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The effect of exchange rate pass-through to inflation in Nigeria

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Abstract

The study examines the effect of exchange rate pass-through (ERPT) to inflation in Nigeria. The study period spans from 1990 to 2022 and data were sourced from Central Bank of Nigeria Statistical Bulletin and World Bank's Development indicators (WDI). The study employed preliminary test of Augmented Dickey Fuller unit root test. Analytical technique of Autoregressive Distributed Lag (ARDL) model was used for the analysis. The dependent variable is Consumer price index proxied by inflation while the explanatory variables include monetary policy rate (MPR), nominal effective exchange rate (NEER), import price index (IMPI) and Global oil price (GOP). The result of unit root suggests mixed order of integration while the ARDL bound test demonstrate long run relationship among the variables under consideration. Findings indicate that exchange rate exhibit a positive and significant impact on consumer price while import price exerts a negative and significant influence on consumer price. Based on this outcome, the study suggests that monetary authority should exercise caution in using devaluation of the domestic currency to promote economic growth, as that would not only aggravate domestic inflation but also likely increase the ERPT. Given that exchange rate devaluation is unlikely to improve the country's chances in the international market vis-à-vis its exports.

Keywords: Exchange Rate Pass-Through; Import Price Index; Consumer Price Index; Autoregressive Distributed Lag Model

1. Introduction

For some decades, the Nigeria economy has experienced increases in inflation resulting from imported inflation. This is attributed to among others, Nigeria's overdependence on foreign inputs and goods.

Spike in the general price of domestic goods and services can also be caused by a depreciation of the currency, which leads to higher prices of imported goods. With more economic openness, several countries, especially in the emerging markets and developing economies (EMDEs) have been known to deal regularly with exchange rate volatility and the attendant impact on inflation. (Lopez-Villavicencio and Mignon, 2018) reckoned that with the adoption of floating exchange rate regimes, inflation targeting monetary policies and removal of capital controls, emerging markets may likely face more exchange rate volatility and imported inflation. (Fischer, 2015) observed that fluctuations in the exchange rate are key drivers of inflation with implications for monetary policy decision making. Consequently, it is important to understand and correctly assess the pass-through of the exchange rate to inflation to avoid severe policy slip-ups

Exchange rate pass-through is defined as the percentage change in import price attributed to a certain percentage change in exchange rate. (Goldberg & Knetter 1997) defined exchange rate pass-through (ERPT) as the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing economies. ERPT is generally used to refer to the effect of exchange rate changes on import and export prices, consumer prices, investments or trade volumes (Frimpong & Adam, 2010). The significance of exchange rate

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changes in macroeconomic adjustment is determined, to a large extent, by its influence on domestic prices and the speed of its transmission.

1.1. Statement of Problem

The Nigeria economy has experienced continuous rise in the prices of goods and services over the years. One of the demanding situations to economic policy management particularly in emerging and developing economies has been the effect of changes in exchange rates on inflation and economic activities. It is believed that exchange rate movements would create domestic economic distortions and affect a country's economic competitiveness.

(Ha et al, 2019) found that EMDEs have more significant increases in consumer price inflation based on large depreciation episodes than in advanced economies. In terms of the nature of shocks, they found that higher exchange rate pass-through stems mostly from monetary policy shocks compared to other domestic shocks, while global shocks have different effects. Also, countries with more flexible exchange rate regimes and a credible commitment to an inflation target experience lower exchange rate pass-through to inflation.

In Nigeria exchange rate movements have been most volatile in the past decade, hence the need to assess the effect of exchange rate pass-through to inflation in Nigeria; with two specific objectives: a) the magnitude of exchange rate and import price pass-through to inflation, (b) to determine if there is a long run relationship among the variables of interest (1990-2022).

The rest of the paper is organized as follows. A review of theoretical and empirical literature is presented in section two. The methodology and results of the model estimation are in section three and four respectively, while section five concludes the paper, and proffers policy recommendations.

2. Literature Review

The law of one price (LOOP), the purchasing power parity (PPP) and the monetary theory to exchange rate determination are theoretical foundations on which exchange rate pass-through relies on. The bases of these theories are discussed in this study.

2.1. The Law of One Price and Purchasing Power Parity

The relationship between prices and exchange rates evolves from the doctrine of purchasing power parity (PPP), an offshoot of the law of one price (LOOP), with the supposition that there are no trade barriers and transport costs. However, in real world situations, trade frictions exist and these distort the underlying assumptions of PPP. The law of one price (LOOP) states that in the absence of trade frictions and under a system of free competition and price flexibility, identical goods sold in different locations must be sold for same price when prices are expressed in the same currency. Thus, a change in domestic currency in a market would have equal change in price in the foreign market, even though the markets are in two different countries. However, because of trade frictions, the LOOP may or may not hold in certain instances. This is based on the fact that many factors such as cost of production, producers' mark up and movements in exchange rate influences domestic & import prices.

2.1.1. Monetary Approach to Exchange Rate Determination

The monetary approach to exchange rate determination principally depends on (Krugman's, 1986) monetary exchange rate model which uses the LOOP and PPP to explain how changes in the exchange rate has an impact on price level. The monetary approach suggests that all things being equal, an increase in money supply growth should be the same to the increase in the inflation rate and rate of exchange rate depreciation. This method emphasizes that in the long-run money supply, inflation, interest rate, and exchange rate are correlated.

The commitment of central banks to maintain a low inflation environment play a critical role in firms transmitting their prices. Using a microeconomic model of staggered pricing, (Taylor, 2000) produced a theoretical framework where the degree of pass-through depends on the inflation environment. He finds that a lower passthrough is caused by lower perceived persistence of cost changes. Drawing on (Taylor, 2000), the links between pass-through and inflation has been further examined by (Gagnon & Ihrig, 2004) who carry out an analysis of twenty industrialized countries. They concluded that the pass-through subsided in countries whose central banks have adopted inflation targeting since the 1990s.

Critical role in determining ERPT is played by the composition of a country's import basket in determining the pass-through, and this assumption has been confirmed by (Campa & Goldberg, 2005) who concludes that changes in the pass-through are mainly caused by changes in the composition of a country's import basket. They stress that moving away from energy which has a high pass-through to manufactured goods which the pass-through is comparatively low will reduce the pass-through to import prices, leading to lower prices for consumers.

2.1.2. Theoretical Framework

Based on the propositions of (Berga, 2012), the starting point in the study of the link between exchange rate and domestic prices is the law of one price (LOP) which states that the price of identical commodities sold in different markets should be the same when converted into the same currency. The mathematical expression of LOP is given as:

$$P_t = E_t P_t^* \quad (2.1.1)$$

Where P_t = domestic price index, E_t = nominal exchange rate, while P_t^* = foreign prices. The validity of this relationship is confirmed in the case of the purchasing power parity theory using price indices across countries. When considered in logarithmic form, the LOP takes the form:

$$p_t = g e_t + g p_t^* \quad (2.1.2)$$

Where p_t , p_t^* and e_t are the natural logarithm of import price, export price and nominal exchange rate respectively. The LOP implies that $g = 1 = 1$ in which case changes in the exchange rate completely pass through to the domestic price of the traded good. This simple expression forms the basis of analysing the long run pattern of exchange rate pass-through.

Based on this fundamental relationship, studies such as Goldberg and Knetter (1997); and Campa and Goldberg (2002) developed more advanced models to analyse the extent of the transmission of the variations in exchange rate to domestic price. These studies considered the extent to which changes in exchange rate are transmitted to the prices of traded goods as well as the margin of profit accruable to producers. The concentration of industries and the acquisition of larger market shares formed a major part of the indices used by the studies above to interpret the differences in the channel of transmission. Therefore, Goldberg and Knetter (1997); and Campa and Goldberg (2002) analysis started from the basic model:

$$P_t = g e_t + e_t \quad (2.1.3)$$

Where, e_t = error term, g = coefficient of pass-through of exchange rate. Note that the degree of the coefficient of pass-through depends on g value. If prices of imports respond on a one-to-one basis to changes in exchange rate, then there is complete pass-through; thus $g=1$, while if the coefficient is less than one ($g < 1$) pass-through is said to be incomplete.

2.1.3. Empirical Literature Review

(Abdullahi, 2023) examines the macroeconomic shocks effect on exchange rate pass through into consumer price inflation using structural vector auto regression methodology. The results show that exchange rate pass through to consumer price inflation in Nigeria is low and incomplete. Moreover, the speed of adjustments to structural shocks, such as those from the exchange rate, output, monetary policy rate, and money supply is high.

(Nuhu, 2021) examined the effect of exchange rate volatility on inflation in Nigeria using annual time series data covering the period 1986-2019. Using the VECM his findings showed that money supply and nominal exchange rate has a positive and significant effect on consumer price index.

(Abiodun et al, 2016) states that the magnitude and length of exchange rate pass-through to consumer prices have increased in many developing countries in view of its profound implications on price and exchange rate stability as well as the macroeconomic policy environment.

(Razafimahefa, 2012) analyzed the exchange rate pass-through to domestic prices and its determinants in sub-Saharan African countries. The study found that pass-through is incomplete. The pass-through is larger following depreciation than after an appreciation of the local currency. The average elasticity is estimated at about 0.4. It is lower in countries with more flexible exchange rate regimes and in countries with a higher income. Also, a low inflation environment, a prudent monetary policy, and a sustainable fiscal policy are associated with a lower pass-through.

Similarly, (Lopez-Villavicencio & Mignon, 2016) found that emerging economies share same characteristics with advanced countries in terms of declining pass-through once inflation is controlled for and that low inflation environment and transparency of monetary policy decisions clearly reduce exchange rate pass-through.

(Ogundipe & Egbetokun, 2013) adopted the SVAR approach for the period 1970-2008 in estimating the pass-through effect of the exchange rate to inflation in Nigeria. The Authors found a substantially large pass-through from the exchange rate to inflation and Some studies have carried out an empirical analysis of the subject matter in Nigeria using an SVAR. Leading the way is (Zubair et al, 2013) who find the ERPT to be incomplete while it takes eight quarters for the full impact of the pass-through to be felt. (Ogundipe & Egbetokun, 2013) adopted the SVAR approach for the period 1970-2008 in estimating the pass-through effect of the exchange rate to inflation in Nigeria. The Authors found a substantially large pass-through from the exchange rate to inflation and asserted that the depreciation of the currency over the period influenced the results. They further observed that when the depreciation of the currency is persistent, the attendant increase in costs gets passed on to consumers by firms and importers. The Authors also noted that the large share of imports in the consumption basket coupled with high and persistent inflation in Nigeria during the examined period could explain the degree of exchange rate pass-through. Similarly, (Bada et al, 2016) examined the exchange rate pass-through to import and consumer prices for the period 1995 – 2015. The study also found that the pass-through from the exchange rate to inflation was incomplete in Nigeria, utilizing the Johansen approach to cointegration and a vector error correction model. Also, the exchange rate passthrough was found to be higher in import prices than in consumer prices.

3. Methodology

In order to determine the impact of exchange rate and import price pass-through to inflation in Nigeria, the study used time series data for 1990-2022 period. The study is designed in such a way that unit root test was used to test the stationarity of the variables. The data used was sourced from Central Bank of Nigeria statistical bulletin and World Bank indicators (WDI).

3.1. Model Specifications

The implications of exchange rate and import price pass-through to inflation in Nigeria was estimated taking cue from the model by Jiang and Kim (2013). The functional form of the model of this study is stated in equation 1 below:

$$[1] \quad CPI_t = \alpha_0 + \alpha_1 MPR_t + \alpha_2 NEER_t + \alpha_3 IMPI_t + \alpha_4 GOP_t + U_t$$

Where CPI_t is consumer price index; MPR_t connotes monetary policy rate; $NEER_t$ represents the nominal effective exchange rate; $IMPI$ import price index and GOP_t is global oil price and U_t = Error term respectively.

This study adopts the Autoregressive Distributed Lagged (ARDL) model proposed by Pesaran, Shin, and Smith (2001) to examine the cointegration relationship between exchange rate and import price pass-through to inflation in Nigeria. The ARDL model specification of the above functional form in equation 1 is express in equation 2

$$[2] \quad \Delta \ln CPI_t = \delta_0 + \delta_1 \ln MPR_{t-1} + \delta_2 \ln NEER_{t-1} + \delta_3 \ln IMPI_{t-1} + \delta_4 \ln GOP_{t-1} + \sum_{i=0}^q \varphi_1 \Delta \ln FDI_{t-1} + \sum_{i=0}^q \varphi_2 \Delta \ln EXCH_{t-1} + \sum_{i=0}^q \varphi_3 \Delta \ln MCAP_{t-1} + \delta_4 \ln GOP_{t-1} + \lambda ECM_{t-1} + \varepsilon_t$$

where $\delta_1 - \delta_4$ are the long-run parameters; $\varphi_1 - \varphi_4$ are the short-run parameters; δ_0 and ε are the intercept term and the white noise stochastic term respectively; λ is the parameter of the error correction mechanism (ECM); \ln is the natural logarithm of the variables, and; Δ is the difference operator. The ECM_{t-1} is a one lag error correction term that accounts for the speed of adjustment to the long-run equilibrium.

4. Results

The Skewness measures the degree of asymmetry of the sampled data around its mean. Thus, we can see that all the variables are positively skewed since they all have positive values. While Kurtosis measures the degree of peakness or flatness of the sampled data. NEER, IMPI and GOP are platykurtic in nature since $\beta < 3$ while CPI and MPR are Leptokurtic since $\beta > 3$. This implies that NEER, IMPI and GOP have most of the values lower than the sample mean. Conversely, CPI and MPR have more of higher values in it than is sample mean. The Jarque-Bera statistic (JB) measures the degree of normality of a given distribution. Here NEER, IMPI and GOP are normally distributed since their associated and

corresponding p-values are greater than 0.05 ($p > 0.05$) while CPI and MPR are not normally distributed since their associated and corresponding p-values are less than 0.05 ($p < 0.05$).

Table 1 Descriptive Statistics

	CPI	MPR	NEER	IMPI	GOP
Mean	114.4321	13.87353	151.8318	90.64735	51.14000
Median	68.20000	13.50000	130.2450	92.35500	45.48000
Maximum	425.5000	26.00000	426.0800	122.0400	109.4500
Minimum	2.400000	6.000000	8.040000	57.43000	12.28000
Std. Dev.	120.6135	3.829594	126.6808	21.11746	32.48843
Skewness	1.289482	0.657550	0.803496	0.032434	0.496232
Kurtosis	3.681670	4.819205	2.679466	1.591796	1.863943
Jarque-Bera	10.08062	7.138577	3.803983	2.815268	3.223778
Probability	0.006472	0.028176	0.149271	0.244722	0.199510
Sum	3890.690	471.7000	5162.280	3082.010	1738.760
Sum Sq. Dev.	480071.4	483.9712	529585.1	14716.26	34831.44
Observations	32	32	32	32	32

Source: Authors Computation

4.1. Unit Root Test

Testing for the presence of unit root in all the variables, using the Augmented Dickey Fuller (ADF) tests.

Table 2 ADF Unit Root Test

Variables	Level	First Difference	Second difference	Order of Integration	Decision	Max Lag Length
LNCPI	-4.166593**	-2.634114	-5.300442**	1(0)	Stationary	8
LNMPR	-2.683299	-6.870194**	-8.519602**	1(1)	Stationary	8
LNNEER	-1.235000	-5.696782**	-5.182716**	1(1)	Stationary	8
LNIMPI	-1.565227	-8.596716**	-10.09391**	1(1)	Stationary	8
LNGOP	-0.923344	-5.307746**	-5.052488**	1(1)	Stationary	8
Critical Values						
1% (*)	-3.646342	-3.653730	-3.670170			
5% (**)	-2.954021	-2.957110	-2.963972			
10%	-2.615817	-2.617434	-2.621007			

Source: Authors computations

The result of Augmented Dickey Fuller unit root test in Table 2, reveals that only CPI exhibits stationarity at level [i.e., I(0)] while the rest Variables are stationary at first difference [i.e., I(1)]. Given the mixed order of integration, ARDL model and bound cointegration test are employed for the analysis.

Table 3 The Results of ARDL cointegration test

Diagnostic tests					
Estimated Model	Optimal lag length	F-Statistics	R ²	Ajd-R ²	D.W test
$CPI_t = f(MPR_t, NEER_t, IMPI_t, GOP_t)$	1, 0, 0, 0, 0, 0	8.375342	0.484167	0.463475	2.893215
CointEq(-1)*		-0.785332	0.156345	-5.033987	0.0001
Bounds testing to cointegration					
Significant Level		Critical Values Lower bounds I(0)		Upper bounds I(1)	
1% level		2.77		3.88	
5% level		2.17		3.18	
10% level		1.99		2.94	
Post-Estimation Results					
Linearity test Ramsey RESET		Autocorrelation test LM Test		Heteroscedasticity test Breusch-Pagan-odfrey	
0.230797 (0.1185)		0.277235 (0.4245)		0.743567 (0.5309)	

Source: Authors computation

This study is an impact analysis; thus, the appropriate lag selection criterion is the Schwarz information criterion (i.e. 1, 0, 0, 0, 0, 0) as displayed in Table 3. The results reported in Table 3 reveal that our computed F-statistics is greater than lower and upper critical bounds generated by Pesaran et al. (2001) at 1per cent, therefore connoting the decision of presence of cointegration. Table 3 holds the Error Correction Term (ECT), which has value of -0.78 or 78%, may be quickly observed to be substantial and negative. Accordingly, if there is a short-term disturbance, balance can be regained by 78% in the current year. The weak adjusted R-squared reveal that the variable in the model accounts for 48% of the fluctuations that may be explained, which means that the remaining 51% of the explanations for the ERPT comes from additional explanatory factors. Given this scenario, the appropriate approach is to rely on the conditional error correction regression which represents the short run equation for the analysis of the result. Table 4 below holds the result of short-run and long run analysis.

The Durbin Watson Stat of 2.89, which is reinforced with the F-Statistic of 0.28 and Probability of 0.43 of the Breusch-Godfrey Serial Correlation LM test, do reveal that the disturbance terms of the succeeding periods are mutually independent of each other. The Breusch-Pagan-Godfrey test for Heteroskedasticity with an F-Statistic of 0.74 and Probability of 0.53 show that the results meet the Ordinary Least Square Assumptions of constant variance of the disturbance term. The null hypothesis of linearity is maintained and the model is stable.

Table 4 represents the short run and long run estimates among the variables in the model. Accordingly, the short run and long run pass-through effect from exchange rate and import price to domestic price is estimated. A 1 per cent increase in nominal exchange rate will lead to -0.24 and 0.43 per cent increase in consumer price index (inflation) in the short run and long run, this implies that nominal exchange rate exerts some level of influence on consumer price index (inflation) in Nigeria. Both estimates are statistically significant at 5percent significant level. However, import price index exhibits a significant relationship with consumer price index (inflation) in Nigeria. This implies that a unit change in IMPI, will bring about 0.45 and 1.85 per cent increase in consumer price index in Nigeria. Changes in import prices are found to have greater impact on the consumer price index in the long-run.

The outcome of the impulse response function as depicted in Table 5 showed that CPI responded positively to its own shock in the first to tenth year. Furthermore, the result shown in Table 5 indicated that CPI responded positively to shocks by MPR in the first to the tenth year respectively.

Lastly, CPI responded negatively to shocks in NEER in the second to tenth year, it also responded negatively to shocks in IMPI in the third year to the tenth year respectively. The results also indicate that the pass-through effect from exchange rate itself is high, persistent and significant, implying that exchange rate depreciation leads to further depreciation as established by Aliyu *et al* (2008).

Table 4 ARDL Short Run and Long Run estimates

Panel B: Short run estimates	Coefficient	Std. Error	T-Stat.	Prob.
Constant	5.372433	2.645643	2.327215	0.0225
ΔCPI_{t-1}	-0.242142	0.059206	-3.176542	0.0023
ΔMPR_{t-1}	0.226963	0.075860	-2.670320	0.0004
$\Delta NEER_{t-1}$	-0.246733	0.032307	-3.610584	0.0025
$\Delta IMPI_{t-1}$	0.453176	0.351225	1.2023475	0.2204
ΔGOP_{t-1}	0.350143	0.261244	1.201723	0.2004
ECT_{t-1}	-0.542072	0.214722	-3.116380	0.0002
Panel B: Long run estimates				
MPR	0.701457	0.314651	-3.617022	0.0021
NEER	0.432992	0.124942	-3.355013	0.0525
IMPI	1.854221	1.533421	1.145364	0.2431
GOP	-0.224692	0.118962	-3.426110	0.0514

Source: Authors computation

Table 5 Impulse Response Function

Response of CPI:					
Period	CPI	MPR	NEER	IMPI	GOP
1	2.435683	0.000000	0.000000	0.000000	0.000000
2	1.040435	1.142044	-1.264521	0.035671	1.152076
3	1.349564	1.034210	-0.524453	-0.422780	1.045386
4	1.007644	0.856733	-0.75800	-0.312390	0.973442
5	1.102453	1.013745	-0.683710	-0.331622	1.014567
6	0.784522	1.022254	-0.822246	-0.269520	1.033325
7	0.887545	1.032877	-0.733480	-0.288768	1.042925
8	0.843426	1.035822	-0.756744	-0.217670	1.046364
9	0.864542	1.035884	-0.763520	-0.288901	1.049449
10	0.857016	1.040654	-0.740451	-0.286177	1.050961

Source: Authors computation

5. Conclusion

This paper examines the effect of the exchange rate and import price pass-through to inflation in Nigeria covering the period of 1990 to 2022. The result of unit root suggests mixed order of integration while the ARDL bound test demonstrated the existence of long run relationship among the variables under consideration. Findings indicate that exchange rate exhibit a positive and significant impact on consumer price while import price exert a negative and significant influence on consumer price. In most economies, exchange rate stability constitutes a significant part of price stability. Increase in price resulting from exchange rate depreciation could spill over to other sectors of the economy, rise in domestic production costs might lead to inflation. Consequently, the need to gauge an appropriate monetary policy response to such pass-through effects by the central bank and make the external sector competitive through appropriate exchange rate adjustment.

The rate of reaction of inflation to a one percentage change in the exchange rate is less than the rate of reaction inflation exhibits to a one percentage change in import prices. In effect, the response of inflation to shocks coming from import prices is higher than that of those coming from the exchange rate. The prevailing domestic inflation had some effects on the pass-through of import prices.

Recommendations

Monetary authority should exercise caution in using devaluation of the domestic currency to promote economic growth, as that would not only aggravate domestic inflation but also likely increase the ERPT. This is even more so, given that exchange rate devaluation is unlikely to improve the country's chances in the international market vis-à-vis its exports.

If the pattern of ERPT is clearly and correctly identified, the task of achieving a stable exchange rate including price stability, by the Central Bank of Nigeria through appropriate policies and interventions in the foreign exchange market and efficient management of foreign reserves could be achieved.

Also, relevant authorities need to strengthen domestic industries and instill confidence through enlightening consumers to reduce reliance on imports.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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