OIL PRICE SHOCKS, UNCERTAINTY AND EXCHANGE RATE RETURNS IN DEVELOPING COUNTRIES

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ABSTRACT

Based on DCC-GARCH and Markov regime switching models, the paper examines how country-specific economic policy uncertainty and Brent oil price shocks affect the currency returns of 20 African countries. This paper focused on monthly series, and the timeframe used was between June 1, 2016, and December 31, 2023. Findings of the DCC-GARCH model indicate that country-specific uncertainty and oil price shocks had a negative impact on the returns of exchange rate, and were relevant both in developing and developed economies. The outcomes estimated indicate that shocks from oil price variations as well as the uncertainty index were associated with depreciation of the exchange value of local currencies and therefore reduced returns. The uncertainty that comes with economic policies determines exchange-rate fluctuations. The Markov regime switching model estimations confirm that when there is a boom surge, exchange rate returns are greatly and positively influenced by oil price shocks, whereas uncertainty in market news results in considerable fall in returns at both low and high volatility phases. Higher oil-price shocks have adverse effects on the external value of a currency during a high volatility period. This influence gives off unsettling signals to overseas activities of forex market investors, which could harm the market's performance. This study is valuable for foreign exchange market investors in search of positive returns.

Keywords: Oil price shocks; exchange rate variations; asymmetric effects, national economic policy uncertainty, Markov regime switching, low/high volatility regimes

JEL classification: F31, Q43, D81, O13, F41

1. Introduction

Oil is a major commodity that has tremendous impact on the world economy. Crude oil accounts for 53% of the energy used in the Middle East and 32% in Europe and Asia, while Africa consumes 41% of the same energy resources (OECD, 2019). Volatility of oil prices can be attributed to different causes, among which are changes in the geopolitical landscape or, for example, the recent COVID-19 pandemic. Oil prices are among the key factors that determine the terms of trade of a nation. Any changes in oil prices, consequently, may have a direct impact on the economy of a country, its balance of trade and fiscal status, all of which influence the value of its currency cumulatively. An increasing trend in oil prices creates a surplus in an oil-exporting nation's current account and a large influx of foreign currency and hence, helps in the appreciation of the local currency. Oil-importing countries lose some of their wealth to the oil-producing countries which may lead to the creation of trade deficit and subsequent depreciation of the currency of the importing country.

Policy uncertainty does not function independently; it alters the behaviour of markets in relation to oil price changes. At low uncertainty, the market response to oil shocks is highly predictable, based on basic supply-and-demand factors. On the contrary, when the level of uncertainty is high, the impact of oil shocks increases; this is referred to as a multiplier effect. Increased policy uncertainty, as Nilavongse et al. (2020) showed, can make a currency more sensitive to demand-side shocks but less responsive to supply-side information due to the fact that investors prefer not to risk their money on domestic currency and would prefer to use a currency considered safe, like the US dollar. An analysis of these dynamics can help firms and policymakers to predict some of these phenomena like the Dutch Disease or balance of payments crises before they occur. Therefore, it is of great interest to analyse the effects of fluctuating oil prices and uncertainty in economic policies on currency returns.

The exchange rate is a fundamental determining factor in the economy of oil importing and exporting countries because it correlates with macroeconomic variables. A substantial body of literature has formed a nexus between the two variables: exchange rate and oil prices (Gylych et al., 2020; Das, 2021). However, these studies vary in various aspects, including the frequency domain, time-varying analysis, volatility spillover, and long-run and short-run relationships. Exchange rate is one of the most conspicuous means by which the impacts of fluctuations in oil prices are transmitted into the economy (Umoru et al., 2023b). Theoretical studies suggest three ways in which oil price variations impact the exchange rate before triggering other wider economic impacts (Buetzer et al., 2016). According to Beckmann et al. (2017), the applicable channels are the terms-of-trade, wealth, and portfolio-reallocation channels. Price level influences the actual exchange rate because it relates to oil prices, which channels in through trade. The wealth and portfolio effects, on the contrary, are concerned with the short, medium, and long-term effects of the changes in oil prices on the US dollar as compared to those of the oil exporter currencies.

Together with macroeconomic volatility, sudden policy changes surrounding the implementation of currencies could create uncertainties and impact businesses. The currency rate may also be impacted by uncertainties about imminent government actions and policies. Bartsch (2019) elucidates that market agent expectations regarding cost and benefit may impact pricing due to uncertainty surrounding government policy. Demand and supply are likely to be impacted by these predictions, which might ultimately have an impact on currency values. Periods of significant economic uncertainty are likely to see more volatility in the exchange rate. The present study aims to evaluate the effects of oil price shocks and national economic policy uncertainty (NEPU) on exchange rate returns in developing countries.

The paper makes contributions from the following perspectives. First, the relevance of considering the implications of variability of the prices of crude oil and uncertainty in policy origins arises due to its ability to inform macroeconomic forecasts, optimize risk containment measures, guide the design of policies, stabilize the economies of the countries, and enhance international trade relationships. The study of this is therefore invaluable to policy-makers, investors and corporate leaders who have to work their way through the complex and interconnected economic environment across the globe. In the case of multinational enterprises, the understanding of oil shock amplification by the NEPU index makes it possible to implement advanced hedging approaches. In the event that empirical data show that a given currency is hypersensitive to oil at times of high NEPU, companies can hedge foreign-exchange exposure in advance instead of concentrating on energy-cost hedging alone. The resulting implications allow central banks to detect the presence of either transient shock in the supply of oil or a deeper-rooted violation in policy credibility. Similarly, the governments of the oil-related states can use such results in fine-tuning the ratio of foreign-exchange reserves to keep as a buffer to certain shocks involving OIL-EPU interaction, and provide a scientific explanation of why capital investment may be deferred or accelerated. Understanding the asymmetric effect of oil shocks helps businesses remain liquid in unstable regimes, which improves resilience. Secondly, the study will use dynamic correlational analysis, based on the DCC model with multivariate normal distribution, and Markov regime switching, which provides supportive scientific findings in identifying the behaviour of currency returns within different periods of scales while taking cognizance of the specific time shifts in the parameters associated with the research variables in regime-specific values.

The methodologies applied in the study capture more intricate and dynamic patterns by allowing time and interval dynamics to characterize estimated coefficients. This indeed provides the guarantee that the research findings will stand the test of time. Third, by including fresh empirical evidence on the linkage between foreign policy uncertainty and currency volatility, this study adds to the body of knowledge already available on economic policy uncertainty. As a potent tool used by policy makers, the government, financial industry participants, and the monetary authorities for evaluating the risk of uncertainty in relation to all the countries researched, the findings of this study are worthwhile for investors in foreign exchange markets across regimes.

Additionally, the study will provide policymakers with recommendations on how to improve the economy by altering exchange rate policies and deal with oil price shocks. Furthermore, macroeconomic adjustment has not yet fully fulfilled this crucial role, despite the efforts being made. The views of those who oppose its operation have gained traction as they have enumerated certain problems with macroeconomic policy concerning the growth of the economy. Developing nations still have a long way to go before their people become used to a stable economic structure. Because the study provides a clear picture of the exchange rate and creates the foundation for further research, it will be useful for academics and students alike.

2. Prior Findings

2.1 On policy uncertainty and exchange rate returns

In economic theory, the business cycle theory describes fluctuations in economic activity over time. It posits that economies experience periods of expansion and contraction, known as booms and busts, in a cyclical manner (Garg & Sah, 2024). The theory suggests that these fluctuations are a natural part of the economic system and are driven by a variety of factors, including changes in consumer and business confidence, government policies, and external shocks, such as wars or natural disasters (Saini et al., 2021). During an expansion phase of the business cycle, economic activity increases, leading to job growth, rising incomes, and increased consumer spending. This period is characterized by high levels of optimism and investment as businesses seek to capitalize on the growing demand for goods and services. However, as the economy reaches its peak and demand begins to wane, the cycle enters a contraction phase. During a contraction phase, economic activity slows down, leading to job losses, declining incomes, and reduced consumer spending (Summa et al., 2023)

Numerous studies have examined the link between uncertainty and currency returns. For example, after controlling for potential heterogeneity, the findings of Korley and Giouvris (2023) from a study on a panel of 12 ECOWAS nations indicate that short-term exchange rate swings cannot be explained by domestic EPU. However, the currency exchange rates of the 12 countries studied increased as a result of foreign EPU. The region's inadequate institutional framework was cited as responsible for this. Significant evidence of the predictive power of EPUs in emerging nations on the BRIC EPU has been identified. Moldovan et al. (2025) provide empirical evidence in the United Kingdom that economic policy uncertainty has a direct negative impact on real exchange rate. According to Aina (2025), the negative effect of EPU in relation to macroeconomic stability and currency pressure is greater than the positive effect of policy clarity, which generates downward bias in exchange rate returns around the transition periods. Yang

(2025) using an advanced partial wavelet coherence analysis to show that implied volatility in foreign-exchange markets gradually tracks global EPU indices on a variety of temporal scales, particularly during crisis regimes.

Karimo and Ochoche (2025) proved that increased uncertainty of policy discourages FX-market volatility, but EPU serves as a predictor of exchange-rate volatility and domestic market risk stands out as a stronger predictor than global risk. According to Glebocki and Saha (2024), the shocks of uncertainty that originate primarily in the United States trigger extreme volatility and depreciation in emerging markets' currencies, typically superseding the domestic stabilizing process. Juhro and Phan (2018) found that, out of ten ASEAN nations, global EPU had significant forecasting influence on exchange rate volatility for six of them, while global EPU had significant predicted influence on exchange rate volatility for all the ten nations.

Also, a distinct body of research examined how EPU affects exchange rate volatility and other asset classes, including bonds, equities, commodities, insurance, and derivatives (Umoru et al. 2025; Ekeocha, 2025; Munandar, 2025; Jiang & Wu, 2025; Shair et al., 2023; Uche et al., 2022b). According to Umoru et al. (2025), empirical evidence links news-based uncertainty to fluctuations in foreign currency values in developing African nations. Oil and forex market volatility elaborated the variation scores linked to oil prices, currency exchange rates, and news uncertainty. The incidence of business cycles was illustrated by this outcome. Munandar (2025) used the PMG estimator to estimate a PARDL model, and the empirical results show that higher global and US EPUs caused emerging ASEAN-6 currencies to appreciate over the long term. In order to counteract inflationary pressures and the decline in competitiveness in the export sector, the study reinforces how important it is for ASEAN-6 central banks to keep a close eye on the US and global EPU developments and modify their forex policies accordingly. Using the EGARCH model for Pakistan, Shair et al. (2023) discovered that EPU positively impacts Pakistan's exchange rate.

The results of Sohag et al. (2022) reveal that when controlled floating exchange rates are in place, a rise in the uncertainty surrounding Russian policy leads to appreciation of the ruble, but when the system is in place, it produces depreciation. The contraction period is marked by pessimism and risk aversion as businesses become more cautious in their investment decisions. Eventually, the economy reaches a trough before starting the cycle all over again with a new period of expansion (Okorie et al*.*, 2021). Overall, the business cycle theory points to the cyclical nature of economic activity and the potential for both growth and downturns. By studying the business cycle, policymakers can make informed decisions to mitigate the impact of economic fluctuations and promote long-term stability and growth. In today's complex global economy, the business cycle theory remains a valuable tool for economists and policymakers alike to navigate the uncertainties of the market (Saini et al., 2021; Paramanik et al*.*, 2021).

Another body of research examined the connection between macroeconomic factors and EPU (Hashmi & Chang, 2021). A country's exports and imports may be impacted by unclear economic policies, which may alter the demand for foreign currencies and, consequently, exchange rates. Changes in interest rate policies have an impact on the exchange rate because they influence the borrower's decisions to borrow in foreign currency or in the local currency. Though there is a theoretical connection between exchange rate and EPU, as mentioned above, there is not much actual research that looks at the relationships between the underlying variables. Bahmani-Oskooee & Maki-Nayeri (2019) investigated the nonlinear link between macroeconomic activity and EPU in G7 nations. His research led to the conclusion that the G7 nations' economic indicators are asymmetrically impacted by EPU. The findings of the study by Basher et al. (2019) substantiate the evidence that while a shock to economic policy uncertainty significantly increases realized stock market volatility, a positive shock to commodity prices decreases it.

2.2 On oil price and exchange rate returns

According to Haseen et al. (2025), there is a significant negative relationship between oil prices and international exchange rates when there is global economic instability. Additionally, the authors determined that, in times characterized by usual economic activities, there is a disconnect between petroleum prices and currency rates. Umoru et al. (2023a) submit that devaluation has a detrimental impact on oil prices and returns in developing nations. The study by Molina-Muñoz and Soriano-Felipe (2025) goes a step further and considers price fluctuation in explaining the uncertainty of future oil prices as a cause of currency fragility, which indicates that future oil price uncertainty has a significant impact on currency returns through portfolio rebalancing and investor expectations. Diaf (2025) used fractal regression to analyse how changes in oil prices affect returns on the nominal exchange-rate, showing that the relationship between the effects of oil price changes on currency returns and the time-scale varies smoothly, with greater effects at longer horizons than at a high frequency of data. The findings from Nigeria as reported by Ayodele et al. (2025) show that there are asymmetric impacts of oil price shocks on the exchange rate with negative shocks having a stronger impact on the depreciation of the currency compared to positive shocks causing an appreciation effect, hence the need to research the risk in oil-dependent currency markets.

Sanchez-Espigares et al. (2025) used the technique of fractal regression to identify short-term decoupling in regimes of high volatility, indicating that short-term shocks can be effectively countered by monetary policy intervention; however, long-run trends in the oil-price environment have a strong presence and can hardly be neutralized. Recent studies are increasingly applying nonlinear models to show the asymmetric response of currency returns to increases and decreases in oil prices. Sanusi (2024) confirmed that a fall in the currency value immediately after a fall in the price of oil is higher and worse compared to the complement that happens after a similar increment. Umoru et al. (2024a) argue that such asymmetry is caused by the fact that oil is both a factor of production and a critical consumption good; therefore, higher prices result in an increase in income, and also an increase in industrial expenses and the cost of imported petroleum products, offsetting the gains made in currency to some degree. The authors noted that the rate at which the oil market influences the currency market in more than 21 developing economies exceeds the rate at which the currency market influences the oil market. Ben Dahmash (2023) and Gong et al. (2025) made use of structural vector autoregression (SVAR) to prove that demand-side shocks (i.e., global economic growth) result in persistent currency appreciation to exporters, and that supply-side shocks (i.e., production cuts) result in less persistent, more volatile currency reactions, usually accompanied by increased EPU.

Song et al. (2022) investigated the network linkages among China's commodities, currency rates, and categorical economic policy concerns. They determined that the USD/CHY pair primarily controls the domestic system in China. Furthermore, China's commodity returns are dominated by the uncertainties surrounding fiscal and monetary policies. When policy uncertainty increases in a foreign nation relative to a stable one, international investors will react swiftly to alter their investment choices. Additionally, investors cannot alter their selections during slight policy changes since they are associated with costs in both investment and policy decisions. On the other hand, if there are notable shifts in the level of uncertainty around foreign policy, they could modify their decisions.

Nyangarika et al. (2019) investigated how Russia's macroeconomic indicators were affected by oil prices. The Granger causality and vector autoregression models were applied, using data from 2014 to 2016. Results demonstrate how oil prices affect Russia's GDP and exchange rate. Hajiyev (2019) also examined the link between changes in oil prices and inflation, money supply, and exchange rates using co-integrated vector autoregressive and error correction models. Altarturi et al. (2018) examined the interaction by determining the nonlinear causation between the prices of gold, oil, and the real exchange rate using wavelet partial coherence and higher-order coherence. They found that the short-term USD exchange rate had a negative effect on gold and oil prices, whereas oil prices had a negative long-term influence on the exchange rate. Similar to this, Hasanov et al. (2017) investigated how macroeconomic variables in Kazakhstan, Russia, and Azerbaijan, three nations that export oil, were affected by changes in oil prices.

Standard theory assumes that in case oil prices rise, the currencies of countries that export oil will appreciate. However, more current empirical data indicate that commodity currencies, like the Nigerian naira or the Canadian dollar, undergo joint downturn at the same time as the global EPU is high during oil boom periods. No clearly defined demarcation of uncertainty exists where the classical terms-of-trade advantage of oil production is fully neutralized by the flight-to-safety demand of resources like the US dollar and gold. It follows that it is immediately necessary to determine the critical level of the NEPU index past which the exchange rates of any oil-producing country lose their positive association with fluctuations in the price of crude oil, and how the interaction between NEPU and the volatility of oil prices reforms the long-term equilibrium of exchange rate returns.

3. Materials and Methodology

3.1 Data: Measurement and sources

A total of 90 months, from June 1, 2016, to December 30, 2023, were covered by our panel data observations for 20 nations. This resulted in a grand total of 180 observations for each country. Exchange rate volatility was calculated as the average return on the bilateral exchange rate. We used the monthly indices on NEPU based on the constructed indices by Davis (2016). It was the national EPU indices of sixteen nations that generated two-thirds of the global output that were averaged by Davis (2016) to create the monthly global policy uncertainty index. Each country's GDP was used to weight the index. In addition to reflecting the ambiguity in fiscal and monetary policies that impact the economic settings in which profit-making enterprises operate, particularly in relation to business choices and welfare, index captured uncertainty from government announcements, policy, market, and economic indicators (Farooq et al., 2022; Amin & Dogan, 2021; Al-Thaqeb & Algharabali, 2019). Using www.policyuncertainty.com, we accessed the news-based uncertainty index constructed by Baker et al. (2016). This database consists of a monthly compilation of newspaper publications that contain at least one term associated with policy, economy, or uncertainty.

The exchange rates that were analysed were sourced from DataStream and are the daily market rates of the home currencies relative to USD. The daily standard deviation of the corresponding exchange rate returns was calculated to take into consideration the volatility of each country's currency rates. Oil price shock measured the change in the price of Brent oil relative to the price of oil that consumers and firms expected. The data measured the net oil price changes. The set of developing nations at the focal point of this study are emerging market nations, which have been shown to be extremely sensitive to transmission shocks from advanced economies and to have a high rate of exchange rate volatility, given the floating exchange regime that these economies are implementing (Abid & Rault, 2021; Bhattarai et al. 2020). These emerging countries include Algeria, Botswana, Burundi, Sierra Leone, Congo, Egypt, Ethiopia, Ghana, Guinea, Burkina Faso, Kenya, Liberia, Libya, Benin, Malawi, Gambia, Morocco, Nigeria, Angola and South Africa.

3.2 Theoretical and empirical models

The real business cycle (RBC) hypothesis serves as the foundational paradigm in this work. It extends the Ramsey model to include aggregate variations, including shocks to the price of oil and exchange rate volatility, as a model for the overall economy. The economy is assumed to be made up of many similar price-taking enterprises and numerous identical, price-taking households, among other things. It highlights disruptions to the economy's production technology, which is represented by a Cob-Douglas production function and is as follows:

$$GDP_t = S(L_t^{1-d} K_t^d), \quad 0 < d < 1 \tag{1}$$

The GDP elasticity of labour and capital are represented by the parameters 1-*d* and *d* respectively, and *S* is the productivity parameter. Since *d* is between 0 and 1, 0 < *d* < 1 indicates that the production function shows decreasing returns. The DCC-GARCH model is the volatility model that was estimated in this study. This is obtained from the fact that it measures time-varying volatility; this volatility measure is better suitable for time series data with greater frequencies. For the purpose of creating volatility using GARCH, the volatility produced is transformed into daily data in order to facilitate additional research. The DCC technique has been utilized by Daba et al. (2024) to simulate variation and conditional relations of multiple series. The conditional correlations between disturbances, according to this approach, are dynamic throughout time. The column vector with the three examined series is symbolized as X_t.

$$X_t = (EXRA, OPSH, NEPU) \tag{2}$$

The *X* vector is given by *EXRA* which is exchange rate variability, *OPSH* which is oil price shock, *NEPU* which is global economic policy uncertainty. The mean equation for *X* series is specified in equation (3):

$$X_t = \phi + QX_{t-1} + \in_t \tag{3}$$

such that *Q* remains a diagonal matrix of AR coefficients and the error term $\in_t = (\in_{1t}, \in_{2t}, \in_{3t})'$ can be written in the form:

$$\in_t = M_t^{1/2}\omega_t \tag{4}$$

such that $M_t^{1/2}$ is a positive definite square matrix of order two, and its random vector, ω_t, has a zero mean and a var-cov matrix which equals identity matrix of order two: $E(\omega_t) = 0$ and $Var(\omega_t) = I_2$. The decomposition of the M_t matrix is given in equation (5):

$$M_t = \mathrm{B}_t\omega_t\mathrm{B}_t \tag{5}$$

where: $\mathrm{B}_t = diag(m_{1t}^{1/2}, m_{2t}^{1/2})$ and ω_t is the conditional relation matrix r_t, such that:

$$M_t = diag(m_{1t}^{1/2}, m_{2t}^{1/2})\begin{bmatrix} 1 & r_t \\ r_t & 1 \end{bmatrix} diag(m_{1t}^{1/2}, m_{2t}^{1/2}) = \begin{bmatrix} m_{1t} & \rho_t\sqrt{m_{12t}} \\ \rho_t\sqrt{m_{21t}} & m_{2t} \end{bmatrix} \tag{6}$$

The conditional variances for the GARCH model are thus specified as:

$$\sigma_{ii}^2 = a_i + b_i\varepsilon_{i,t-1}^2 + \vartheta \in_i \sigma_{ii,t-1}^2 \tag{7}$$

The stationary condition necessitates that, for all *i*, we have:

$$b_i + \vartheta_i < 1 \tag{8}$$

The dynamic correlation matrix can be expressed in the following manner, as the DCC model indicates that the conditional correlation of our variables is dynamic.

$$\omega_t = r_t D_t r_t \tag{9}$$

with $r_r = diag(D_t)^{1/2}$ and $D_t = (1-\phi_1-\phi_2)D^{-} + \phi_1 v_t - v'_{t-1} + \phi_2 D_{t-1}$. The features of the matrix D_t are given by equation (10):

$$d_{ij} = (1-\phi_1-\phi_2)D_{ij} + \phi_1 v_{i,t-1} + \phi_2 y_{ij,t-1},\ i = j = 1,2 \tag{10}$$

where $D_{\bar{ij}}$ is a constant relation between the v_1 and v_2 and $|\rho t|<1$. The maximum likelihood estimator was used to estimate the DCC-GARCH model's parameters. This entails substituting $M_t = \mathrm{B}_t r_t \mathrm{B}_t$ into the logarithm of L[]. This is demonstrated in equation (11):

$$\begin{aligned}(\phi) &= -0.5\sum_{t=1}^{T}\left(T(2\pi) + \ln(|M_t|) + \in_t^T M_{t-1} \in_t\right)\\ &= -0.5\sum_{t=1}^{T}\left(T(2\pi) + \ln(|\mathrm{B}_t\omega_t\mathrm{B}_t|) + \in_t^T \mathrm{B}_{t-1}\omega_{t-1}\mathrm{B}_{t-1} \in_t\right)\\ &= -0.5\sum_{t=1}^{T}\left(T(2\pi) + 2\ln(|\mathrm{B}_t|) + \ln(|\omega_t|) + \in_t^T \mathrm{B}_{t-1}\omega_{t-1}\mathrm{B}_{t-1} \in_t\right)\end{aligned} \tag{11}$$

On the basis of the log-likelihood estimation, the set of parameters is estimated twice. In the first phase, the likelihood is applied by substituting the identity matrix for ω_t. The parameters are calculated in the second phase by utilizing the suitably provided log-likelihood in equation (4). The study also uses the Markov Regime Switching Regression (MSRR). The MSRR model is used because economic data frequently discloses two or more conditions. The entire time is split into two regimes by the MSRR. There are low-volatility periods under regime 1 and high-volatility periods under regime 2. Periods of regime 1 are defined as unstable, while periods of high-volatility are defined as stable. Low and high exchange rate volatilities alternate based on Markov transition probabilities. If the process is filtered such that the likelihood of falling into a low-volatility phase is lower than 0.5, it is categorized as being in a low-volatility phase. Assume j_t = 1 for the low volatile regime 1 and j_t = 2 for the highly volatile regime 2. The empirical model specification is therefore given in equation (12):

$$\Delta \log EXRA_t / j_t = \gamma_0 j_t + \gamma_1 j_t \Delta \log EXRA_{t-1} + \gamma_2 j_t \Delta \log OPSH_t + \gamma_3 j_t \Delta \log NEPU_t + e_t / j_t \tag{12}$$

Since $EXRA_t / j_t \approx N(0, \sigma_{s_t}^2),\ j_t = 1\ or\ 2$, we define the Markov likelihood of transition as follows:

$$P_{ij} = \left[p_{11}\ , p_{12}, ..., p_{ij;}\ p_{21}, p_{22}, ..., p_{ij}. \right]\ \forall\ i = 1, 2 \tag{13}$$

where $P_{i1} + P_{i2} = 1$, i = 1, 2, and P_{ij} is the likelihood of changing from regime 1 to regime *j* and the parameter space ϕ is given as:

$$\phi = \begin{bmatrix} \gamma_0 j_t \\ \gamma_1 j_t \\ \gamma_2 j_t \\ \gamma_3 j_t \\ \gamma_0 j_t \sigma_i^2 \\ p_{12} \\ p_{21} \end{bmatrix} \tag{14}$$

We use the Markov switching function of Tan & Wu (2025) so that the log-differentials of the currencies of the nation being examined vary by γ_{2jt} if the difference in the exchange rate between them deviates from the mean by one standard deviation. The MSRR enables the coefficients of a regression equation to fluctuate as time passes between various phases otherwise known as regimes. These phases were identified from the data using an implicit Markov chain. Regimes were further characterized as either times with high fluctuation and low returns or periods of low fluctuations and high returns, given that the study focuses on modelling exchange rate returns. By jointly simulating the phase-switching processes in each country and incorporating regional heterogeneity and any cross-country exchanges, the MSRR of a panel of nations was estimated. The error variances and the model's coefficients were subjected to a process of switching between phases/states, which was frequently controlled by a Markov chain. At each successive phase, the likelihood of changing regimes was determined by the software of Markov chains. The stochastic character of this transitioning process implies that, depending on the shift in probabilities, the model could move to a different phase even if it was in one.

4. Results

4.1 Descriptive/summary statistics

The series were tested descriptively to ascertain normal distribution. The descriptive statistics results are included in Table 1. The means and medians of all series in the table indicate very substantial consistency. All their scores were within the maximum and minimum values; none of the values were too high or low. The majority of the selected series were distinctly close to their respective means, with the implication that they showed very little discrepancy in all cases surrounding their means. A condition supported by very tiny values of standard deviation in each data set. Each variable had a positive skew. Since all the series were very symmetrical around the mean, the skewness coefficient implies that they were almost completely within the normal bounds' range. Kurtosis statistics indicate all variables were just mashed together with long-tails. All Jarque Bera statistics values for series had pro-values below 0.05, denoting that all variables were not distributed well within 5% reliability.

Table 1: Descriptive Results for Developing Countries

Measures	EXRA	OPSH	NEPU
Mean	300.4024	3.765384	1.105472
Median	14.40959	0.031063	1.089311
Maximum	9565.082	64.81644	2.06513
Minimum	132.6798	6.396425	4.879208
Std. Dev.	958.6114	10.53614	3.036452
Skewness	6.922630	3.459330	4.778590
Kurtosis	56.58540	14.88058	27.75883
Jarque-Bera	117290.7	7237.741	26970.33
Probability	0.000000	0.000000	0.000000
Sum	276069.8	3460.388	1.017615
Sum Sq. Dev.	8.256408	101907.5	8.400897

Source: E-views 13 estimated results by authors

4.2 Unit root test results

Table 2 shows the results of the unit root tests carried out at the level and the stability tests of the first difference for each series. The tests indicate that exchange rates are I(1); oil prices and uncertainty are also I(1) with a maximum 95% threshold of significance.

Table 2: Unit Root Results for Developing Countries

Variables	EXRA	OPSH	NEPU
ADF Levels statistics	27.4952 (0.9333)	22.6218(0.6542)	16.1361 (0.9997)
ADF Difference statistics	91.7343** (0.0000)	109.109**(0.0000)	240.713*(0.0000)
IPS Levels statistics	1.20583(0.8861)	-0.31718 (0.3718)	5.01234(1.0000)
IPS Difference statistics	-2.95414**(0.0016)	-12.9735** (0.0000)	-13.7934(0.0000)
Results/Findings	Order 1	Order 1	Order 1

Source: E-views 13 estimated results by authors

4.3 Co-integration

The co-integration test results in Table 3 show that most tests had probabilities less than 0.5%, which allowed us to accept the hypothesis of a co-integration vector amongst the variables of the study.

Table 3: Perdoni Co-integration Test Results for Developing Countries

Testing Methods	Statistics	p-value
Panel v-Statistic	6.505589	0.0000
Panel rho-Statistic	-10.100961	0.0000
Panel PP-Statistic	11.422439	0.0000
Panel ADF-Statistic	10.623501	0.0000
Group rho-Statistic	-10.569950	0.0000
Group PP-Statistic	11.504944	0.0000
Group ADF-Statistic	11.065203	0.0000

Source: E-views 13 estimated results by authors

4.4 Results of ARCH test

Heteroscedasticity was examined for the variables prior to MS estimation. Table 4 presents the findings. The findings support accepting H0 (the null hypothesis) and rejecting H1 (the alternative hypothesis) (p-value < 0.26). Thus, the ARCH effect does not exist. Table 4 displays the findings of the pre-ARCH effect test, which examined the likelihood that the variance could not be homoscedastic. The high values of the F-statistic and R-squared and their accompanying p-values indicate that the constant variance null hypothesis should not be accepted because of the return series' ARCH effect. Thus, it makes sense to utilize the GARCH-DCC models to explain the series' heteroscedasticity (Engle, 2002). It is crucial to use the appropriate volatility model to account for heteroscedasticity since the ARCH influence might reduce the volatility model's efficacy.

Table 4: ARCH Effect (Heteroscedasticity) Test for Developing Countries

F-statistic	101.0736
Obs*R-squared	18.36585
Prob. F(1,20)	0
Prob. Chi-Square(1)	0

Source: E-views 13 estimated results by authors

4.5 DCC-GARCH results

Two models were created: one with a multivariate skew normal distribution and the other with a multivariate normal distribution. Nevertheless, DCC with multivariate normal distribution was fitted for the study because it produced a lower Akaike Information Criteria. The significance of the DCC-GARCH parameters as reported in Table 5, namely the alpha and theta coefficients, explains significant cross-correlations and time-varying volatility between the variables because the DCC-GARCH model combines elements of the GARCH model with the dynamic conditional correlation parameters. Thus, the findings indicate that news-based uncertainty and a rise in oil price volatility can have enormous effects on currency market return. In particular, the autoregressive evolution of the correlations over time was addressed by the DCCALPHA and DCCBETA. The long-run period's contribution was provided by the DCCBETA, whilst the realized correlation matrix from the previous period was offered by the DCCALPHA. In essence, the conditional correlation from the prior era connects with the realized empirical correlation matrix from the previous period to offer a substantial weighted combination of the dynamic interaction effect between the variables of the study.

Therefore, a high DCCBETA coefficient indicates that the instability in the previous period has a substantial influence on the current fluctuation, while a large DCCALPHA indicates that today's correlation is more comparable to prior day correlation.

With a significant negative coefficient for the NEPU, the dynamic correlation coefficients between the exchange rate and uncertainty index exhibit the opposing trend effect. The connection's strength is also strong, and the negative coefficient indicates the period during which uncertainty and the exchange rate move in the contrasting direction. Higher uncertainty results in lower returns on currency rates. The adverse effect may be linked to further underlying economic events in the countries investigated in the research. This may help to explain why, during the research period, the majority of the coefficients were negative. Given that certain African nations produce oil, one would anticipate that the correlation coefficient during this time would be entirely positive; unfortunately, the research findings indicate that rising oil price shocks exert pressure on the currency rate and drive it upward, resulting in a lower return that is associated with a depreciated currency. The estimated result aligns with economic theory. Hence, the forex market's performance theoretically declines in response to a shock resulting from a rise in Brent crude oil price. According to the empirical analysis, there is a strong time-varying connection between the variables under investigation for the whole study period.

Table 5: Estimated DCC-GARCH for Developing Countries

Variables	Coefficient	Std. Error	z-Statistic	p-Value
OPSH	-0.75055***	0.000175	-4288.8571	0.0000
NEPU	-1.50186**	0.017530	-85.67370	0.0000
MU	0.128913***	0.000046	2802.4565	0.0000
DCCALPHA(1)	0.435879*	0.001735	251.22709	0.0000
DCCBETA1	0.586752*	0.013548	43.309123	0.0000
Avg. log likelihood			-10.89925	
Hannan-Quinn criter			67.18419	
Akaike info criterion			0.628438	

* Stability condition: ALPHA(1) + BETA(1) < 1 is met while *** indicate statistical significance at the 1% level

Source: E-views 13 estimated results by authors

4.6 Standard deviations and conditional variance for developing countries

One often used metric for assessing forex market volatility is the standard deviation. Figure 1 displays the plot of the SD of exchange rate return. Since the standard deviation quantifies the dispersion of returns, a greater deviation corresponds to a higher likelihood of either positive or negative returns. Plots showing the SD of the returns from 2000 to 2022 are displayed in Figure 2. The standard deviation is computed using the results. The charts show that the weekly returns standard deviations are around 4%. This suggests that the majority of returns fell between the ranges of 8% to -8%. The standard deviation was more than 16% during the 2008-2010 worldwide financial crises, meaning that the majority of returns were between 32% and -32% percent. In essence, it can be observed that high standard deviations are associated with years with exceptional returns.

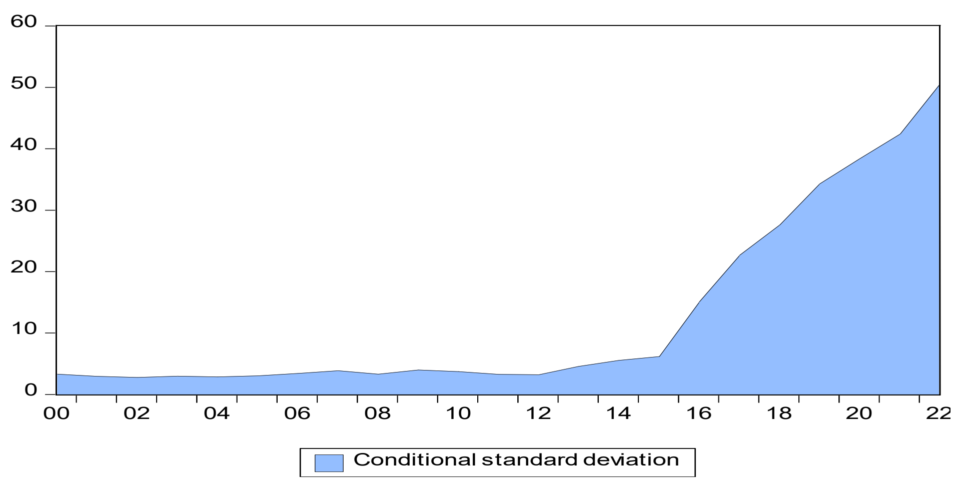

Figure 1: Plot of Standard Deviation of Exchange Rate Return

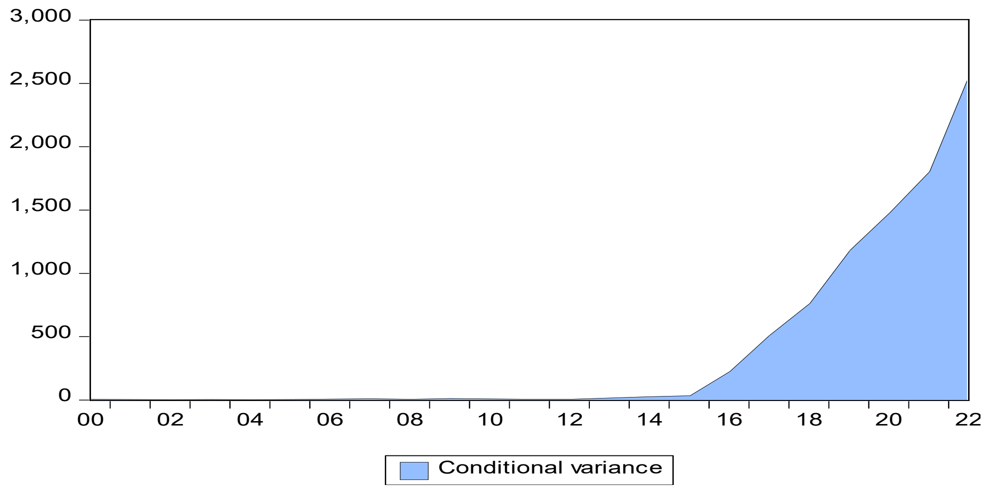

Figure 2: Plot of Variance of Exchange Rate Return

The fact that returns since 2012 have not displayed exceptionally high volatility suggests that the forex markets of developing nations are stable. Standard deviations show that returns have been less volatile recently based on historical data. There are two possibilities to explain this. First of all, traders who trade in the futures markets do so with inaccurate information on the stocks' worth. As a result, transient prices are generated and then magnified. Alternatively, fresh knowledge can influence future contract prices; as a result, contracts might have reduced transaction costs, which would result in simultaneous fund pricing. However, a variety of factors, including the state of the economy, downturns, financial leverage, and operations leverage, to mention a few, may be influencing volatility.

There are times in the markets when returns fluctuate very little (market serenity) and times when returns move much after they do (market turbulence). Since developing nations' currencies are more susceptible to positive or negative news, stock returns in these nations typically reflect the currency's volatility. Consequently, the dynamic correlations between the variables are rather rickety. Currency returns and oil price shocks have dynamic conditional relationships that are all fully negative. Generally, over the study period, there was a negative dynamic conditional correlation between the returns and the price of oil. This suggests that the exchange rate and the oil price shock are opposing each other.

4.7 Results from the Markov Regime Switching Model

According to the DW statistic (2.0796), which is obtained from the evaluation of the models' goodness of fit for return displayed in Table 4, it no longer contains any statistically significant evidence of autocorrelation in returns. This implies that MS, the volatility model, is suitably described. As shown by the results in Table 4, in both high- and low-volatility phases, global economic uncertainty had negative coefficients of -5.987106 and -8.097653 respectively. This indeed upholds an inverse correlation between exchange rates and uncertainty with the implication that lower returns on currency rates are the outcome of greater uncertainty. The Algerian dinar, Angolan Kwanza, Burundian franc, Egyptian pound, Liberian dollar, Kenyan shilling, Ghanaian cedi, Moroccan dirhams, Gambian dalasi, Libyan dinar, Nigerian naira, Guinean franc, Ethiopian birr, South African rand, Congolese franc, Malawian kwacha, Botswana pula, Burkina Faso and Benin CFA franc, all depreciated in value relative to the USD due to uncertainty surrounding global economic policy decisions.

Table 4 displays the MSRR results and, the regimes' invariant error distribution coefficients, in particular. Every regime-specific coefficient of oil price shocks in the MSRR models of low-volatility phase is 4.1571 and high-volatility phase is 6.0073, is significant at 5%. The news base variable was significant in regime 1 and regime 2, and the corresponding coefficients are low-volatility phase, -5.987106 and high-volatility phase, -8.097653. The outcomes of the models' transition probabilities are also displayed in Table 4. We investigate the transition probabilities of the MSRR in place of the transition matrix parameters of the MSRR model.

Also, the MSRR model's transition probabilities indicate strong likelihood that the returns system will stay in same regime, suggesting that there will be few changes to that state or regime. The findings also show that there is an 85.5% chance that the returns will remain in the accumulation low-volatility phase and 14% in the high-volatility phase that they will transfer to the big-move and excess/panic regimes. A system that is in a highly capricious regime has an 86% chance of staying in that regime; the odds of switching to an excess/panic regime and an accumulation/distribution regime are 13%. According to Figure 3, the transition probability findings indicate that the series between regimes, namely low-volatility phase (accumulation/

distribution phase) and high-volatility phase (big move phase), can only be switched by extraordinary or huge occurrences. It further suggests that since all transition probabilities are zero, no regime is permanent. The distribution regime has an average length of 6 weeks, but the big moves have durations of 9 weeks for exchange rate returns, according to the estimated duration values in Table 4. The estimated regime probabilities for the MS model are shown in Figures 1, 2, and 3.

Table 6: MSRR Outputs for Exchange Rate (EXRA) Returns

Variable	Coefficient	Std. Error	z-Statistic	Prob.
		Low-volatility Phase		
OPSH	2.397878	0.076803	31.221150	0.0000
NEPU	-5.987106	0.001342	-4461.3308	0.0000
AR(1)	4.157100	1.025552	4.0535243	0.0000
		High-volatility Phase		
OPSH	-2.406973	0.004671	-515.30143	0.0000
NEPU	-8.097653	0.011890	-681.04735	0.1095
AR(1)	6.007308	0.038737	155.07932	0.0000
DW Statistic	2.079680	Schwarz Criterion	9.551378	
Transition Probability		low-volatility phase	High-volatility phase	
low-volatility phase		0.855188	0.144812	
Regime 2		0.132187	0.867813	
Expected duration		low-volatility phase	High-volatility phase	
		6.905499	9.565065	

Source: Authors estimated data using Stata 13 software

A seamless transition from one regime to another is still likely, as seen in Figure 3.

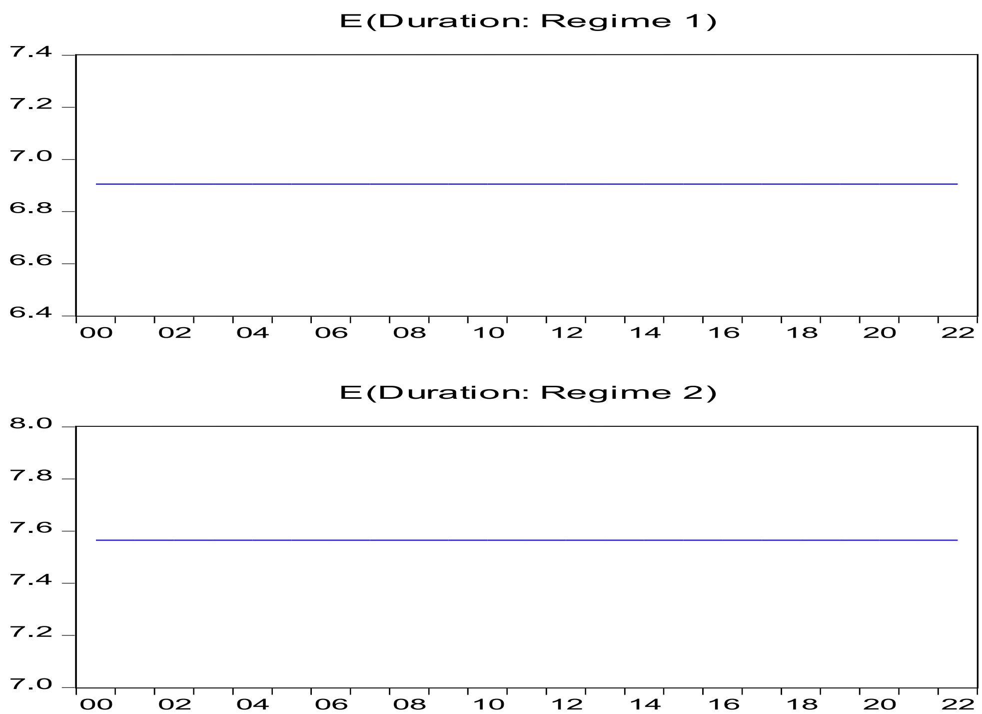

Figure 3: Constant Markov Expected Durations

Source: E-views 13 estimated results by authors

5. Discussion of Results and Findings

The DCC GARCH clearly illustrates the direction and magnitude of the effects. The estimated results are shown in the MSRR. It reveals a positive outcome in each of the two regimes, with the first regime exhibiting a greater significant result in accordance with Das' (2021) findings. It demonstrates that unexpected developments in economic policy uncertainty will lower global oil prices; this conclusion is congruent with human reasoning. Decision-makers will select a more conservative investing strategy when the economy and markets become unstable. The market mechanism will cause the price of oil to decrease whenever demand tightens. The findings suggest that an unexpected increase in oil price shocks can significantly reduce the uncertainty surrounding global economic policy. The reaction of exchange rate returns to an oil price shock switches significantly between the first and second regimes and lessens in the third regime, thus decelerating the rate of decay.

The result for NEPU is negative and significant for exchange rate returns. Ünlü (2024) and Glebocki and Saha (2024) have all reported quantitative outcomes that have been empirically validated by the present research estimates and policy findings. According to Glebocki and Saha (2024), uncertainty had a major effect on exchange rates globally. In emerging markets, exchange rate returns reacted to policy uncertainty by becoming more volatile and depreciating. The authors observed that risk-averse investors were moving away from developing markets and towards advanced economies in response to uncertainty shocks. Ünlü (2024) likewise reported that the majority of the fluctuations in the BIST-100 Return Index of the Turkish stock exchange can be attributed to real exchange rate shocks.

The current research outcomes support those of Çakar (2024), who indicated that the returns of the yen/lira, Australian dollar/Turkish lira, and euro/lira exchange rates are influenced by the EPUs of Australia, the European Union, and Japan respectively. These findings concur with those of the current research. The current study's findings reflect those of Falak et al. (2024), who identified a negative correlation between EPU and Pakistan's currency return volatility. Additionally, our study's findings complement those of Hossain and Sultana (2022), who utilized monthly series to estimate the MM-QR panel conditional QR and so demonstrated that the economic policy uncertainty of wealthy nations fuelled currency depreciation in underdeveloped nations. Additionally, the authors noted that the exchange rates of developing nations versus the US dollar were impacted asymmetrically by the uncertainties of US economic policies both prior to and following the global financial crisis. Both developed and developing nations' currencies have lost value in relation to the US dollar as a result of the US's monetary policy uncertainties. The present research outcomes support those reported by Nilavongse et al. (2020).

Our results contradict the findings of Abid and Rault (2021). The outcomes, in view of the negative implications of economic policy uncertainty on oil price shocks, challenge the prediction by Ntonakakis et al. (2018) that supply-side shocks were strongly no longer relevant for macroeconomic trends. The regime outcomes also showed a quick and strong hostile response to uncertainty when a unit of positive impact was applied to oil price shocks. Thereafter, the response tremendously decreased in pace. Increased uncertainty is envisaged to lower productivity and consequently declines in oil-demand, as expected from oil-price responses. These outcomes are in line with those observed by Kang et al. (2020). Increased risks associated with uncertainty will impede the growth of both developed and emerging economies; however, rising global oil prices will act as a catalyst. When faced with risks, the output tends to be cautious, and the positive reaction to shocks in the price of oil is in line with the findings of Cunado et al. (2019).

We find evidence of depreciation of currencies of the nations covered by the research over the short term. Given that these nations are profoundly reliant on the export of primary commodities, this behaviour makes sense in the long run. For example, Omer et al. (2023) argue that real depreciation in terms of trade shocks might increase exports and perhaps contribute to the preservation of foreign reserves. Hence, the research outcome supports the findings of Boer et al. (2024), who found that the current account's empirically predominant factors at business-cycle dynamics are caused by macroeconomic shocks. All things considered, policy uncertainty has discernible short-term links and also influences the returns on exchange rates over an extended period of time. It is not unexpected that there is short-term impact because elevated levels of uncertainty have an impact on investment, production, demand, and currency rates (Sharma & Paramati 2021). For a prolonged period, nevertheless, the impact's nature changes depending on the exchange rate arrangement and time frames (pre- and post-crisis). For example, in wealthy nations, real currency appreciation is caused by news-based uncertainty. Although there is no discernible correlation for emerging nations, we might assume with caution that uncertainty has a greater effect on exchange in developing nations than in developed ones. The disparity in impact between emerging and developed regions may be ascribed to regulatory variations resulting from exchange rate agreements and capital controls. To be more precise, industrialized nations implement a rigid system of exchange rates.

When it comes to time horizons, uncertainty causes the currency rate to gain after a crisis has occurred rather than depreciate prior to it. The theory that uncertainty causes the currency rate to depreciate over time appears to be at odds with the appreciation of the exchange rate brought about by changes in uncertainty over time. According to Glebocki and Saha (2024), uncertainty encourages businesses to put off investments, leading these businesses to take a rash stance. This, in turn, may make financial markets less appealing to both local and international investors, which eventually causes the currency's value to fall. Our results also demonstrate that uncertainty regarding foreign economic policy has a positive long-term influence on the real exchange rate and a negative short-term one, irrespective of the sample period and exchange rate arrangement. However, depending on the sample period (pre/post-crisis), the association's strength varied. The exchange rate and foreign economic policy of the industrialized economies were more closely correlated before the crisis than they were afterwards. Following the crisis, there was an intensification of the link between the factors in the emerging economy. This finding is in line with the theory that a financial crisis might change how different economic and financial factors relate to one another; thus, it is not surprising (Cossiga et al., 2025).

The remarkable influence of uncertainty about foreign policy on the home nations is a reflection of the inadequate institutional frameworks that prevent developing nations from being able to absorb these external shocks (Nwankwo, 2018). Consequently, the transfer problem evidently put the financial system of the home countries at risk of exposure in the event of a large rise in capital movements. For instance, rising Greenfield investment was expected to drive foreign direct investment into Africa to 57 billion USD in 2018 (African Economic Outlook, 2017). As these nations strive for economic openness, there is a greater likelihood that they will be impacted by foreign economic policies, which will have a greater effect on their currency rate. This result is distinct from comparable research by Yahaya and Adeoye (2020) and Korkpoe and Howard (2019). Also, MSRR estimations suggested a good chance that currency returns will stay in their current state and that the series can only move from a lowly volatile phase (accumulation/distribution phase) to a highly volatile phase (big-move phase) via unorthodox or extreme events and vice versa. Additionally, it was shown that the high volatility and excess/panic regimes would take an average of 4 months and 6 months respectively. In contrast to the panic phase, the accumulation and distribution phase had a greater transition probability and predicted length. Similar results were found by İlhan et al. (2022) and Adejumo et al. (2020), who confirmed that regime-switching activities in the stock market. Thus, it is clear that the MSRR model is unquestionably reliable and a useful addition to the toolkit for simulating the volatility of the forex market throughout the panic phase.

The results of the present research also show that oil price shock has a negative connection with exchange rate returns at the high volatile phase. This demonstrates how economic benefits drive up demand and subsequently the price of oil as a factor of production as earlier reported by Umoru et al. (2025; 2024b; 2023a; 2023b). The finding also aligns with the results of Tlili et al. (2024), Ibrahim (2025), Upadhyaya et al. (2025), and Louka and Michail (2024). Upadhyaya et al. (2020), in their analysis of impulsive reactions, reveal an enormous drop in real GDP after an oil price shock during exchange rate volatility. Harding et al. (2020) assessed how bilateral real exchange rates will be affected by massive oil and gas finds. After significant oil discovery worth 10% of a nation's GDP, the real exchange rate increases by 1.5% within ten years. Louka and Michail (2024) reported that the euro trade rate depreciates either nominally or actually in the short term as a result of increased oil prices. In response to an oil price shock, Bedin et al. (2021) observed that the real rate of exchange adjusted slowly and the GDP reacted sharply, while the real currency rate adjusted quickly and the GDP adjusted slowly.

6. Conclusion

In the study, MRSR and DCC GARCH techniques were used for the same task – to investigate the dynamic effects of oil price shocks and country-specific policy uncertainty on exchange rate returns in emerging nations. The study first considered co-integration in the model after determining if the variables were stationary. The variables were all co-integrated. The DCC GARCH findings also demonstrated that both NEPU and oil price shocks had a negative influence on exchange rate returns, and were significant in developing countries. Precisely, higher uncertainty results in lower returns on currency rates. According to the study, variations in the price of oil have adverse impact on currency returns. The estimated findings demonstrated that the shock of the oil price and uncertainty index caused depreciation in the exchange rate over the time period. The findings of MSRR showed that oil price had positive and considerable influence on the exchange rate return only in the low volatile phase; however, the impact is negative in the big-wage and more unstable phase. In all the regimes, the NEPU uncertainty had a harmful effect. Lower oil prices result from more policy uncertainty, which also tends to reduce output and may affect oil demand. On the contrary, both positive and negative shocks to the price of oil could influence currency rates amidst policy uncertainties. For instance, currency rates of energy-dependent countries could be impacted if policy instability results in a decline in consumption of oil and, consequently, price cuts.

Foreign exchange demand strategies should be the main emphasis of exchange rate management policies, and they should also take the movement of global oil prices into account. As the globe looks for more globally-friendly energy, production broadening is essential to boost foreign exchange supplies from other commodities and prevent harm to oil-exporting nations' economies from the increased outflow of wealth during protracted oil price shocks. The fact that the chosen nations are interconnected with international markets is indicated by the uncertainty index's negligible long- and short-term effects on the currency rate. Exchange rate policy and hedging techniques will be significantly impacted by this. The danger of external uncertainty will cause the sample nations to appreciate over time; one way for governments to help would be to encourage the usage of locally made goods. In view of that, increases in aggregate demand are needed to reduce the uncertainty around economic policy at the same time that the price of oil rises. Exchange rate policies are also affected by the short-term depreciation of the currency rate. Given that these nations are comparatively more import-dependent, it is critical that policymakers take the appropriate steps and modifications to discontinue the devaluation of their currencies. When designing policies during downturns, policymakers in established economies should exercise greater caution than in emerging economies. To calm the exchange rate market, policymakers should keep an eye on the situation and make any required modifications to lower the exposure to foreign uncertainty risk. In light of the recent advancement and ensuing interest in the domain, we think that future research in the oil price shocks, uncertainty index, and currency rate nexus should focus on adding more African nations in order to ensure that conclusions achieved would be applicable to the entire continent.

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