Asian Journal of Economics, Business and Accounting

Volume 23, Issue 18, Page 105-116, 2023; Article no.AJEBA.103429
ISSN: 2456-639X

Reactions of Stock Prices to Changes in Exchange Rate and Monetary Policy Rate of Central Banking System: Symmetry or Asymmetry

Solomon Edem Effiong [a], Odion Jonah Benson [a] and David Umoru [b*]

[a] Department of Economics, Wellspring University, Irhirhi Airport Road, Benin City, Edo State, Nigeria.
[b] Department of Economics, Edo State University, Uzairue, Iyamho, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Authors SEE and OJB designed the study, wrote the protocol and wrote the first draft of the manuscript. Author DU reviewed the literature specified the models and performed the statistical analysis. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJEBA/2023/v23i181061

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/103429

Original Research Article

Received: 26/05/2023
Accepted: 24/07/2023
Published: 05/08/2023

ABSTRACT

This study examines the reactions of stock prices to variations in the monetary policy rate of the central banks and exchange rate shock, which is if the responses are similar or differ in a comparative analysis between developed and emerging stock markets. Data were obtained on daily stock market prices, exchange rates, and variations in policy rate. The panel non-linear autoregressive distributed lag (NARDL) estimation method was utilized for this study. The NARDL showed the existence of a significant asymmetric long-run link between stock market price, exchange rate, and variation in monetary policy rate variables. For developing countries, the long-run results show that a percentage rise in the currency rate stimulated a 0.596% increase in the price of stock while it resulted in a 0.574% drop in the prices of stock. The same results were

**Corresponding author: E-mail: david.umoru@edouniversity.edu.ng, david.umoru@yahoo.com;*

obtained for the short-run analysis. Also, the results show that a positive shock to the policy rate led to a 0.26% drop in the price of stock in the long term while it induced a 0.35% rise in the prices of stock. These estimates are similar to those obtained for developed economies. By and large, the findings imply that variations in the currency and monetary policy rate of the central banks have significant implications for stock market prices. There is a need for central monetary authorities to base effective regulations of exchange and monetary policy rates on market mechanisms while stock market investors are advised to frequently study the behavior of the two variables when dealing with the stock market.

Keywords: Changes in exchange rate; interest rate variation; NARDL method.

JEL Classification: D40, F21, E80.

1. INTRODUCTION

A key indicator of a nation's economic activity is the stock market's level, which when combined with the interest rate, and the exchange rate provides a synopsis of the macroeconomy. Additionally, stock values have been known to fluctuate most often and this stimulates excessive worries about potential bubbles that could harm the economy. According to Kerry ET AL. [1], a stock market crash was the cause of many financial crises in the past, and stock market declines are one of the effects of financial crises. In reality, the stock market's performance is a vital economic indicator that is frequently discussed because of how crucial it is to every economy. Nigeria has its stock exchange, formerly known as the Lagos Stock Exchange. The stock market is the strongest predictor of future economic activity and can explain the true causal relationship between stock prices and future economic growth [2]. Economists are confronted with the difficult challenge of making financial intermediaries function successfully and efficiently in the context of emerging countries [3]. This is because stock prices are among the most extensively monitored asset values in the economy and are thought to be very sensitive to economic conditions.

The idea that monetary policy is transmitted through the stock market is supported by the fact that changes in monetary policy have a considerable impact on stock returns [4]. The institutional and structural distinctions between developed and developing nations motivate the researcher to look into the relationship between these variables. Among other macroeconomic variables, a country's stock market and exchange rate play a significant influence in promoting economic development in the majority of nations [5]. However, given their significance to the economy, these variables continue to be important in the implementation of monetary and fiscal policies to foster the sustainable development of the financial sector. It has been noted that the stock market displays volatile behavior because it is susceptible to changes in stock prices, capital returns, interest rates on loans, inflation, exchange rates, and the consumer price index [5]. Such behavior is relevant from a policy standpoint, according to Stern et al. [6] since it suggests that volatility in the stock market or the exchange rate market may have a large impact on the economy through a variety of channels. Against this backdrop, our objective in this study is to quantify the response of stock prices to variations in the monetary policy rate of the central banks and exchange rate shock. To confirm the accuracy of the research findings, the underlying hypothesis that stock markets in industrialized and developing nations respond to variations in the monetary policy rate of the central banks and exchange rate policy shocks symmetrically was evaluated. The structure of the paper is divided into 5. Part 2 is the literature review while part 3 deals with the research methods adopted in the study. Section 4 presents and analyzes the data while the concluding part is Part 5.

2. LITERATURE REVIEW

2.1 Theoretical Review

This section reviews relevant theories of exchange rates and stock prices. In the theoretical review, we consider the following theories. The flow-oriented model provides support for the idea that through their impact on input and product prices, exchange rate changes have an impact on a firm's ability to compete [7]. Theoretically, exporters suffer when the currency value increases as exports will cost more on the global market as a result of the currency's rise [8]. Given that buyers on the global market will

perceive them as costly; this will result in a fall in their exports. As a result, their profits will drop, and if profits drop, the firm's ability to compete on the local stock market will suffer. On the other hand, the balance of payments (BoP) theory emphasizes how closely the position of a country's BoP affects its exchange rate. A country's imbalance in its BoP indicates that there is a surplus of demand for foreign currency. As a result, the cost of foreign currency must increase relative to domestic currency, which implies that the domestic currency's exchange rate must decrease. Conversely, a country's BoP surplus indicates that there is a bigger demand than there is supply for its domestic currency abroad. As a result, the value of a domestic currency in terms of foreign currency increases, improving the exchange rate.

The Dornbusch overshooting model of exchange rates is an economic framework that seeks to explain the short-term volatility of exchange rates in response to changes in monetary policy. According to the model, exchange rates adjust more rapidly in the short run than what would be justified by changes in economic fundamentals. The main tenet of the Dornbusch overshooting model is that short-term price and wage stability exist. This implies that they do not instantly adapt to changes in monetary or political situations. Prices and wages in particular are thought to be more fixed in the non-tradable products sector than in the tradable goods sector.

According to the theory, when there is an unanticipated rise in money stock, interest rates decline, leading to a devaluation of the local currency. However, the initial impact on the exchange rate is much larger than the long-run impact. This overshooting occurs because prices and wages do not adjust immediately, leading to a temporary disequilibrium in the forex market. Interest rate differences can be used to explain the overshooting effect. Short-term capital outflows could occur if investors lose interest in the domestic currency as interest rates drop as a result of an expansionary monetary policy [8]. The value of the local currency decreases due to an increase in its supply on the foreign exchange market. The currency rate steadily moves towards its long-run equilibrium level as wages and prices adapt. The Dornbusch overshooting model has several implications. First, it suggests that exchange rates are inherently volatile in the short run, reflecting the delayed adjustment of prices and wages. Second, the model emphasizes that exchange rates do not immediately reach their long-run equilibrium levels, but rather exhibit temporary deviations [9].

2.2 Empirical Review of Previous Studies

Using the ARDL, and quarterly data from Q1 1992 through Q4 2019, the effects of central bank policy rates on the volatility of the currency rate in Indonesia was examined by Ho et al. [10]. To examine the effects of the variables, an Autoregressive Distribution Lag estimate was used in the procedure. The exchange rate volatility includes the rupiah's relationship to the US dollar, the Singapore dollar, the Australian dollar, the British pound sterling, and the euro. According to the results, using the ARDL estimation, the adjustment period for exchange rate volatility to reach long-run equilibrium ranged from 1.77 to 2.26 quarters. Second, it was discovered that, a decline in the central bank rate greatly reduced exchange rate volatility. All five models were subjected to this Full Modified Ordinary Least Square (FMOLS) estimation. The Indonesian Rupiah's volatility versus five foreign exchange rates was found to be significantly positively impacted over the long term by the central bank policy rate.

The currency rate variations on Sudan's demand for money were investigated by Wong et al. [11]. Data from 1960 to 2018, the non-linear ARDL model was used. The empirical findings imply that the exchange rate's influence is asymmetric. Positive changes in the exchange rate lead to an increase in short-term money demand, while negative changes have no impact. However, over time, both a positive and negative shift in the exchange rate has the same impact on the demand for money. The devaluation of the Sudanese pound has a bigger long-term impact than a positive shift in the exchange rate since this is true. Quarterly data from 2008 to 2020 was used to evaluate the variables influencing currency rate variations in Turkey [12].

The West African Monetary Zone (WAMZ)'s real effective exchange rate (REER) reactions to shocks in exchange rate determinants were investigated by Adu et al. [13] for the period 1980 -2015. The outcome shows a significant variation in how these nations' REERs responded to real oil price shocks. Additionally, it appears that various economies differ in the relative contribution of these shocks to REER movements in the short and long runs. In [13] Indonesian provinces, [14,15] looked at how the monetary policy shock affected regional output

disparities using the VAR method. According to the regional analysis, economic structure and financial depth significantly and positively influence the asymmetric responses mentioned above. However, they are negatively impacted by economic size and trade openness. Other studies that evaluated the asymmetric impact of monetary policy and exchange rate movements on stock market performance include [16-24].

3. METHODOLOGY

Asymmetric shocks (negative shocks) cannot be captured by the GARCH model, which can only capture symmetric shocks (positive shocks). Hence, we have chosen to execute the NARDL methodology in this paper following the works of [25-37].

The modeling framework of our panel NARDL regression model for exchange rate is specified as follows:

$$STOCKPRC_t = \varphi^{+}EXCHRAT_t + \varphi^{-}EXCHRAT_t + \mu_t \quad (1)$$

$$\Delta EXCHRAT_t = \mu_t \quad (2)$$

Where $STOCKPRC_t$ and $EXCHRAT_t$ are scalar I(1) variables, and $EXCHRAT_t$ is decomposed as $EXCHRAT_t = EXCHRAT_0 + EXCHRAT^{+} + EXCHRAT^{-}$ and $EXCHRAT^{+}$ and $\mathrm{EXCHRAT}^{-}$ are the partial sum of positive and negative changes in the exchange rate:

$$EXCHRAT^{+} = \sum_{j=1}^{t} \Delta\, EXCHRAT_j^{+} = \sum_{j=1}^{t} \Delta\, max\left(\Delta EXCHRAT_{j,} 0\right), \quad (3)$$

$$EXCHRAT^{-} = \sum_{j=1}^{t} \Delta\, EXCHRAT = \sum_{j=1}^{t} \Delta\, min\left(\Delta EXCHRAT_{j,} 0\right) \quad (3!)$$

With the aid of equations (3) and (3!), asymmetric co-integration defines a linear combination of the partial sum mechanism as specified in equation (4) accordingly:

$$z_t = \varphi_0^{+} STOCKPRC_t^{+} + \varphi_0^{-} STOCKPRC_t^{-} + \varphi_1^{+} STOCKPRC_t^{+} + \varphi_1^{-} STOCKPRC_t^{-} \quad (4)$$

The standard linear (symmetric) co-integration is a special case of (4), obtained only if $\varphi_0^{+} = \varphi_0^{-}$ and $\varphi_1^{+} = \varphi_1^{-}$. Based on [38] restriction, equation (4) could be re-specified into a non-linear ARDL model as shown in equation (5):

$$STOCKPRC_t = \sum_{j=1}^{p} \varphi_j STOCKPRC_{t-j} + + \sum_{j=0}^{q} (\varphi_j^{+\prime} EXCHRAT_{t-j}^{+} + \varphi_j^{-\prime} EXCHRAT_{t-j}^{-}) + \varepsilon_t \quad (5)$$

Where φ_i^{+} and φ_j^{-} are the non-linear lagged parameters, $EXCHRAT^{+}$ and $EXCHRAT^{-}$ are the positive and negative changes in the exchange rate respectively. The generalized NARDL specification becomes.

$$STOCKPRC_t = \rho STOCKPRC_{t-1} + \vartheta_j^{+\prime} EXCHRAT_{t-j}^{+} + \vartheta_j^{-\prime} EXCHRAT_{t-j}^{-} + \sum_{j=1}^{p-1} \emptyset_j \Delta STOCKPRC_{t-j} + \sum_{j=0}^{q-1} (\emptyset_j^{+\prime} \Delta EXCHRAT_{t-j}^{+} + \emptyset_j^{-\prime} \Delta EXCHRAT_{t-j}^{-} \quad (6)$$

The non-linear conditional ECM is given in equation (7):

$$\Delta STOCKPRC_t = \rho \partial_{t-1} + \sum_{j=1}^{p-1} \omega_j \Delta STOCKPRC_{t-j} + \sum_{j=0}^{q-1} (\omega_j^{+\prime} \Delta EXCHRAT_{t-j}^{+} + \omega_j^{-\prime} \Delta EXCHRAT_{t-j}^{-}) + \mathrm{e}_t, \quad (7)$$

Where $\omega_0^{+} = \emptyset_0^{+}, +e,\ \omega_0^{-} = \emptyset_0^{-} + e\omega_j^{+} = \emptyset_j^{+} + e\Lambda_j$, and $\omega_j^{-} = \varphi_j^{-} + e\Lambda_j$ for $j = 1, \ldots\ldots, q-1$. Similarly, the panel NARDL regression modeling framework for monetary policy shock measured as variations in interest rate is specified as follows:

$$STOCKPRC_t = \partial^{+} VARINR_t + \partial^{-} VARINR_t + \epsilon_t \quad (8)$$

$$\Delta VARINR_t = \epsilon_t \quad (9)$$

Where $STOCKPRC_t$ and $VARINR_t$ are scalar I(1) variables, and $VARINR_t$ is decomposed as $VARINR = VARINR_0 + VARINR^{+} + VARINR^{-}$ and $VARINR^{+}$ and $VARINR^{-}$ are partial sum of positive and negative variations in interest rate:

$$VARINR^{+} = \sum_{j=1}^{t} \Delta\, VARINR_j^{+} = \sum_{j=1}^{t} \Delta \max\left(\Delta VARINR_{j,} 0\right), \quad (10)$$

$$VARINR^{-} = \sum_{j=1}^{t} \Delta\, VARINR = \sum_{j=1}^{t} \Delta \min\left(\Delta VARINR_{j,} 0\right) \quad (10!)$$

With the aid of equations (10) and (10!), asymmetric co-integration defines a linear combination of the partial sum mechanism as re-specified in equation (11) accordingly:

$$z_t = \partial_0^{+} STOCKPRC_t^{+} + \partial_0^{-} STOCKPRC_t^{-} + \partial_1^{+} STOCKPRC_t^{+} + \partial_1^{-} STOCKPRC_t^{-} \quad (11)$$

The standard linear (symmetric) co-integration is a special case of (11), obtained only if $\partial_0^{+} = \partial_0^{-}$ and $\partial_1^{+} = \partial_1^{-}$. The non-linear ARDL model is shown in equation (12):

$$STOCKPRC_t = \sum_{j=1}^{p} \partial_j STOCKPRC_{t-j} + \sum_{j=0}^{q} (\partial_j^{+\prime} VARINR_{t-j}^{+} + \partial_j^{-\prime} VARINR_{t-j}^{-}) + \epsilon_t \quad (12)$$

Where φ_i^{+} and φ_j^{-} are the non-linear lagged parameters, $VARINR^{+}$ and $VARINR^{-}$ are the positive and negative changes in the variations in the monetary policy rate of the central banks respectively. The generalized NARDL specification becomes.

$$STOCKPRC_t = \rho STOCKPRC_{t-1} + \alpha_j^{+\prime} VARINR_{t-j}^{+} + \alpha_j^{-\prime} VARINR_{t-j}^{-} + \sum_{j=1}^{p-1} \gamma_j \Delta STOCKPRC_{t-j} + \sum_{j=0}^{q-1} (\gamma_j^{+\prime} \Delta VARINR_{t-j}^{+} + \gamma_j^{-\prime} \Delta VARINR_{t-j}^{-}) \quad (13)$$

The non-linear conditional ECM is given in equation (14):

$$\Delta STOCKPRC_t = \rho \partial_{t-1} + \sum_{j=1}^{p-1} \beta_j \Delta STOCKPRC_{t-j} + + \sum_{j=0}^{q-1} (\beta_j^{+\prime} \Delta VARINR_{t-j}^{+} + \beta_j^{-\prime} \Delta VARINR_{t-j}^{-}) + \epsilon_t, \quad (14)$$

Where $\beta_0^{+} = \gamma, + v,\ \beta_0^{-} = \gamma_0^{-} + v\beta_j^{+} = \gamma_j^{+} + v\Lambda_j$, and $\beta_j^{-} = \gamma_j^{-} + v\Lambda_j$ for $j = 1, \ldots \ldots, q-1$. Equations (7) and (14) explain both long and short-run asymmetries in exchange rate movements and variations in the interest rate of the central banks. Both equations can be estimated by OLS. The data used consist of daily stock market price, exchange rate volatility, and variations in variations in the monetary policy rate of the central banks which were calculated as the discount rate or interest rate used by the central banks to lend to deposit money banks of ten developing countries.

4. RESULTS AND DISCUSSION

The data collected were analyzed in this chapter using inferential statistical techniques. As part of this analysis, we shall first present the data of the daily stock market price, consumer price index, interest rate of the central banking system, and exchange rate of emerging economies of ten African countries.

4.1 Discussion on Developing Markets

As displayed in Table 1 the p-values of the test were smaller than 0.05 at level; hence, we refused to accept the null hypothesis of unit root (non-stationarity) at 5%levelof significance and thus conclude that the stock market price, exchange rate volatility, and variations in the monetary policy rate of the central banks are non-stationary over the period from 1990 - 2022.

Table 2 shows the estimates of the asymmetry of exchange rate movements in financial markets. The long-term results of the NARDL approach for estimated asymmetric exchange rate variations (positive and negative) indicate statistically

significant asymmetrical effects of exchange rate movements on stock market price. In particular, the results show that a percentage rise in the currency rate led to a 0.596% increase in the price of stock while a percentage reduction in the exchange rate resulted in an almost equivalent proportion, a 0.574% drop in the prices of stock. The same results were obtained for the short-run analysis where positive exchange rate shock stimulated a 0.62% increase in stock prices. Relatively, 1% negative exchange rate shocks induced a 0.61% fall in stock prices. The policy findings in this paper support earlier findings of Umoru [39] where a positive long-term association was established between the exchange rate positive shock and prices of stock in the Nigerian stock exchange.

Table 3 shows estimates of the asymmetry of interest rate shock on stock prices. The result of the NARDL approach for estimated asymmetry of the variations in variations in the monetary policy rate of the central banks on stock prices indicates statistically significant asymmetrical effects of the variations in the interest rate on stock market price. The long-term results show that a positive shock to interest rate led to a 0.26% drop in the price of stock while a percentage reduction in the variations in interest rate of the central banking system resulted in a 0.35% upward movement in prices of stock. Similarly, the short-run analysis shows that a 1% positive variation in the interest rate induced a 0.17% decline in stock prices. On the other hand, a 1% negative variation in interest rate induced a 0.14% rise in stock prices.

Table 1. Unit Root Test Results at a level based on Levin, Lin & Chu

Variable	Test Statistic	P – value	Critical value
STOCKPRC	10.00801	0.0032	1%, 5%, 10%
VARINR	-123.58615	0.00004	1%, 5%, 10%
EXCHRAT	-243.27159	0.00005	1%, 5%, 10%

Table 2. Non-Linear ARDL model estimation of exchange rate volatility on stock prices

Variable	Coefficient	t-Statistic	Prob.*
Long-run estimation			
EXCHRAT_POS	0.596230	20.339253	0.0000
EXCHRAT_NEG	-0.574323	-10.185270	0.0000
Short-run estimation			
ERROR COEFFICIENT	-0.136359	-32.196498	0.0000
D(EXCHRAT_POS)	0.62116	40.742358	0.0000
D(EXCHRAT_NEG)	-0.605653	-13.664699	0.0000
D(EXCHRAT_POS(-1))	0.145446	16.78292	0.0000
D(EXCHRAT_POS(-2))	1.463870	19.36836	0.0000
D(EXCHRAT_POS(-3))	0.093518	22.337839	0.0000
D(EXCHRAT_NEG(-1))	-0.12353	-30.4793	0.0000
D(EXCHRAT_NEG(-2))	-1.23478	-10.35626	0.0000
D(EXCHRAT_NEG(-3))	-0.029361	-10.3783	0.0000
C	1.035785	20.48795	0.0000
Log-likelihood	-1051.592		

Table 3. Non-Linear ARDL model estimation of monetary policy shocks on stock prices

Variable	Coefficient	t-Statistic	Prob.*
Long-run estimation			
VARINR_POS	-0.25544443	-130.04574	0.0000
VARINR_NEG	0.34823151	560.06819	0.0000
Short-run estimation			
ERROR COEFFICIENT	-0.352997	-121.08700	0.0000
D(VARINR_POS)	-0.16688.4	-13.59700	0.0000
D(VARINR_NEG)	0.142368	15.090860	0.0000
C	0.980409	17.235440	0.0000
Log-likelihood	-1000.592		

Table 4 shows the significant interactive effects of exchange rates and variations in the monetary policy rate on stock prices. The short-term and long-term estimates report similar findings. The interactive effects are symmetrical for both periods.

4.2 Discussion on Developed Markets

The data used for the developed countries consist of daily stock market prices, exchange rates, and variations in the monetary policy rate of the central banks of ten developing countries. Table 5 shows that all the variables are stationary at first difference.

Table 6 shows the estimates of the asymmetry of exchange rate movements on stock market prices. The non-linear ARDL analysis looks at the relationship between developing-country exchange rates and stock prices. According to the NARDL estimates, a rise in the exchange rate raises stock prices in both the short and long run. In particular, the results show that a percentage increase in the exchange rate stimulated a 0.137% rise in stock prices while a 1% fall in the exchange rate induced a 0.33% drop in stock prices in the long run. During the short-run, a 0.14% increase in stock prices was observed as a result of a 1% rise in the exchange rate while it necessitated a 0.13% decline in stock prices. However, the positive component of interest rates has a greater short-run impact on stock prices, whereas the negative component had a greater long-run impact. According to the NARDL results, exchange rate devaluation results in higher stock prices while an appreciation of the currency rate reduces the prices of stock in the market accordingly. The results thus suggest asymmetry in the effects of exchange rate movements on stock prices.

Table 7 shows the estimate of the asymmetry of interest rate variability on stock prices. The results of the NARDL results indicate statistically significant asymmetrical effects of interest rates on the stock market prices. According to the NARDL results, a positive variation in the interest rates stimulated a 0.26% decline in stock prices, whereas a 1% negative variation in the interest rate led to a 0.17% increase in stock prices over the long-term period.

In the short-run relationship between the variables, it is revealed that the difference of lag1, lag 2, and lag3 of the positive variation in the monetary policy rate of the central banks all had a negative effect on stock prices. This implies that higher variation in the policy rate of the previous periods led to a significant decline in stock prices. On the other hand, the difference of lag1 negative interest, the difference of lag 2 negative monetary policy rate, and difference of lag3 negative interest rate all reported a significant positive impact on stock prices. Consequently, lower variations in the monetary policy rate of the central banks of the past period resulted in higher stock prices. Overall, the findings imply that variations in interest rates have significant non-linear implications for stock market prices.

Table 4. Non-linear ARDL Model Estimation of the Interactive Effects of Exchange Rates and Monetary Policy Variables on Stock Prices

Variable	Coefficient	t-Statistic	Prob.*
Long-run estimation			
EXCHRAT*VARINR	-0.001968	-20.595345	0.0000
EXCHRAT*VARINR_POS	-0.135120	-10.561870	0.0000
EXCHRAT*VARINR_NEG	-0.912854	-10.675583	0.0000
Short-run estimation			
ERROR COEFFICIENT	-0.473981	-16.418807	0.0000
D(EXCHRAT*VARINR)	-0.438908	-20.591857	0.0000
D(EXCHRAT*VARINR_POS(-1))	-0.637136	-102.033717	0.0000
D(EXCHRAT*VARINR_POS(-2))	-0.045420	-9.28423	0.0000
D(EXCHRAT*VARINR_NEG(-1))	-0.012735	-12.34784	0.0000
D(EXCHRAT*VARINR_NEG(-2))	-0.103478	-11.23759	0.0000
C	13.18297	190.207257	0.0000
Log-likelihood	-10459.592		

Table 5. Unit root test results at a level based on levin, lin & chu

Variable	Test Statistic	P – value	Critical value
STOCKPRC	-112.15840	0.0004	1%, 5%, 10%
VARINR	-2341.78465	0.0002	1%, 5%, 10%
EXCHRAT	-5220.07636	0.0096	1%, 5%, 10%

Table 6. Non-linear ARDL model estimation of exchange rate volatility on stock prices

Variable	Coefficient	t-Statistic	Prob.*
Long-run estimation			
EXCHRAT_POS	0.136515	180.33253	0.0347
EXCHRAT_NEG	-0.33071	-190.18270	0.0092
Short-run estimation			
ERROR COEFFICIENT	-0.336359	-13.196498	0.0016
D(EXCHRAT_POS)	0.142416	10.742358	0.0000
D(EXCHRAT_NEG)	-0.131005	-40.664699	0.0000
C	10.53383	16.850381	0.0000
Log-likelihood	-1052.592		

Table 7. Non-Linear NARDL model estimation of monetary policy shocks on stock prices

Variable	Coefficient	t-Statistic	Prob.*
Long-run estimation			
VARINR_POS	-0.26158	-501.007305	0.0002
VARINR_NEG	0.17578	110.007305	0.0002
Short-run estimation			
ERROR COEFFICIENT	-0.697614	-40.134974	0.0000
D(VARINR_POS(-1))	-0.079758	-15.165011	0.0000
D(VARINR_POS(-2))	-0.018950	-26.324872	0.0000
D(VARINR_POS(-3))	-0.214422	-17.500380	0.0000
D(VARINR_NEG)	0.501349	210.009574	0.0000
D(VARINR_NEG(-1))	1.004519	140.956531	0.0000
D(VARINR_NEG(-2))	1.012430	205.931554	0.0000
D(VARINR_NEG(-3))	0.164589	131.065990	0.0000
C	5.50E+10	126.148448	0.0000
Log-likelihood	-1000.592		

Table 8 shows the estimates of the interactive effects of exchange rate movements and variations in the policy rate of the monetary authorities on stock prices. The result for developed countries indicates statistically significant asymmetrical interactive effects of the variability of exchange rate and monetary policy rate of the central banks on stock market prices. Again, the lagged values of the positive interactive effect of interest rate variation and exchange rate movements are statistically significant and positively impacted stock market prices. Similarly, the lagged values of the negative interactive effect of policy rate variation and exchange rate movements are statistically significant but negatively influenced stock market prices. In the short-run period, a 1% rise in the interactive effect of interest rate variation and exchange rate movements stimulated a 0.11% decline in stock prices. Also, a 1% reduction in the interactive effect of interest rate variation and exchange rate movements resulted in a 0.12% reduction in prices of stock.

The study is significant because empirical finding regarding the response of asset prices to central bank policy and changes in currency rates is a key component for analyzing the impact of monetary policy and foreign exchange rate movements on the economy. Moreover, determining quantitatively whether there is a stock price/return reaction to changes in interest and exchange rates policy is pertinent to the study of stock market determinants, and also making provision for the understanding of potential economic effects of policy actions or

Table 8. Non-LINEAR ARDL model estimation of the interactive effects of exchange rates and monetary policy variables on stock prices ARDL

Variable	Coefficient	t-Statistic	Prob.*
Long-run estimation			
EXCHVOL*VARINR	-0.01968	-60.5954	0.0001
EXCHRAT*VARINR_POS	-0.11335	-12.56187	0.0000
EXCHRAT*VARINR_NEG	-0.12684	-43.67558	0.0000
Short-run estimation			
D(EXCHRAT*VARINR _POS(-1)	0.24396	-23.46670	0.0000
D(EXCHRAT*VARINR _POS(-2)	0.76232	-28.0392	0.0000
D(EXCHRAT*VARINR _POS(-3)	0.20446	-11.74317	0.0000
D(EXCHRAT*VARINR _POS(-4)	0.47148	-25.29111	0.0000
D(EXCHRAT*VARINR _NEG	1.29491	-38.5540	0.0000
D(EXCHRAT*VARINR _NEG(-1)	-0.04076	-10.2118	0.0000
D(EXCHRAT*VARINR _NEG(-2)	-0.60272	14.89690	0.0000
D(EXCHRAT*VARINR _NEG(-3)	-0.34452	3.655752	0.0003
D(EXCHRAT*VARINR _NEG(-4)	-0.36258	14.65719	0.0000
D(VARINR_POS)	-0.01926	-20.26278	0.0000
D(VARINR_NEG)	0.18256	40.80542	0.0000
D(VARINR_NEG(-1)	1.25697	24.77970	0.0000
D(VARINR_NEG(-2)	0.179230	33.1191	0.0000
C	0.022985	66.0103	0.0000

inactions. For the sake of efficacy of the transmission mechanism of monetary policy, it becomes imperative for the management of an economy to be situated on the empirical finding on how different countries' stock markets perform in response to volatile currency rates, and expansionary or contractionary monetary policy. Investors and researchers generally agree that having accurate estimates of how asset prices respond to policy instruments is important. The availability of such estimates aids in developing sensible policy choices.

5. CONCLUSION

The study identifies and establishes the nature of the response of stock prices to exchange rate changes and monetary policy rate of the central monetary authorities in developed and developing stock markets. This study adopted the Non-Linear ARDL testing approach to establish these relationships. It was established for all emerging markets in the study that the estimated asymmetric exchange rate movement on stock prices is significant. It is revealed that variations in the monetary policy rate of the central banks decrease stock market prices in both the short-run and long-run in the emerging stock markets. The impact of exchange rates and monetary policy rates on stock prices in developed countries is significant and asymmetrical. There is a significant positive interactive effect of lagged values of a positive exchange rate shock and policy rate variation on stock market prices in the developed stock markets. Relatively, the lagged values of the negative exchange rate shock and monetary policy rate variability significantly results in a decline in stock prices also in the developed stock markets. For emerging markets, there is a significant negative interactive effect of lagged values of a positive and negative exchange rate shock and monetary policy rate variation on stock market prices. Relatively, the lagged values of the negative exchange rate shock and policy rate variability significantly results in a decline in stock prices also in the developed stock markets. There exists a significant asymmetrical effect of the interest rate variations on stock prices. Whereas the positive variation in policy rate reduces stock market price, the reduction in variation in the variations in the monetary policy rate of the central banks raises it.

ACKNOWLEDGEMENTS

The authors deeply appreciate the reviewers for their valuable comments. This had actually helped in improving the research paper. All other errors are the responsibility of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kerry L. The effects of COVID-19 on Chinese stock markets: An EGARCH approach. Economic and Political Studies, 2021: 9(2): 148-165.
DOI: 10.1080/20954816.2020.1814548
2. Kocaarslan B, Sari R, Gormus A, Soytas U. Dynamic correlations between BRIC and U.S. stock markets: The asymmetric impact of volatility expectations in oil, gold and financial markets. Journal of Commodity Markets. 2017;7:41-56.
Available:https://doi.org/10.1016/j.jcomm.
3. Sosa M, Ortiz E, Cabello A. Dynamic linkages between stock market and exchange rate in MILA Countries: A markov regime switching approach (2003-2016). Cuadernos de Economía, 2018; 33(83):1-20.
Available:https://doi.org/10.24275/uam/azc/dcsh/ae/2018v33n83/sosa
4. Bermudez Delgado NA, Bermudez Delgado E, Saucedo E. The relationship between oil prices, the stock market and the exchange rate: Evidence from Mexico. The North American Journal of Economics and Finance. 2018;45: 266-275.
Available:https://doi.org/10.1016/j.najef.2018.03.006
5. Nguyen VH, Shin Y. Asymmetric price impacts of order flow on exchange rate dynamics. 2010. Mimeo. Leeds: Leeds University Business School.
6. Stern PC. Information, incentives, and proenvironmental consumer behavior. Journal of consumer Policy. 1999;22(4):461-78.
7. Fama EF. The behavior of stock market prices. Journal of Business 1965;38:34-105.
8. Umoru D. Devaluation, shocks and Realities: Evidence Disciplining Strength.

4th inaugural lecture series of Edo state university Uzairue, Nigeria; 2022.

9. Dornbusch R. Expectations and Exchange Rate Dynamics. Journal of Political Economy. 1976;84:1161-1176.
10. Ho LC, Huang CH. The nonlinear relationships between stock indexes and exchange rates", Japan and the World Economy. 2015;33:20-27.
DOI: 10.1016/j.japwor.2015.02.002.
11. Wong, H.T. Volatility spillovers between real exchange rate returns and real stock price returns in Malaysia, International Journal of Finance and Economics. 2018:24:131-149.
DOI: 10.1002/ijfe.1653.
12. Wong, H.T. Real exchange rate returns and real stock price returns in the stock market of Malaysia, The Singapore Economic Review, 2019:64(5) 1319-1349,
DOI: 10.1142/S0217590816500387.13. Adu et al (2019)
13. Adu R, Litsios I, Baimbridge M. Real exchange rate and asymmetric shocks in the West African Monetary Zone (WAMZ). Journal of International Financial Markets, Institutions and Money. 2019;59:232-49.
14. Sugiharso Safuan & Sugeng Triwibowo & Defy Oktaviani. Asymmetric impacts of monetary policy shock on output gap: Evidence from regions in Indonesia. Bulletin of Monetary Economics and Banking, Bank Indonesia. 2022;25(3), 371-398.
15. Adamu Bello, Usman & Abdullahi, Nazeer. Effect of monetary policy dynamics on exchange rate volatility in Nigeria. 2022;14:49-67.
16. Zhang, Xiaoyu, Pan, Fanghui. Asymmetric effects of monetary policy and output shocks on the real estate market in China. Economic Modelling, Elsevier. 2021;103(C).
17. Salvatore C, Marcella D'U, Cristiana F, Oreste N. Spatial asymmetries in monetary policy effectiveness in Italian Regions. Spatial Economic Analysis. 2022;16:27-46.
18. Sambo NU, Farouq IS, Isma'il MT. The asymmetric effect of exchange rate volatility on the trade balance in Nigeria. National Accounting Review; 2021.
Available:https://doi.org/10.3934/NAR.2021018
19. Sharma C, Pal, D. Exchange rate volatility and India's cross-border trade: A pooled mean group and nonlinear co-integration approach. Economic Modeling. 2018: 74,230-246.
Available:https://doi.org/10.1016/j.econmod.2018.05.016
20. Sun Y, Wang X. Asymmetric effects of China's monetary policy on the stock market: Evidence from a nonlinear VAR model. Asian Economic and Financial Review. 2018;8(6):745-761.
Available:https://doi.org/10.18488/journal.aefr.2018.86.745.761
21. Triwibowo S, Oktaviani D. Asymmetric impacts of monetary policy shock on output gap: Evidence from regions in Indonesia. Buletin Ekonomi Moneter Dan Perbankan. 2020;25(3): 371-398.
Available:https://doi.org/10.21098/bemp.v25i3.1648.
22. Wong WK, Agarwal A, Jun D. Financial integration for INDIA stock market, a fractional co-integration approach. Paper 0501. Singapore: National University of Singapore Working. Working Paper no. 6/2008. Dusseldorf: Macroeconomic Policy Institute in the Hans-Bockler Foundation. 2005;1–29.
23. Lin, Tzu-Yu. Asymmetric effects of monetary policy. Journal of Macroeconomics. 2021;21(2):425-447.
Available:https://doi.org/10.1515/bejm-2020-0084
24. Mahapatra S., and Bhaduri, S. N. Dynamics of the impact of currency fluctuations on stock markets in India: Assessing the pricing of exchange rate risks. Borsa Istanbul Review, 2019;19 (1):15-23.
Available:https://doi.org/10.1016/j.bir.2018.04.004
25. Allen David E, Michael McAleer. A nonlinear autoregressive distributive lag analysis (nardl) of west texas intermediate oil prices and the dow jones index. Energies. 2021;13:4011.
26. Adu R, Litsios I, Baimbridge M. Real exchange rate and asymmetric shocks in the West African Monetary Zone (WAMZ). Journal of International Financial Markets, Institutions, and Money, 2019;59: 232-249.
Available:https://doi.org/10.1016/j.intfin.2018.12.005
27. Banerjee, Anindya, Juan Dolado, and Ricardo Mestre. Error-correction mechanism tests for co-integration in a single-equation framework. Journal of Time Series Analysis 1998;19:267-83.

28. Çelik A. Dynamics of Exchange Rate Fluctuations in Turkey: Evidence from symmetric and asymmetric causality analysis. Ekonomika. 2022:101(1),125-141.
DOI: 10.15388/Ekon.2022.101.1.7.
29. Christie, Andrew A. The stochastic behavior of common stock variances: Value, leverage, and interest rate effects. Journal of Financial Economics 1998; 3:407–32.
30. Delatte AL, López-Villavicencio A. Asymmetric responses of prices to exchange rate variations: evidence from the G7 Countries. Mimeo: Rouen University Business School; 2010.
31. Elhassan, T. Asymmetric impact of exchange rate fluctuations on money demand in Sudan. Asian Economic and Financial Review. 2021:11(5): 406–417.
Available:https://doi.org/10.18488/journal.aefr.2021.115.406.417.
32. Harb Sayed Ahmed, N. Exchange rate volatility and tourism stock prices: Evidence from Egypt. Journal of Association of Arab Universities for Tourism and Hospitality. 2019;17(2): 55-68.
DOI: 10.21608/jaauth.2019.91944
33. Jordan, Soren, Andrew QP. Dynamac: dynamic simulation and testing for single-equation ARDL Models; 2020.
Available:https://CRAN.R-project.org/package=dynamac.
34. Natsiopoulos K, Nickolaos T. ARDL: ardl, ecm, and bounds-test for c-integration. R Package Version 0.1.1; 2021.
Available:https://CRAN.R-project.org/package=ARDL.
35. Pesaran MH, Shin Y, Smith RJ. Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 2021;16:289-326.
36. Suhendra I, Anwar CJ, Istikomah N, Purwanda E, Kholishoh LN. The short-run and long-run effects of central bank rate on exchange rate volatility in Indonesia. International Journal of Innovative Research and Scientific Studies. 2022; 5(4):343-353.
Available:https://doi.org/10.53894/ijirss.v5i4.851
37. Zaghdoudi T. NARDL: Nonlinear co-integrating autoregressive distributed lag model. R Package Version 0.1.6; 2021.
Available:https://CRAN.R-project.org/package=nardl.
38. Shin Y, Byungchul Y, Greenwood-Nimmo M. Modeling asymmetric co-integration and dynamic multipliers in a nonlinear ARDL framework. In The Festschrift in Honor of Peter Schmidt.: Econometric methods and applications in Robin C. Sickles and William C. Horrace. New York: Springer. 2014;281-314.
39. Umoru D, Asekome MO. Stock prices and exchange rate variability in Nigeria. Econometric Analysis of the Evidence. 2016;9(25):261-285.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/103429