, and LNINFL become stationary only after taking their first differences. Their ADF test statistics exceed the critical values at levels but are significant after differencing the series once. So these variables are integrated of order one, I(1), meaning they required differencing once to achieve stationarity. The cocoa price, gold price, and oil price logs are I(0) while the diesel price, petrol price, exchange rate and inflation rate logs are I(1).

Table 4 presents bound test results examining cointegration relationships between the commodity prices and exchange rate in one model, and commodity prices and inflation rate in a second model. The F-statistics from the bound tests are compared to critical values at the 10%, 5%, and 1% significance levels to determine if cointegration exists.

The bound cointegration test aims to check for a long-run equilibrium relationship among the non-stationary variables. The first model tests if a cointegrating relationship exists between the exchange rate (LNEXER) and the commodity price variables (LNDIEP, LNGOLD, LNOILP, LNPETP). The F-statistic of 1.575 is lower than even the 5% critical value bounds for both the I(0) and I(1) series. Therefore, the null hypothesis of no cointegration cannot be rejected, implying no stable long-run relationship between these variables. However, the test results for the second model - between inflation (LNINFL) and commodity prices - show that the null hypothesis of no cointegration can be rejected at the 5% level. The F-statistic of 4.109 is higher than the 5% upper bound critical value of 3.863 for the I (1) series. Since the F-statistic exceeds the upper critical value bound, we can conclude there is a cointegration between inflation and commodity prices in Ghana at the 5% significance level. This means there is evidence for a statistically significant long-run equilibrium relationship between these variables.

Further analyses examined the short- and long-term relationships between the variables. For the model with the exchange rate (LNEXER) and commodity prices, which showed no cointegration, only a short-run Auto-Regressive Distributed Lag (ARDL) model was estimated. The optimal ARDL specification was selected using the Akaike Information Criterion (AIC). However, since the bound test indicated cointegration between inflation (LNINFL) and commodity prices, both short and long-run dynamics were analyzed using an error correction model (ECM). The ECM framework accounts for long-run equilibrium as well as short-run adjustment dynamics towards that equilibrium. Table 5 presents short-run coefficient estimates from a model examining the effects of various commodity prices on Ghana's exchange rate.

The short-run effects of independent variables on the exchange rate are presented in Table 5. The diesel price coefficient stands out as having the most sizable positive relationship. The coefficient of 0.2297469 suggests that if diesel prices rise by 1% in the short term, it corresponds to a 0.23% appreciation in Ghana's currency. This positive relationship between diesel prices and the exchange rate is consistent with findings from previous studies. Butt et al. [34] documented a unidirectional causal link between oil prices to the nominal exchange rate in Malaysia over the short run. Umoru et al. [33] also noted that oil price changes could drive exchange rate fluctuations in both oil-exporting and importing countries. This is statistically significant having a p-value of 0.019. The petrol coefficient of 0.1222222 also indicates the exchange rate strengthens by 0.12% for a 1% increase in petrol prices. This is not statistically significant based on the p-value. However, the negative short-run coefficients for cocoa (-0.042), gold (-0.024) and oil prices (-0.004) are also not statistically significant. Zou et al. [36] documented a robust positive relationship between commodity prices and exchange rates in commodity-exporting countries like Australia and New Zealand. The divergence for cocoa, gold and oil prices warrants further investigation, as the existing empirical evidence generally points to commodity price increases appreciating currencies, especially in commodity-dependent economies. Potential explanations could relate to specific factors in the Ghanaian economy or global market conditions during the study period. So short-term percentage rises in those commodities relate to less than even a 0.05% decrease in the exchange rate. The effects are marginal, but imply those price changes put some downward pressure on the currency over the short horizon. The coefficients show diesel price changes have the most pronounced positive linkage.

Table 6 displays estimated long-run coefficients from an Autoregressive Distributed Lag (ARDL) model assessing the impact of commodity prices on inflation in Ghana. An ARDL specification with lags (2, 1, 1, 1, 2, and 1) is used to evaluate the lagged and long-run associations between inflation and logged commodity prices of cocoa, diesel, gold, oil, and petrol over an extended period.

The coefficient of diesel price is 1.758926 and is statistically significant at the 5% level, with a p-value of 0.012. This implies in the long term, a 1% increase in diesel prices associated with a 1.76% rise in Ghana's inflation rate. As diesel costs stay elevated over the years, it puts upward pressure on overall inflation. The coefficient of crude oil is -0.2884047 and is significant, with a p-value of 0.000. This finding of a positive long-run effect of diesel prices on inflation in Ghana aligns with the empirical evidence cited that global commodity prices, particularly oil and energy prices, cause inflationary pressures in many emerging economies like Brazil, Russia, India, Indonesia, China, and South Africa [26]. The negative coefficient indicates that a 1% permanent oil price increase correlates with a 0.29% decrease in inflation over the long run. Rising world crude oil costs have an enriching impact on domestic inflationary pressures in Ghana in the long term. This contrasts with the cited empirical evidence that higher oil prices tend to increase inflation, except in the case of Russia where they caused deflationary pressures [26]. The result also shows that a 1% increase in the price of gold will lead to a 0.15% increase in inflation in the long term, although this relationship is not statistically significant. However, the remaining variables were not statistically significant.

Table 3. Unit root test using ARDL

Variable	Level		First Difference		IO
	No Trend	Trend	No Trend	Trend	
Augmented Dickey-Fuller Test					
LNCOAP	0.088	-2.184	-9.221	-9.164	I(0)
LNDIEP	2.869	-0.616	-8.676	-9.325	I(1)
LNGOLP	0.966	-1.584	-8.06	-8.231	I(0)
LNOILP	-0.641	-3.528	-8.172	-8.025	I(0)
LNPETP	2.702	-1.235	-9.627	-10.082	I(1)
LNEXER	2.806	-2.272	-9.335	-9.925	I(1)
LNINFL	4.550	-0.986	-3.845	-5.732	I(1)

Statistical significance at 1, 5, and 10% levels of statistical significance, respectively. -2.58, -1.95 -1.615

Table 4. Bound test result for cointegration

F- Statistic		Critical Values							
Model		**10%**		**5%**		**1%**		**p-value**	
		I(0)	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
Fy(LNEXER, LNDIEP, LNGOLD, LNOILP, LNPETP)	1.575	2.279	3.401	2.66	3.865	3.484	4.848	0.313	0.723
Fy(LNINFL, LNDIEP, LNGOLD, LNOILP, LNPETP)	4.109	2.286	3.4	2.667	3.863	3.493	4.844	0.003	0.034

Do not reject H0 if either F or t are closer to zero than critical values for I (0) variables (if either p-value > desired level for I (0) variables) reject H0 if both F and t are more extreme than critical values for I (1) variable (if both p-values < desired level for I (1) variables)

Table 5. Estimated short run coefficient

Dependent Variable: LEXER						
Regressor	**Coefficient**	**std err.**	**t**	**P>t**	**[95% conf.**	**interval]**
LNCOAP	-0.0423954	0.605607	-0.7	0.485	-0.1619482	0.077158
LNDIEP	0.2297469	0.096933	2.37	0.019	0.0383925	0.421101
LNGOLP	-0.0239801	0.08381	-0.29	0.775	-0.1894302	0.14147
LNOILP	-0.0040378	0.041412	-0.1	0.922	-0.0857898	0.077714
LNPETP	0.1222222	0.118134	1.03	0.302	-0.1109869	0.355431
R-squared			0.9972			
Adj R-squared			0.9969			
Root MSE			0.0408			
F(12, 169)			4927.8			
Prob > F			0.000			

Table 6. Estimated long run coefficient

	Dependent Variable: LINFL					
Regressor	**Coefficient**	**Std. err.**	**t**	**P>t**	**[95% conf. interval]**	
LNCOAP	-0.0463429	0.1194298	-0.39	0.698	-0.28212	0.189434
LNDIEP	1.758926	0.6946663	2.53	0.012	0.387526	3.130326
LNGOLP	0.1561513	0.1342864	1.16	0.247	-0.10896	0.421258
LNOILP	-0.2884047	0.0766165	-3.76	0.000	-4396599	-0.13715
LNPETP	-1.096077	0.6865039	-1.6	0.112	-2.45136	0.259208

Table 7. Estimated ARDL short-run coefficients and the error correction estimate

	Dependent Variable: LINFL					
Regressor	**Coefficient**	**Std. err.**	**t**	**P>t**	**[95% conf. interval]**	
LNINFL	0.4471366	0.0644881	6.93	0.000	0.319825	0.574448
LNCOAP	0.008344	0.0132833	0.63	0.531	-0.01788	0.034568
LNDIEP	0.0430288	0.0228618	1.88	0.062	-0.0021	0.088162
LNGOLP	-0.002167	0.018517	-0.12	0.907	-0.03872	0.034389
LNOILP	0.011069	0.0092663	1.19	0.234	-0.00722	0.029362
LD	-0.0041148	0.009634	-0.43	0.67	-0.0231341	0.0149044
LPETP	0.0032902	0.0242639	0.14	0.892	-0.04461	0.051192
_cons	0.1317569	0.0406913	3.24	0.001	0.051425	0.212089
R-squared =			0.5078			
Adj R-squared =			0.4697			
Root MSE =			0.0089			
Log likelihood =			608.0736			
Prob > F			0.000			

Table 7 presents short-run coefficient estimates and error correction parameters from an ARDL model examining the effects of commodity prices on inflation in Ghana. The lagged inflation rate is included alongside logged cocoa, diesel, gold, oil, and petrol prices to analyze their short-term impacts.

The estimated short-run dynamics point to past inflation having the most dominant association with current inflation in Ghana, as depicted by the largely positive and statistically significant coefficient of 0.4471366. This indicates rising prices exhibit substantial inertia - a 1 percentage point increase in inflation in the previous year links to about a 0.45 percentage point increase in the current inflation rate. The diesel price coefficient is 0.0430288, meaning a 1% increase in diesel prices corresponds to nearly a 0.04 percentage point uptick in the inflation rate within the year. As diesel costs spike over weeks or months, it feeds appreciably into consumer price inflation in the economy. This positive short-run impact of diesel prices on inflation aligns with the empirical evidence from Rizvi & Sahminan [26]. found global diesel and energy prices cause inflationary pressures in many emerging economies. The positive short-run effects are

consistent with Abaidoo & Agyapong [10] who found that crude oil prices and diesel had a significant positive impact on inflation in Ghana. Changes in gold and petrol prices have negligible associations with current price levels and are also insignificant. The insignificant error correction term indicates there are no rapid self-correcting forces that revert inflation to its long-run rate either.

4. CONCLUSION

This study analyzed the changing relationship between commodity prices (Cocoa, diesel, gold, oil, petrol) and macroeconomic factors - exchange rate and inflation - in Ghana from 2000 to 2020. Augmented Dickey-Fuller unit root tests indicated the logs of cocoa, gold and oil prices were stationary at levels I(0), but logs of diesel and petrol prices, exchange rate and inflation rate needed first differencing to reach stationarity I(1). The bound cointegration test indicated no evidence for a long-run equilibrium link between the exchange rate and the commodity prices however, the test demonstrated cointegration between the inflation rate and the commodity prices. This indicates a statistically insignificant long-term relationship between inflation level and commodity price variations. The estimated short-run impact emphasized diesel price fluctuations having the most significant positive link with exchange rate swings. A 1% increase in diesel prices correlated to a 0.23% appreciation of Ghana's currency during the following year.

The long-run research found a 1% permanent increase in diesel prices corresponding with a substantial 1.76% spike in Ghana's inflation over time. This long-term inflationary impact is statistically significant at 5%. A permanent 1% increase in global crude oil prices correlated with a 0.29% eventual drop in domestic inflation. As global oil prices keep growing throughout the years, it has an enriching influence, alleviating inflation pressures in Ghana's net oil-importing economy. The short-run inflation trends reveal strong inertia in Ghana's inflation. A one-percentage point spike in historical inflation related to a 0.45 percentage point increase in the present inflation rate. Alongside this major inertia impact, short-run surges in diesel prices can considerably lead to heightened consumer price inflation.

To mitigate the impact of global commodity price fluctuations on Ghana's inflation and exchange rates, policymakers should adopt a multi-faceted approach. This includes reducing reliance on imported diesel, promoting alternative energy sources, investing in storage facilities for diesel and related products to buffer against global price shocks, strengthening domestic production and distribution of essential commodities to reduce the pass-through effect on inflation, and implementing targeted monetary and fiscal policies to anchor inflationary expectations and address inflation inertia caused by medium to long-term commodity price spikes. These measures will help stabilize exchange rates, manage inflation, and enhance Ghana's economic resilience in the face of global commodity price volatility.

AVAILABILITY OF DATA AND MATERIALS

The data used in the study that support the findings of this study have been downloaded from the Ghana Statistical Service (GSS)(https://statsbank.statsghana.gov.gh/pxweb/en/Macro%20Economic%20Indicators/)

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kozlovtceva I, Ponomarenko A, Sinyakov A, Tatarintsev S. A case for leaning against the wind in a commodity-exporting economy. International Economics. 2020;164:86–114.
Available:https://doi.org/10.1016/j.inteco.2020.08.003
2. Coletti D, Lalonde R, Masson P, Muir D, Snudden S. Commodities and monetary policy: Implications for inflation and price level targeting. Journal of Policy Modeling. 2021.
Available:https://doi.org/10.1016/j.jpolmod.2021.02.013
3. Wang Y, Zhu Q, Wu J. Oil price shocks, inflation, and Chinese monetary policy. Macroeconomic Dynamics. 2017;23(1):1–28.
Available:https://doi.org/10.1017/s1365100516001097
4. Siami-Namini S. Commodity prices, monetary policy and the taylor rule; 2018.
Available:https://scholar.googleusercontent.com/scholar.bib?q=info:ssf6kdi_RgJ:scholar.google.com/&output=citation&scisdr=Cl

HW2a1AELjR4Lkl5y0:AFWwaeYAAAAAZhQj_y1_BR1znGboPijc3cpKbYI&scisig=AFWwaeYAAAAAZhQj_5PxpNejy_CHPBwuOgau4TU&scisf=4&ct=citation&cd=-1&hl=en

5. Sahu P. A study on the dynamic behaviour of headline versus core inflation: Evidence from India. Global Business Review; 2019.
Available:https://doi.org/10.1177/0972150919836035
6. Semeyutin A, Downing G. Co-jumps in the U.S. interest rates and precious metals markets and their implications for investors. International Review of Financial Analysis. 2022;81:102078.
Available:https://doi.org/10.1016/j.irfa.2022.102078
7. Shahrazi M, Ghaderi S, Sanginabadi B. Commodity prices and inflation: an application of structural VAR. Applied Economics. 2022;1–11.
Available:https://doi.org/10.1080/00036846.2022.2108753
8. Volodymyr K, Dmytro K. The impact of globalization on the dynamics of inflation. 2023(1):85–101.
Available:https://doi.org/10.33763/finukr2023.01.085
9. Mauro SF. Global shocks and emerging economies: Disentangling the commodity roller. Revista Brasileira de Economia. 2022;76(3).
Available:https://doi.org/10.5935/0034-7140.20220014
10. Abaidoo R, Agyapong EK. Commodity prices, inflation and inflation uncertainty among emerging economies. Journal of Economic and Administrative Sciences; 2022.
Available:https://doi.org/10.1108/jeas-10-2021-0203
11. Araujo EL, De-Araújo E, da Fonseca MRR, Mourão PR. External shocks and monetary policy under the inflation targeting regime (ITR): An analysis of the determinants of inflation for the period 2000-2021. PSL Quarterly Review. 2023;76(306):293–311.
12. Luccas AA. Impact of Oil and Agricultural Shocks on the Financial Markets of Emerging Market Economies. International Economic Journal. 2023;37(2):270–293.
Available:https://doi.org/10.1080/10168737.2023.2207086
13. Hevia C, Juan PN. Research Insights: Do Primary Commodity Prices Account for the Fluctuations of Exchange Rates? [Internet]; 2022.
Available:https://doi.org/10.18235/0004605
14. Souza RS, Mattos LB, Lima JE. Commodity prices and the Brazilian real exchange rate. International Journal of Finance & Economics. 2020;26(2):3152–3172.
Available: https://doi.org/10.1002/ijfe.1955
15. Haider S, Nazir MS, Jiménez A, Jibran Qamar MA. Commodity prices and exchange rates: evidence from commodity-dependent developed and emerging economies. International Journal of Emerging Markets; 2021.
Available:https://doi.org/10.1108/ijoem-08-2020-0954
16. Pedersen M. The impact of commodity price shocks in a copper-rich economy: the case of Chile. Empirical Economics. 2018;57(4):1291–1318.
Available:https://doi.org/10.1007/s00181-018-1485-9
17. Ayisi RK. The asymmetry effect of oil price changes on inflation, and the welfare implication for Ghana. African Journal of Economic and Management Studies. 2020;12(1):55–70.
Available:https://doi.org/10.1108/ajems-01-2020-0009
18. Archer CL, Peterson OJ, Adam AM, Asafo-Adjei E, Stephen YB. Asymmetric dependence between exchange rate and commodity prices in Ghana. Annals of Financial Economics. 2022;17(02).
Available:https://doi.org/10.1142/s2010495222500129
19. Chudik A, Pesaran MH. Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. Journal of Econometrics. 2015;188(2):393–420.
Available:https://doi.org/10.1016/j.jeconom.2015.03.007
20. Berka M, Crucini MJ. The consumption terms of trade and commodity prices. RePEc: Research Papers in Economics; 2009.
Available: https://doi.org/10.3386/w15580
21. Gruss B, Suhaib K. Commodity Terms of Trade. IMF Working Papers. 2019;(21):1–38.
Available:https://doi.org/10.5089/9781484393857.001.a001
22. Tröster B, Küblböck K. Unprecedented but not unpredictable: effects of the covid-19 crisis on commodity-dependent countries.

The European Journal of Development Research; 2020.
Available:https://doi.org/10.1057/s41287-020-00313-9

23. Lee D. Commodity terms of trade volatility and industry growth. SSRN Electronic Journal; 2022.
Available:https://doi.org/10.2139/ssrn.4252533
24. Alimia AS, Olaniranb D, Ayubac TO. An asymmetric evaluation of oil price- inflation nexus: Evidence from Nigeria. Energy Economics Letters. 2020;7(1):1–11.
Available:https://doi.org/10.18488/journal.82.2020.71.1.11
25. Aloui C, Hkiri B, Hammoudeh S, Shahbaz M. A multiple and partial wavelet analysis of the oil price, inflation, exchange rate, and economic growth nexus in Saudi Arabia. Emerging Markets Finance and Trade. 2018;54(4):935–956.
Available:https://doi.org/10.1080/1540496x.2017.1423469
26. Rizvi SAR, Sahminan S. Commodity Price and Inflation Dynamics: Evidence from BRIICS. Buletin Ekonomi Moneter Dan Perbankan. 2021;23(4):485–500.
Available:https://doi.org/10.21098/bemp.v23i4.1418
27. Salisu AA, Isah KO. Revisiting the oil price and stock market nexus: A nonlinear Panel ARDL approach. Economic Modelling. 2017;66:258–271.
Available:https://doi.org/10.1016/j.econmod.2017.07.010
28. Anderl C, Caporale GMC. Global food prices and inflation. Social Science Research Network; 2024.
Available:https://doi.org/10.2139/ssrn.4756074
29. Garratt A, Petrella I. Commodity prices and inflation risk. Journal of Applied Econometrics; 2021.
Available: https://doi.org/10.1002/jae.2868
30. Zhang Q, Hu Y, Jiao J, Wang S. Exploring the trend of commodity prices: a review and bibliometric analysis. Sustainability. 2022;14(15):9536.
Available:https://doi.org/10.3390/su14159536
31. Abaidoo R, Agyapong EA. Commodity price fluctuations and development: perspective from emergisporadic.mies. Journal of Financial Economic Policy; 2021.
Available:https://doi.org/10.1108/jfep-02-2021-0039
32. Kliesen KL. The link between higher commodity prices and inflation. Economic Synopses. 2021;(22).
Available:https://doi.org/10.20955/es.2021.22
33. Umoru D, Solomon EE, Okpara E, Robert IE, Davidson I, Cletus UN, Muhammed AO, Anna NT, Kasimu E. Oil-exchange rate volatilities and returns nexus. Corporate Governance and Organizational Behavior Review. 2023;7(2, special issue):325–337.
34. Butt S, Ramakrishnan S, Loganathan N, Chohan MA. Evaluating the exchange rate and commodity price nexus in Malaysia: evidence from the threshold cointegration approach. Financial Innovation. 2020;6(1).
Available: https://doi.org/10.1186/s40854-020-00181-6
35. Salisu A, Sikiru AA. Palm oil price–exchange rate nexus in Indonesia and Malaysia. Buletin Ekonomi Moneter Dan Perbankan. 2021;24(2):169–180.
Available:https://doi.org/10.21098/bemp.v24i2.1620
36. Zou L, Zheng B, Li X. The commodity price and exchange rate dynamics. Theoretical Economics Letters. 2017;07(06):1770–1793.
Available:https://doi.org/10.4236/tel.2017.76120
37. Cui J. The relationship between the gold price, crude oil price, exchange rate and chinese stock market indexes. Highlights in Business, Economics and Management. 2023;10:180–188.
Available:https://doi.org/10.54097/hbem.v10i.8037
38. Devereux MB, Smith GW. Testing the present-value model of the exchange rate with commodity currencies. Journal Of Money, Credit And Banking. 2021;53(2-3):589–596.
Available:https://doi.org/10.1111/Jmcb.12774
39. Jiménez-Rodríguez R, Morales-Zumaquero A. Impact of commodity prices on exchange rates in commodity exporting countries. The World Economy; 2020.
Available:https://doi.org/10.1111/twec.12952
40. Pesaran MH, Shin Y, Smith RJ. Bounds testing approaches to the analysis of level relationships. Journal of

Applied Econometrics. 2001;16(3):289–326.

41. Nagle AK, O. PF, Yamazaki T. Causes and consequences of industrial commodity price shocks. The World Bank EBooks. 2022;221–261. Available:https://doi.org/10.1596/978-1-4648-1911-7_ch4
42. Dumitrescu E-I, Hurlin C. Testing for granger non-causality in heterogeneous panels. Economic Modelling. 2012;29(4): 1450–1460. Available:https://doi.org/10.1016/j.econmod.2012.02.014
43. Glebocki KH, Saha S. Foreign exchange and global monetary shocks: The asymmetric effects of advanced economies' quantitative easing on exchange rate volatility in emerging markets. International Economic Journal. 2022:1–23. Available:https://doi.org/10.1080/10168737.2022.2098353
44. Hove S, Touna Mama A, Tchana Tchana F. Terms of trade shocks and inflation targeting in emerging market economies. South African Journal of Economics. 2015;84(1):81–108. Available:https://doi.org/10.1111/saje.12086
45. Krichene N. Recent Inflationary trends in world commodities markets. 2008(130):1–26. Available:https://doi.org/10.5089/9781451869897.001.a001

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/115820