Interest Rate Pass-through in Nigeria: An Asymmetric Cointegration Approach

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This paper empirically examines the pass-through of the Central Bank of Nigeria policy rate to commercial banks' retail rates. The study covers the pre-liberalization (1962M01–1987M07) and post-liberalization (1987M08–2020M09) periods, and emplys asymmetric cointegration and error-correction modelling approach. The empirical results indicate that the pass-through is incomplete during both periods, though, it is larger during the pre-liberalization period. The study further reveals that the banking crises lead to an increase in the lending rate in the long and short run. The effect of the crises on the deposit rate is also positive but only significant in the short run. The empirical analysis demonstrates that all the threshold cointegration tests for the two sample periods exhibit asymmetric behaviour. The retail loan/lending rate adjustment to changes in the policy rate during both periods appears asymmetric with upward rigidity. The finding supports the adverse customer reaction hypothesis, suggesting that banks are more rigid in raising loan rates than reducing them. The results also support customer reaction on the deposit side, showing among others, downward rigidity in deposit rates in both periods. Therefore, the study recommends that the monetary authorities should strengthen monetary operations to ensure efficient transmission of monetary policy rate. There is also a need for measures that can enhance competitiveness in the banking sector and improve the efficacy of the interest rate channel. More commitments to preventing a systemic crisis in the industry and those that can effectively contain unavoidable ones are also desirable.

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1. Introduction

As part of its price stabilization role, the Central Bank of Nigeria (CBN) adjusts its policy tools leading to changes in the lending and deposit rates, which influences economic agents' decisions on investment, savings, and consumption. Ultimately, economic activities may change as consumer and business spending react to interest rate changes. The efficiency of the system is essential, especially for Nigeria that uses the interest rate as the main monetary policy transmission channel. However, before 1986, the financial institutions in the country operated predominantly under government regulation. During that period, the government empowered the CBN to set both lending and deposit rates (Asogwa, 2005; Okpara, 2010). This interference, however, created some considerable distortions. For example, the regulated interest rate policy prevented financial institutions from raising loanable funds through saving or money markets (Ojo, 1993). This resulted in low investment levels and the economy almost came to a standstill (Okpara, 2010). Thus, the monetary authorities liberalized the financial system in July 1987.

Liberalization of the financial market allows the conduct of monetary policy to be mainly through market-oriented instruments designed to stimulate short-term interest rates. However, the market-oriented financial system did not last long as the central bank stopped licensing new banks in 1993 following the crisis that Nigeria's banking industry experienced in the early 1990s and reintroduced interest rate regulation in January 1994 (Eboreime & Egboro, 2012)[3] . Nonetheless, the central bank noted that these and other controls introduced in 1994 and 1995 had adverse economic effects and opted for total deregulation of interest rates in October 1996 (CBN, n.d., Asogwa, 2005; Udoka & Anyingang, 2012). Financial liberalization encourages new entry, which also creates the possibility of enlarging the banking market, fostering competition and ultimately increasing operational efficiency among banks.

Banks' behaviour in a competitive market assumes complete information where monetary policy rate pass-through to banks deposits, and lending rates is fast and complete (symmetric) and one-to-one. However, in practice, lagged responses and asym-

[3] According to the Global Financial Development (2019) data, the banking sector in Nigeria had a banking crisis between 1991 and 1995

metries are likely to be present due to systemic factors, which include: central bank intervention (Mark & Moh, 2003; McMillan, 2004), menu and transaction costs (Barro, 1972; Obstfeld & Taylor, 1997), imperfect information (Stiglitz, 1979), high ratio of non-performing loans, inefficiency and low competition (Krstevska, 2008).

Related to the preceding argument, it is worth mentioning that Nigeria's banking market seems to be highly concentrated, as available data from the five largest (Tier 1) banks control close to 70% of the industry assets (The Banker, 2021). One of the reasons for concern about that stem from the fear that a highly concentrated market tends to exhibit behaviours that could adversely affect competition in the banking industry and ultimately put investment prospects into a precarious position (Berger, 1995; Ben-Zekry, 2007). For example, studies show that banks in more concentrated markets tend to charge higher rates on business loans and pay lower retail deposit rates in response to changes in market interest rates (Berger & Hannan,1989; Hannan, 1991; Hannan & Berger, 1991; Neumark & Sharpe, 1992).

In addition, apart from the crisis that the Nigerian banking system experienced in the early 1990s, the industry also entered a period of sustained insolvency crisis following the 2008 global financial meltdown. Financial experts hinted that a severe crisis in the banking market could impair the influence of the interest rate channel in the transmission of monetary policy (Knell & Stix, 2015; Bloom *et al.*, 2007; Morgan 1993). Considering the economic effects of financial crises, it has become increasingly important to understand the potential links between monetary policy transmission and financial crisis.

Given the above, this paper sought to answer the following research questions: to what extent do the central bank policy rate changes pass through into the retail deposit and lending rates in Nigeria? Are the speeds and magnitudes of the adjustments to monetary tightening and easing uniform? How do bank crises affect the response of commercial banks' retail rates to adjustments in the Central Bank's policy rate?

Detecting asymmetric behaviour in how retail rates react to policy rate changes is vital for several reasons. First, it can provide insights into how the central bank's policy rate changes pass through to retail rates over important periods of government-regulated and deregulated (market-determined) interest rate regimes (the pre- and post-financial sector liberalization periods) in Nigeria. Second, notwithstanding the significance of investigating the possible asymmetries in the transmission process of monetary policy in an economy, there is a paucity of research investigating this issue in Nigeria. The few exceptions include studies by Sanusi (2010), Fomum (2011), Bangura (2011), Mangwengwende (2011), Ogundipe and Alege (2013), Kelilume (2014), and Mordi *et al.*, (2019). Third, the crisis episodes experienced by the banking industry also provide a natural experiment to test the effect of the banking crisis of 1991-1995 and 2009-2012 on the degree of pass-through of the monetary policy rate to retail rates in the long run. Excluding crisis periods from interest rates' pass-through models limits understanding of the monetary policy transmission mechanism via the interest rate channel. Therefore, this study builds on the monetary policy literature by modelling the banks' crisis as a predictor of Nigeria's retail rate adjustments. The rest of the paper is organized as follows: Section 2 reviews related studies; Section 3 describes the data, methodology, and empirical procedure; Section 4 presents the estimation results and discussion; finally, Section 5 presents the conclusion and offers some policy recommendations.

2. Literature Review

2.1 Theoretical Literature

In principle, monetary policy can transmit into the real economy through the credit channel or the interest rate channel (Mishkin, 1996). The credit channel can affect the entire economy either through bank lending or via balance sheet channels. Both channels highlight information asymmetry in the financial markets, leading to adverse selection and moral hazard problems. The focus of this paper is on the interest rate channel. The interest rate channel theory signifies the proposition that due to 'sticky prices,' changes in the central bank's overnight interest rate will cause changes in the real short-term rate. Practically, an increase in the short-term nominal interest rate will cause the real short-term interest rate to rise. Accordingly, business investment expenditures and household spending on durable assets will increase (Mishkin, 1996).

However, it would be difficult, for policy rate changes to reflect completely in short-term lending and deposit rates and then pass onto long-term retail rates if banks operate in a highly concentrated market. Studies such as Berger (1995), Scholnick (1999), Ben-Zekry (2007), among others, warned that higher market concentration could lead to a higher incidence of weak competitive environment. Berger (1995) argued that competitive imperfections in the banking market could motivate banks via collusive pricing arrangements to asymmetrically alter rates to their advantage. They can do that by lowering deposit rates or raising loan rates (Scholnick, 1999). A highly concentrated market might encourage the formation of collusive behaviour among banks, and thus facilitate rigidity in the adjustment of policy rate (Hanna & Berger, 1991; Scholnick, 1996). Related to the preceding argument, Cottarelli and Kourelis (1994, p. 592) state that, "price stickiness has often been considered a feature of oligopolistic markets." Imperfections such as information asymmetry and switching costs in the financial sector could introduce lags or proliferate asymmetry in banks' ability to manage interest rates (Khemraj, 2010; Fuertes *et al.*, 2010).

In the presence of information asymmetry, if banks raise lending rates, it can create adverse selection problems in the loan market, causing banks to face the risk of default from riskier borrowers. Banks, in that case, may prefer credit rationing to raise loan rates mainly to prevent loan default. Consequently, one may expect rigidity in lending rate increases (Stiglitz & Weiss, 1981; Payne & Waters, 2008). It is also possible for banks operating in a concentrated market to form a collusive arrangement. In that, they would be reluctant to adjust retail rates to monetary policy changes as it would be costly for them. Lagged responses and asymmetries can lead to incomplete pass-through of interest rate changes, particularly from the central bank policy rates to commercial banks' lending/deposit rates and the adjustment process (Payne, 2007; Payne & Waters, 2008).

Opportunity cost is another possible explanation of why the pass-through of policy rate onto retail rates would not be fast and complete. It is common knowledge in the monetary policy literature that banks must incur costs ("menu costs") when changing the interest rate in response to central bank policy action. Because of these adjustment costs, how banks react to central bank monetary policy action could depend on whether a variation in the monetary policy rate is temporary or permanent (Herrero *et al.*, 2017). Therefore, banks will decide to smoothen interest rates, partially or entirely, depending on the prevailing conditions. Thus, an environment of highly volatile interest rates will probably lower the magnitude and speed of error adjustments, as every shift in the policy rate might be temporary (Mojon, 2000; Cottarelli & Kourelis, 1994). If menu costs play a part in changing retail rates, then the adjustment of deposits or lending rates to policy rate changes may likely be asymmetric.

Another line of reasoning focuses on the bank-customer relationship (Hannan & Berger, 1991). According to this view, the extent to which the central bank policy rates pass-through to deposit rates, in the long run, could be strongly connected with the bank-customer relationship. If, for instance, banks recognize that depositors can react unfavourably to adverse interest rate changes, they are likely to be relatively slow when increasing interest rates. Consequently, deposit rates will be somewhat more rigid when they are rising than when they are decreasing. On the lending side, Scholnick (1996) extends the argument of deposit rate rigidity by Hannan and Berger (1991) for more stiffness in a loan rate increase. If commercial banks observe that a high cost to them of varying the loan rate emanates from adverse customers' reactions, they will be reluctant to raise loan rates. Also, as pointed out by Lim (2001) rigidity in lending rate increases may also signify the unwillingness of banks to lend to riskier borrowers. As a result, one may expect a greater upward rigidity of loan rates. However, in aggregate, such a strategy will provide very little if any, return over the banks' cost of borrowing funds, thus, negatively affecting their revenue and profits (Hannoun, 2015).

According to Payne and Waters (2008), if commercial banks adjust lending rates faster to rising central bank policy rates, but are slow to change when policy rates fall, then the effect of monetary tightening will be greater than that of monetary easing, thus, lending rates will be rigid downward. Downward rigidity of lending rates implies a decrease in loan supply, which in sequence, will increase the cost of credit, particularly for bank-dependent investment businesses, thereby affecting the real economy negatively (Olivero, *et al.*, 2011)[4].

[4] Lim (2001) makes this point and provides its implication on loan performance of commercial banks and the likely strategic lending choices.

Studies also indicate that the pass-through of the monetary policy can be distorted during financial crisis periods. Indeed, consistent with this contention, there is a theoretical argument that market participants might lose trust or confidence in banks during crisis periods (Knell & Stix, 2015). In such a situation, interest rates are likely to become less critical for determining investment decisions and household spending, thereby making the monetary policy lose its impact (Morgan 1993; Bloom *et al.*, 2007). Uncertainty in the banking system could significantly affect how investors behave in loan markets and household decisions to save. Ultimately, the central bank's influence on output and inflation could be affected. However, a contrary view holds that monetary policy intervention could be useful if it is powerful enough to ease some of the financial market's adverse features and reduce uncertainty. Interest rate adjustments may gain prominence when financial market distress and uncertainty abate and when the real sector begins to recover (Mishkin 2009).

2.2 Empirical Literature

There is a considerable amount of empirical research on the response of retail rates to monetary policy actions. A study by Scholnick (1996) uses an asymmetric error correction method to examine the rigidity of commercial bank interest rates for Malaysia and Singapore. The author found deposit rates to be faster when they are above equilibrium level than when they are below it. This finding seems consistent with an earlier study by Neumark and Sharpe (1992), which found that banks in concentrated markets are sluggish to increase interest rates on deposits in response to rising market rates but are quicker to lower interest on deposits in response to decreasing rates. The preceding arguments confirm earlier research (Hannan & Berger, 1991), which found greater price rigidity in more concentrated markets. The sluggishness was higher when there was an incentive to increase deposit rates. In another study, Sander and Kleimeier (2000) found the asymmetric adjustment of lending rates to policy rate changes in Belgium, Luxembourg, the Netherlands, and Greece.

Lim (2001), utilizing a multivariate asymmetric error-correction procedure, found that though the deposit and lending rates adjust to changes in the Australian bank bill rate symmetrically, in the long run, but asymmetrically in the short run. The study's findings suggest that the adjustment of bank deposit and lending rates due to changes in the bank-bill rate appeared faster when there are negative changes than positive changes. De Bondt (2005) found an incomplete pass-through of market rates onto retail bank rates. The study further demonstrates a higher rigidity in the market rates on overnight deposits and deposits redeemable at notice of up to 3 months with a maximum 40% long-term pass-through. Payne and Waters (2008) found that the US prime rate's response to the federal funds rate changes to be unequal with upward rigidity.

In another finding, a study by Chong *et al.*, (2006) reported the adjustment of administered lending and deposit rates to be asymmetric and faster when they are above equilibrium level than when they are below it. In a similar work to the present study, Aziakpono *et al.*, (2007) use the asymmetric error correction model to examine how market interest rates adjust to policy rate changes under different policy regimes in South Africa. Their findings demonstrate week evidence of asymmetric adjustment and higher speed of adjustment under market-oriented regimes as opposed to government control regimes.

However, only a few studies examined the pass-through of interest rates using Nigeria's data. Sanusi (2010) and Kelilume (2014) studied interest rate pass-through and monetary policy efficiency in the country but assumed a linear adjustment process. Fomum (2011), utilizing a rolling window analysis, examined the possibility of asymmetric pass-through of interest rates in Nigeria and found that lending rates adjust to changes in the Nigerian monetary policy asymmetrically with downward rigidity for the rolling windows (1990-1999, 1991-2000 and 1992-2001) and, upward rigidity for the rolling windows (1999–2008, 2000-2009 and 2001-2010). Another study by Bangura (2011) found the pass-through of the policy rate to deposit rate to be rigid downward and upward to the lending rate in Nigeria. A similar study by Mangwengwende (2011) demonstrates evidence of incomplete pass-through of retail rate in response to policy rate changes in Nigeria. The study further revealed that lending rate adjusts symmetrically, while deposit rate adjusts asymmetrically with downward rigidity. A later study by Ogundipe and Alege (2013) also uses an asymmetric error correction method to examine the rigidity of commercial bank retail rates for Nigeria. The author found downward rigidity of both lending and deposit rates to changes in the policy rate. However, their study ignored the importance of crisis which may have distorted the relationship between the central bank's policy rate and the lending rates and possibly caused structural breaks.

Doubts are thus being raised about the validity of interest tare pass-through studies that do not account for structural breaks in their analysis. Acknowledging the importance of structural break, a study by Jibrilla and Ismail (2016) examined how banks in Nigeria adjust their loan rates in response to changes in monetary policy rates during the pre-and post-banking consolidation periods. They find that changes in the policy rate are transmitted entirely to the lending rate in the long run during the pre-banking consolidation period but incomplete during the post-consolidation period. However, the study strictly stressed the market-determined interest rate regime era but did not examine the deposit rates. The study did not include the period of the regulated interest rate regime. Also missing are the effects of the insolvency crisis in the banking sector that occurred during the sampled period considered. The interest rate regulation reintroduced between 1994 through October 1996 could affect the adjustment process of retail rates following official rate changes. Also, accounting for the possible structural breaks in their modelling approach, a study by Mordi *et al.* (2019) examined the size and adjustment pattern of the interest rate pass-through between the central bank's policy rate and commercial banks' retail rates in Nigeria. Though the break dates identified by the study appeared to coincide with the global financial crisis period, their analysis did not consider the banking crisis that occurred for much of the early 1990s. The adjustment process could also have been influenced not only by the banking crisis of 2008/9-2012 but also that of 1991-1995[5].

2.3 Stylized Facts

Figures 1 and 2 show the plots of data before and after the financial sector liberalization, respectively. Figure 1 presents a monthly plot of the central bank monetary policy rate (policy rate) and the commercial banks' prime (loan) lending and deposit rates. The figure suggests that movements in the deposit rates track the policy rate. As can be observed from the figure, market participants react to actions taken by the central bank, which on average controlled and kept interest rates stable during the

[5]Previous study by Jibrilla and Ismail (2016) did not also account for this issue.

regulated period. It would be observed from Figure 1 that there has been a relatively fixed and steady movement in interest rates during the period 1962-1977, but after 1977 there has been a gradual and steady upward trend through July 1987.

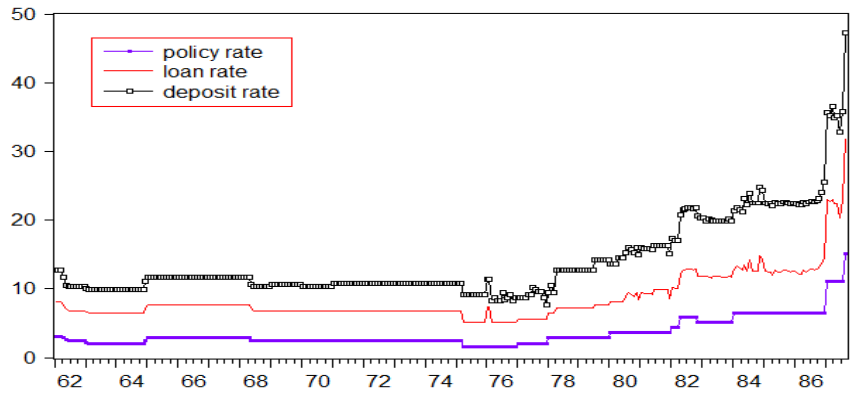

Figure 1: Interest rates (January 1962 to July 1987)

In Figure 2, where the interest rates for the post-liberalization period were plotted, a steady upward trend was also witnessed. The movement, however, reversed towards early 1994 when the banking sector was experiencing a solvency problem. Since then, there was a steady decrease towards 1997 when the rates started increasing steadily up to the year 2002. Subsequently, the rates experienced a gradual and steady downward trend that continued through the sample period. Such changes in movement observed in both Figures 1 and 2 may likely introduce structural breaks in the relationship between the policy rate and the two retail rates.

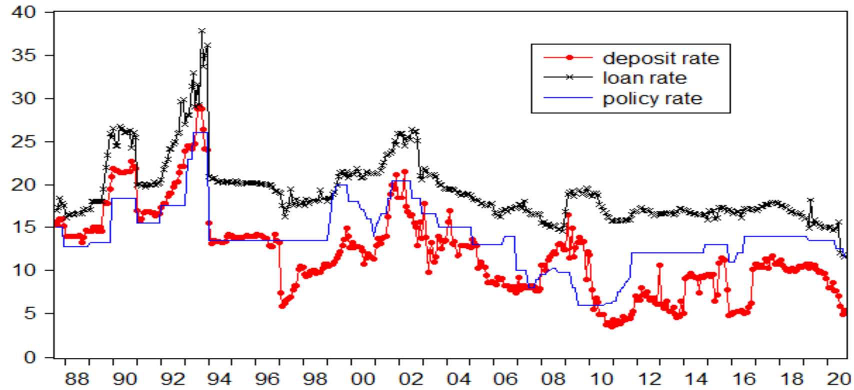

Figure 2: Interest rates (August 1987 to September 2020)

It is apparent from the figures that, on average, all the series seem to move together, which seems to reflect the development in the banking sector. Nonetheless, the time series properties associated with the variables are further examined through unit root and cointegration tests, and consequently, the degree of pass-through.

3. Data and Methodology

3.1 Data

The data for the analysis were taken from the Central Bank of Nigeria's online database[6], which is only available monthly. The three interest rates considered for the study are the monetary policy rate (MPR), prime lending rate (LR), and the average 12 months' deposits rate (DR). Data used covers 1962M01 to1987M07 (for the pre-liberalization period), and 1987M08 to 2020M09 (for the post-liberalization sample, including the consolidation period).

3.2 Theoretical Framework

The marginal cost pricing model is the most often used model to analyse the behaviour of banks in a perfectly competitive banking market. According to this model, optimal conditions are obtained when prices equal marginal costs and the derivative of prices to marginal costs equals one (De Bondt, 2002). However, because the Nigerian banking system can be characterised as an imperfectly competitive market in which the five largest (Tier 1) banks account for close to 70% of the industry assets, the marginal cost pricing model is not appropriate for the current analysis.

[6]http://statistics.cbn.gov.ng/cbn-onlinestats/

Instead, the approach, which assumes an imperfectly competitive banking market, is more suitable. This study, therefore, adopts the Monti-Klein model of imperfect banking competition (Freixas & Rochet, 1997) to examine the relationship between the monetary policy rate and commercial banks' retail lending and deposit rates in Nigeria.

Assuming an imperfectly competitive banking market with N banks (indexed $n = 1,2,...,N$). Each bank has M_n interbank balances and loans L_n on the asset side and deposits D_n on the liability side.

The balance sheet for each bank can then be identified as

$$D_n = L_n + M_n, \;\; n = 1,2,...,N \tag{1}$$

Assuming linearity, each bank has the following cost function

$$C_n\left(L,D\right) = \varphi_L L + \varphi_D D, \; n = 1,2,...,N \tag{2}$$

L represents loans of individual banks and D is the volume of deposits in each bank. $C_n\left(L,D\right)$ is the cost of managing deposits and loan volumes, φ_L and φ_D are marginal costs of loans and deposits, respectively.

At equilibrium, bank loans, deposits, and interbank rates can be represented as *Lr, Dr*, and *IBr,* respectively. Assuming a downward sloping aggregate demand for bank loans (*Lr*), and an aggregate supply of deposits (*Dr*) that slopes upward, and exogenously determined interbank rate, given the policy rate, PR respectively, each bank will seek to maximize the following profit function while taking the volume of loans and deposits of other banks:

$$\pi_n = Lr\left(L_n + \sum_{m \neq n} L_m^*\right) L_n + IB_r\left(D_n - L_n\right) - D_r\left(D_n + \sum_{m \neq n} D_m^*\right) D_n - C_n\left(D_n, L_n\right) \tag{3}$$

where L_m^* and D_m^* denote interbank loans and deposits at equilibrium, respectively. The left-hand-side variable (π_n) denotes the profit of the nth banks, and the terms on the right-hand side represent the volume and loans and deposits of the banks.

Substituting (2) into (3) and taking the partial derivative of (3) with respect to banks loans and deposits yields the following first-order conditions

$$\frac{\partial \pi_n}{\partial L_n^*} = L_r^{'}(L^*)L_n^* + L_r(L^*) - IB_r - \varphi_L = 0 \tag{4}$$

$$\frac{\partial \pi_n}{\partial D_n^*} = IB_r - D_r^{'}(D^*)D_n^* - D_r(D^*) - \varphi_D = 0 \tag{5}$$

The Nash equilibrium of the banking sector will be: $(D_n^*, L_n^*)_{n=1,2,...,N}$ with an exclusive equilibrium setting, $L_n^* = \frac{L^*}{N}$ and $D_n^* = \frac{D^*}{N}$.

The optimal loan and deposit rates of the banking industry can then be expressed as follows (see Lim, 2001):

$$L_r^* = -L_r^{'}(L^*)\frac{L^*}{N} + IB_r + \varphi_L \tag{6}$$

$$D_r^* = -D_r^{'}(D^*)\frac{D^*}{N} + IB_r - \varphi_D \tag{7}$$

Given the exogeneity of IB_r, Equations (6) and (7) describe the long-run relationships between the levels of loan rates and deposit rates. Further, the equations demonstrate the positive response of both retail rates to variations (in the case of the present analysis) in the policy rate in a perfectly competitive banking market($N = \infty$). In that market, the intermediation margin of loan rates $(L_r^* - IB_r)$ and deposit rates $(D_r^* - IB_r)$ equal their marginal costs (φ_L) and $(-\varphi_D)$, respectively. But if the banking market becomes less competitive (or oligopolistic, N gets smaller) and come close to the monopoly situation $(N = 1)$, the intermediation margins of lending/deposit rates increase/decrease since $(L_r^{'} < 0)$ and $(D_r^{'} > 0)$.

Therefore, the relationship between the retail rates and the monetary policy rates can be expressed as (8) and (9) in the long run

$$L_r^* = \varphi_{11} + \psi_{11} IB_r \tag{8}$$

$$D_r^* = \varphi_{21} + \psi_{21} IB_r \tag{9}$$

where $\varphi_{11} = \varphi_L - L_r^{'}(L^*)\frac{L^*}{N}$ and $\varphi_{21} = \varphi_D - D_r^{'}(D^*)\frac{D^*}{N}$.

In the case of complete pass through, both the slope coefficients are expected to be unity, $\psi_{11} = \psi_{21} = 1$ while φ_{11} and φ_{21} maybe treated as constant intermediation margins of loan and deposit rates (expressed in equations 8 & 9) respectively.

3.3 Model Specification

The potential nonlinear adjustment between the central bank's policy rates and the commercial banks' retail rates is examined using the following bivariate relationship (Payne & Waters, 2008).

$$Y_t = \Omega_0 + \Omega_1 PR_t + \varepsilon_t \tag{10}$$

where Y is the retail (lending and deposits) rates, endogenously determined by the policy rate rate, PR is the policy rate, exogenously determined by the central bank, Ω_0 represents the constant term or the intercept while Ω_1 denotes the slope coefficient that describes the relationship between policy rate and retail rates. ε_t represents the error term that follows the Gaussian assumption (Enders & Siklos, 2001). Complete pass-through of policy rates to retail rates requires that Y and PR be cointegrated and the coefficient of PR equals 1.

The effects of the banking crisis, the interest rate regulation reintroduced in 1994, and the consolidation of 2004 are examined using the specification:

$$Y_t = \Omega_0 + \Omega_1 PR_t + \Omega_2 BCRISIS_t + \Omega_3 REGULT94 + \Omega_4 CONSOL04_t + \varepsilon_t \tag{11}$$

where *BCRISIS* represents a dummy of the banking crisis of 1991-1995 and 2009-2012. The dummy variable takes on the value of 1 for the banking crises period, and 0 otherwise. The *REGULAT94* denotes interest rate control reintroduced in January 1994 till October 1996. The dummy is coded one when the rates were under control and zero otherwise. The *CONSOL04* is the consolidation dummy. The dummy variable takes on the value of 1 when banking consolidation is implemented, and 0 otherwise. Ω_i are coefficients to be estimated, where i = 1,2,3, and 4.

3.4 Estimation Procedure

Since this study's key objective is to examine the possible asymmetric relationship among the interest rate series, the analysis follows the methodologies proposed by Enders and Siklos (2001). The procedure, which is an extension of the Engle and Granger (1987) two-step cointegration technique and Enders and Granger (1998) threshold-autoregressive (TAR) and momentum-TAR tests, requires that the variables' integration order be unity.

3.4.1 Unit Root Test for Stationarity

The unit-roots tests were conducted using the conventional Augmented Dickey-Fuller (ADF) test, proposed by Dickey and Fuller (1979). A robustness exercise was performed by a test recommended by Phillips and Perron [(PP), 1988]. The PP test considers the less restrictive nature of the error process. It is a non-parametric unit root test, but modified to account for serial correlation in the asymptotic distribution of the sample. The null hypothesis under both tests is that the interest rate series have a unit root. However, given that the interest rates are constantly changing, it is likely for such fluctuations to cause structural changes that may affect the series' integration order. Besides, studies demonstrated that both the ADF and PP tests might lose power when confronted with a break (Perron, 1989; Zivot & Andrews, 1992). Perron (1989) argued that the failure to account for a structural break when testing the integration properties of time series data could lead to wrong rejection or otherwise of a null hypothesis of a unit root. Accordingly, the present study employs an approach recommended by Zivot and Andrews (ZA, 1992) that accounts for a possible endogenous break (Worthington & Pahlavani, 2007; Narayan, 2005; Chow *et al.*, 2002; Chang, 2002).

The technique, which takes into account a shift in both the intercept and slope is as follows:

$$\Delta y_t = \mu + \alpha y_{t-1} + \beta t + \theta_1 DU_t + \gamma_1 DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \tag{12}$$

where: Δ is the first-order difference operator, t signifies periods in months $t = 1, 2, \ldots, T$. The break period is represented by βt. DU_t is a dummy indicator variable for a mean shift taking place at times βt and DT_t. DU_t takes the value of 1 and DT is a time dummy that takes t- DT_t if $t > DT_t$ and 0 otherwise. The last term in (12) is included to account for the possible existence of serial correlation problems and ensure that the errors follow the conventional assumption. The null hypothesis is that y_t is an integrated series with no break against an alternative of a single break in the trend function, which occurs at an unknown date. The point of the structural break is ascertained at the lowest value of the augmented Dickey-Fuller statistic within [.15, .85] range. The critical value of the test is found in Zivot and Andrews (1992).

3.4.2 Cointegration Tests

Gregory and Hansen (1996) proposed three models of a structural break. The first model signifies level shift as follows:

$$Y_t = \psi_0 + \psi_1 DU_t^{\tau} + \alpha_1 ln\ PR_t + \mu_t \tag{13}$$

where τ denotes timing of the change and DU_t^{τ}takes on the value of 1 if $t \geq \tau$ and 0 if $t < \tau$. ψ_0 is the intercept before the shift and ψ_1 signifies the variation in the intercept at the break date (due to the shift).
The second model, which allows for a level shift and Trend (C/T), is represented as:

$$Y_t = \psi_0 + \psi_1 DU_t^{\tau} + \alpha_0 t + \alpha_1^{\tau} PR_{2t} + \mu_t \tag{14}$$

The third model considers a regime shift which takes the form:

$$Y_t = \psi_0 + \psi_1 DU_t^{\tau} + \alpha_0 t + \alpha_{01}^{\tau} PR_{2t} + \alpha_{11}^{\tau} PR_{2t} DU_t^{\tau} + \mu_t \tag{15}$$

ψ_0 and ψ_1 are as in (13) and (14), α_{01} designates the cointegrating slope coefficient before regime shift, and α_{11} indicates the change in the slope coefficient. To test for the null hypothesis of no cointegration with a structural break in (13) - (15), Gregory and Hansen (1996) propose a set of tests statistics that include bias-corrected augmented Dickey-Fuller (ADF, 1979) and adapted Z_a and Z_t of Phillips (1987) as follows:

$$ADF^* = \inf_{\tau \in T} ADF(\tau) \tag{16}$$

$$Z_a^* = \inf_{\tau \in T} Z_a(\tau) \tag{17}$$

$$Z_t^* = \inf_{\tau \in T} Z_t(\tau) \tag{18}$$

where τ is the breakpoint and T signifies the sample size. If the structural break is unknown, the null hypothesis is tested by estimating (16) for each possible break in the cointegrating relationship between retail rates and policy rate such that $|0.15T| \leq \tau \leq |085T|$. Determining the existence of cointegration with break involves comparing the minimum values for ADF(τ), Za(τ), and Zt(τ) with the critical values in Table 1 of Gregory and Hansen (1996).

Therefore, the following specification is estimated to account for the possible break in examining the magnitude of policy rate pass-through into retail rates in the long-run.

$$Y_t = \Omega_0 + \phi_1 D_t + \Omega_1 PR_t + \Omega_2 BCRISIS_t + \Omega_3 REGULT94 + \Omega_4 CONSOL04_t + \varepsilon_t \tag{19}$$

where D_t is a dummy variable equal to 0 before the break date and 1 afterwards. In what follows, (10) and (11) or (19)[7] will be estimated using DOLS and, the next step consists of examining the integration order of the residual from the estimated DOLS as in (20):

$$\Delta\hat{\varepsilon}_t = \rho\hat{\varepsilon}_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta\hat{\varepsilon}_{t-j} + v_t \tag{20}$$

where v_t represents the usual error term that is assumed to be Gaussian white. For cointegration of the interest rate series, the assumption $\rho = 0$ should be rejected. Nonetheless, the correct specification of the cointegrated relationship between the series using the EG (1998) method required that the adjustment process towards the long run from any deviation should be symmetric. If the adjustment is not symmetric, an alternative technique was proposed by Enders and Siklos (2001), which is a modified version of the EG (1998) cointegration technique in the form of TAR (MTAR) procedure based on Tong (1990). This methodology involves the integration of Heaviside indicator function that partitions lagged order of residuals specified

[7] If structural break is found, (19) will be estimated using DOLS instead of (11).

to depend on the levels or changes of the error terms as follows:

$$\Delta\hat{\varepsilon}_t = I_t\rho_1\hat{\varepsilon}_{t-1} + (1-I_t)\rho_2\hat{\varepsilon}_{t-1} + \sum_{i=1}^{p-1}\lambda_i\Delta\hat{\varepsilon}_{t-i} + \nu_t \tag{21}$$

where $p-1$ *represents* the optimal lag order to render the sequence of the terms in equations (10 & 11 or 19) uncorrelated. In the case that the error terms are in levels, a TAR model with the following indicator function can be estimated.

$$I_t = \begin{cases} 1 & if \;\; \hat{\varepsilon}_{t-1} \geq \tau \\ 0 & if \;\; \hat{\varepsilon}_{t-1} < \tau \end{cases} \tag{22}$$

However, if the error exhibits some degree of persistence in one direction than the other, then the indicator function can be specified to depend on the changes in the residual term as follows:

$$I_t = \begin{cases} 1 & if \;\; \Delta\hat{\varepsilon}_{t-1} \geq \tau \\ 0 & if \;\; \Delta\hat{\varepsilon}_{t-1} < \tau \end{cases} \tag{23}$$

Given (21), (22) and (23), the residuals, (or $\Delta\hat{\varepsilon}_t$) is stationary when $-2 < (\rho_1, \rho_2) < 0$. The determination of the threshold value is done (endogenously) by arranging the TAR and M-TAR values in ascending order and removing the largest and smallest 15% using Chan (1993)'s procedure. The adjustment will, however, hinges on whether the last term residual is positive or negative. From Equations (22 & 23), the adjustments are represented by dummy values: the indicator takes the value of 1 for a deviation above the threshold value and 0 for the deviation below the threshold. The Enders and Siklos method have the following null hypothesis of no cointegration: H_0:$\rho_1 = \rho_2 = 0$, which can be examined using an F-statistics that has non-standard distribution. The critical values of the F-statistics are tabulated (Tables 1 & 2) in Enders and Siklos (2001). Rejection of the null hypothesis implies that either $\rho_1 or \rho_2$ is at least significantly greater than zero. That will allow examining the possible existence or otherwise of asymmetric adjustment processes. The testing can be conducted by setting the null hypothesis as $\rho_1 = \rho_2$ using the standard Fisher statistic. Rejecting this null indicates the existence of asymmetric cointegration, and the adjustment

is nonlinear as well. Once asymmetric cointegration is established, an asymmetric error-correction relationship between the interest rate series can then be modelled to evaluate long-run and short-run dynamics between the series [8] .
In the present analysis, the magnitude of the threshold is assumed unknown. However, Chan (1993) demonstrated that a reliable estimate of the threshold can be found with M-TAR by ordering the estimated residual sequence in ascending order. In this case, $\Delta\hat{\varepsilon}_1^{\tau} < \Delta\hat{\varepsilon}_2^{\tau} < \Delta\hat{\varepsilon}_3^{\tau} < \Delta\hat{\varepsilon}_4^{\tau} ... < \Delta\hat{\varepsilon}_T^{\tau}$, where T represents the number of usable observations searching the lagged residuals sequence's overall values. A consistent estimate is the threshold value with the lowest sum of squares errors (SSE). The present analysis follows the standard procedure of using only 70% of the sample observations as potential thresholds.

3.4.3 Non-linear error-correction models

Assuming weak exogeneity of the policy rate to the retail rates, the following asymmetric error correction can be estimated:

$$\Delta Y_t = \delta_0 + I_t \rho_1 EC_{t-1} + (1 - I_t)\rho_2 EC_{t-1} + \sum_{j=1}^{p} \varpi_j \Delta Y_{t-j} + \sum_{i=0}^{p} \gamma_i \Delta PR_{t-i} + \psi_i DD + \nu_{1t} \tag{24}$$

where DD is the vector of all the dummy variables and Δ is the first-order difference operator,EC_{t-1} is the one period lagged residual term from the cointegration equations (10 &11 or 20), represented as $Y_{t-1} - (\Omega_0 + \Omega_1 PR_{t-1} + \psi_i DD_t)$[9]. Enders and Siklos (2001) suggested that the possible non-linearity in the transmission of policy

[8]However, in the absence of asymmetric cointegration, the analysis will consider the following symmetric error correction equation:

$$\Delta Y_t = \delta_{10} + \sum_{i=1}^{p} \varpi_{1i} \Delta Y_{t-i} + \sum_{i=0}^{p} \lambda_{1i} \Delta PR_{t-i} + \psi_i DD_{t-i} + \eta_1 \hat{\varepsilon}_{t-1} + \nu_{1t} \tag{F1}$$

$$\Delta PR_t = \delta_{20} + \sum_{i=1}^{p} \varpi_{2i} \Delta Y_{t-i} + \sum_{i=0}^{p} \lambda_{2i} \Delta Y_{t-i} + \theta_i DD_{t-i} + \eta_2 \hat{\varepsilon}_{t-1} + \nu_{2t} \tag{F1}$$

where $\hat{\varepsilon}_{t-1}$ is the initial error correction term from the estimated long run equations (10 & 11 or 19) between the commercial banks' lending rates and the central Bank's policy rates. δ_{10}, δ_{20}, ϖ_{1i}, ϖ_{2i}, λ_{1i}, λ_{2i}, ψ_i and θ_i are the estimation parameters. DD_t represents the dummy variables specified in Equation (11 or 19). η_1 and η_2 are the coefficients that capture the speed of adjustments of any short run deviation from the long run equilibrium

[9]Note, however, that dummy proxy, DD, is omitted when estimating pre-liberalization data.

rates, PR_t to the retail rates, Y_t, can be evaluated by the following model

$$\Delta Y_t = \delta_0 \begin{cases} \lambda^+ + \sum_{i=1}^{k} \varpi_i \Delta Y_{t-1} + \sum_{i=0}^{k} \gamma_i \Delta PR_{t-1} + \psi_i \Delta DD_{t-i} + \nu_{it} & if \;\; Y_{t-1} < \theta_0 + \theta_1 PR_{t-1} + \psi_i DD_t \\ \lambda^- + \sum_{i=1}^{k} \varpi_i \Delta Y_{t-1} + \sum_{i=0}^{k} \gamma_i \Delta PR_{t-1} + \psi_i \Delta DD_{t-i} + \nu_{it} & if \;\; Y_{t-1} > \theta_0 + \theta_1 PR_{t-1} + \psi_i DD_t \end{cases} \quad (25)$$

where k represents maximum lag, Y_t represent the two retail rate series at period t, PR_t denotes the monetary policy rates at time t, $\lambda^+ = I_t EC_{t-1}$ and $\lambda^- = (1 - I_t)\ EC_{t-1}$ are the lagged residual errors representing the error correction coefficients, ν_{1t} is the error term that follows the conventional assumptions. The indicator λ^+ measures the speed of adjustment when the interest rate series are above equilibrium, whereas λ^- is for the speed when the variables are below equilibrium.

From (24) or (25), the case $\lambda^+ = \lambda^-$ indicates symmetric in the long-run adjustment of the lending and deposit rates to policy rate changes, while $\lambda^+ \neq \lambda^-$ designates asymmetry adjustment. Meanwhile, the short-run adjustments are captured by the standard F-statistics, which may come from lagged effects of the retail rates regressors. The case of $|\lambda^+| > |\lambda^-|$ indicates thatthe retail rates adjust upward slower than downward, but the case $|\lambda^+| < |\lambda^-|$ suggests that the adjustment is sluggish downward than upward.

From Equation (25), a fall in the monetary policy rate will make the retail rates to adjust by λ^+ if they are above a threshold value and adjust by λ^- for an increase in the policy rate if they are below the threshold. The significance of the asymmetric error correction term implies that the policy rate changes respond to the disequilibrium error terms, which also implies that the policy rate is weakly exogenous.

4. Results and Discussion

4.1 Summary Statistics

Summary statistics of the interest rate variables were presented. Table 1 shows that the mean of the data spans from 10.31 for policy rates to 8.98 and 14.21 for deposit and lending rates, respectively. The median for the policy rate is 10.00 and between 8.21 and 16.10 for deposit and lending rates, respectively. The standard deviation of the variables ranges are 5.11, 5.30 and 6.39 for policy, deposit and lending rates, respectively.

Table 1: Summary statistics of the interest rates

	Deposit rate	Lending rate	Policy rate
Mean	8.98	14.21	10.31
Median	8.21	16.10	10.00
Maximum	29.13	37.80	26.00
Minimum	2.00	6.00	3.50
Std. Dev.	5.30	6.39	5.11
Skewness	0.93	0.40	0.43
Kurtosis	3.63	2.52	2.55
Jarque-Bera	112.76	25.04	27.21
Probability	0.00	0.00	0.00

4.2 Unit Root Test Results

The results of the ADF and PP unit root tests of individual time series are reported in Table 2. Table 3 reports the results of the unit root tests for ZA. Table 2 shows that both ADF and PP test results fail to reject the null hypothesis at levels for both pre- and post-liberalization. Nevertheless, each of the differenced series individually appeared stationarity at 1 per cent level of significance. The PP test results show that all variables are first-differenced stationary except deposit rate which was stationary at levels . Similarly, the test results revealed that each of the interest rate variables are first-differenced stationary.

Table 2: Results of the ADF and PP unit root tests

	Pre-liberalization: 1962M01-1987M07		Post-liberalization: 1987M08-2020M09	
Variables	ADF test	PP test	ADF test	PP test
LR_t	-2.107	-3.179	-3.090	-3.420
ΔLR_t	-14.502***	-24.426***	-8.272***	-22.620***
PR_t	-1.502	-1.578	-2.742	-2.532
ΔPR_t	-16.631***	-16.670***	-19.326***	-19.398***
DR	-1.352	-2.581	-3.313	-3.676**
ΔDR_t	-11.321***	-22.796***	11.579***	-22.357***

LR represents lending/loan rates, *DR* is the deposit rates, and *PR* signifies policy rates. Lag lengths are determined by AIC. **and*** signify significance at 5% and 1% level.

Consistent with the standard ADF and PP test results, the ZA results reported in Table 3 suggest that all interest rate data are stationary at first difference. Consequently, the study employed the Gregory and Hansen cointegration test to analyse the long-run relationship among the retail deposit, lending and policy rates. Table 4 contains the results. The test results for *ADF** indicates the existence of a long-run relationship among the interest rate variables with endogenous structural breaks in August 1978 (for deposits rate) and October 1981 (for lending rate), during the pre-liberalization period.

Table 3: Results of the ZA unit roots tests with an endogenous structural break

	LR_t	ΔLR_t	DR_t	ΔDR_t	PR_t	ΔPR_t
Pre- liberalization:1962M01-1987M07						
BD_t	1980M07	1978M04	1978M04	1978M04	1975M04	1977M01
α	-0.1952	-1.9210***	-0.1357	1.7270***	-0.0790	-0.9642***
	(-4.3131)	(-11.779)	(-3.3796)	(-11.8117)	(-3.0438)	(-16.433)
θ	0.0256	0.0062	0.0220	0.0150	-0.0064	0.0060
	(3.5887)	(1.2925)	(4.3817)	(3.7167)	(-1.2932)	(1.8742)
γ	0.0001	-0.0000	0.0004	-0.0001	0.0003	-0.0000
	(0.5437)	(-0.4144)	(2.7386)	(-1.9277)	(2.7158)	(-0.8202)
K	3	3	6	5	3	0
Post- liberalization:1987M08 – 2020M09						
BD_t	1994M01	1993M10	2010M02	2011M01	2006M12	2010M09
α	-0.1125	-1.1232***	-0.1201	-1.2072***	-0.0719	-0.9944***
	(-5.0055)	(-8.7689)	(-4.8882)	(-9.5695)	(-4.4084)	(-19.6292)
θ	-0.0654	-0.0302	-0.0846	0.0589	-0.0527	0.0356
	(-4.6031)	(-2.3261)	(-2.8003)	(2.1509)	(-3.2548)	(2.7486)
γ	-0.0013	-0.0003	0.0010	-0.0005	0.0004	-0.0002
	(-3.9431)	(-0.95241)	(2.6717)	(-1.3177)	(2.7257)	(-1.5214)
K	1	4	4	4	3	0
Critical values						
1%	-5.57	-5.34	-5.57	-5.34	-5.57	-5.34
5%	-5.08	-4.93	-5.08	-4.93	-5.08	-4.93
10%	-4.82	-4.58	-4.82	-4.58	-4.82	-4.58

Note: *LR* represents lending/loan rates, *DR* is the deposit rates, and *PR* signifies policy rates. *** denote statistical significance at the 1% level. Numbers in brackets are t-values. The lag length was selected by the Akaike information criterion (AIC).

4.3 Cointegration Tests results

There is also evidence of endogenous breaks in June 1993 and February 1997 during the post-liberalization period as shown in Table 4. The structural break date of 1978M08 reflected the time during which commercial banks' average rate on deposits increased from about 2.96 per cent in 1977 to more than 5 per cent by August 1978[10]. Moreover, the break of 1981M10 reflects the periods when the lending rate increased consistently from 7.0 per cent in January 1980 to 9.5 per cent by October 1981. The break observed in 1993M06 coincided with when Nigeria was in the midst of the 1990s banking sector crisis[11]. Also, the break date of 1997M02 corresponded with four months after the central bank deregulated interest rates in October 1996.

Table 4: Gregory and Hansen cointegration tests with an endogenous break

Models	Test statistic	Estimated test value	Break date
Pre-liberalization: 1962M01-1987M07			
$LR_t = f(PR_t):$	$ADF*$	-8.131***	1981M10
	Z_t^*	-8.662***	1980M11
	Z_a^*	-120.581***	1980M11
$DR_t = f(PR_t):$	$ADF*$	-6.872***	1978M08
	Z_t^*	-9.560***	1978M04
	Z_a^*	-137.937***	1978M04
Post- liberalization: 1987M08 – 2020M09			
$LR_t = f(PR_t, DD):$	$ADF*$	-11.828***	1993M06
	Z_t^*	-14.944***	1992M11
	Z_a^*	-287.362***	1993M11
$DR_t = f(PR_t, DD):$	$ADF*$	-9.142***	1997M02
	Z_t^*	-14.749***	1993M09
	Z_a^*	-280.595***	1993M09

Note: *LR* represents lending/loan rates, *DR* is the deposit rates, and *PR* signifies policy rates. *** and ** signify significant at 1% and 5% level of significance. The critical values for the test are available in Gregory and Hansen (1996)'s Table (1).

After establishing a long-run relationship among the variables with structural breaks during the pre-liberalization and post-liberalization periods, further analysis accounted for the structural breaks observed in 1978M08 and 1981M10 (Pre-liberalization); and

[10] Such a phenomenon may have influenced the banks' rate behaviour.
[11] See Cook (2015)

1993M06 and 1997M02 (post-liberalization). Following the conventional process, the analysis was preceded with testing for the existence of a long-run relationship for both pre-and-post banking sector liberalization among the interest rate variables using the methodology proposed by Engle and Granger (1987). The cointegration approach proposed by Enders and Siklos (2001) was then employed to re-estimate the long-run relationship[12]. Table 5 contains the estimated DOLS results including the Engle-Granger (EG) cointegration test. The EG cointegration test utilized the residuals generated from Equations (10 & 11 or 19).

4.4 Long-Run Results

From Table 5, one can observe that the estimated intercepts which denote the intermediation margin of banks' loan and deposits rate are 1.30 per cent and 0.02 per cent, respectively, for the pre-liberalization and, 2.16 per cent and 1.20 per cent for the post-liberalization period respectively. The estimated slope coefficient(s) that measure the degrees of policy rates pass through are more than 42 per cent and 81 per cent, respectively, for the pre-liberalization and, 30 per cent, and 61 per cent for the post-liberalization period respectively. The relationship between banking crisis (BCRISIS) and bank lending rate during the post-liberalization period is positive. The possible reason for this result is that during crisis periods, it would be more difficult for banks to obtain cash due to the general loss of confidence in the system. On the one hand, the depositors may be too afraid to save their money in the banks and may even withdraw their cash from them. Banks, on the other hand, due to the fear that some of them could have liquidity crisis may stop lending to each other and in the process, charge higher rates in the loan markets. Concerning the impact of banks crisis on the deposit rate, the coefficient of BCRISIS is positive but not statistically significant.

It is clear from the long-run results that the slope coefficients of the policy rate are less than unity at conventional significant levels, indicating that the transmission of the monetary policy rates to commercial banks' deposit and loan rates during the pre- and post-interest rate liberalization seems to be incomplete in Nigeria. However, the estimated long-run pass-through for the pre-liberalization period appeared larger than

[12]The long-run results are reported alongside short-run estimates in Tables 3,4,5 and 6.

that of the post-liberalization. The two severe waves of banking crises that occurred during the post-liberalization period and the possibility that banks may be unwilling to offer loans to each other during the crisis periods could explain why the pass-through is smaller during the post-liberalization than during the pre-liberalization period.

Referring to the effects of interest rate regulation reintroduced in 1994 on the lending and deposit rates, one can observe that from Table 5, the coefficient of *REGULAT94* is negative on both rates but only significant on the lending rate (at the 10% level of significance). On the impact of consolidation, it can be observed that the coefficient of *CONSOL04* exhibits a negative sign on both lending and deposit rates and are statistically significant (at the 5% level of significance). The significant negative coefficient of the interest rate regulation reintroduced in January 1994, which lasted up to October 1995 (*REGULAT94*), could imply that such a central bank's action had the effect of lowering interest rates (decrease in the cost of borrowing) that potentially would ultimately spur economic activity via an increase in consumer spending and increased investment. Similarly, the implication of the significant negative coefficient of banking consolidation (*CONSOL04*) is that the consolidation exercise might have induced decreases in the overall cost of borrowing with the potential of spurring economic activity and increasing investment spending. Moreover, the results in each Panel of Table 5 show that for each equation, the results for the Engle-Granger tests indicate the existence of cointegration between the respective retail rates and the policy rate in Nigeria during the pre- and post-liberalization periods.

Table 5: Dynamic least squares (DOLS) estimation results of Equations 9 and 10

Independent variables		
	Lending rate equation	Deposit rate equation
Panel A: Pre-liberalization regressions		
Constant	1.302	0.0248
	(0.0000)	(0.7824)
PR	0.4292	0.8130
	(0.0000)	(0.0000)
R^2	0.81	0.94
F-statistics	182.82	739.20
	(0.0000)	(0.0000)
HST	0.0041	0.0026
	(> 0.2)	(> 0.2)
Engle-Granger tau-statistic	-7.753***	-6.294***
Panel B: Post-liberalization regressions		
Constant	2.164	*1.198*
	(0.0000)	*(0.0035)*
PR	0.3038	0.6079
	(0.0000)	(0.0000)
BCRISIS	0.1527	0.0115
	(0.0000)	(0.8827)
REGULAT94	-0.0897	-0.1762
	(0.0822)	(0.1596)
CONSOL04	-0.1467	-0.1920
	(0.0000)	(0.0283)
R^2	0.65	0.66
F-statistics	28.758	29.639
	(0.0000)	(0.0000)
HST	0.0037	0.0030
	(> 0.2)	(> 0.2)
Engle-Granger tau-statistic	-4.053***	-4.890***

Note: *LR* represents lending/loan rates, *DR* is the deposit rates, and *PR* signifies policy rates. The lag length was selected by the Akaike information criterion (AIC). *HST* is Hansen stability tests. *D* signifies Structural break dummy. *BCRISIS is the banking crisis dummy. REGULAT94* denotes controlled interest rate dummy. *CONSOL04* symbolizes consolidation dummy. Numbers in brackets are p-values.

4.5 Asymmetric Cointegration Test Results

Table 6 reports the estimated results for the threshold autoregression (TAR), and momentum threshold autoregression (M-TAR) tests, respectively. As can be observed from Table 6, both the TAR and MTAR tests reject the null of no cointegration during the pre-liberalization and post-liberalization periods, suggesting the presence of a long-run relationship between the policy rate and retail rates.

Table 6: Tests for symmetric and Asymmetric cointegration

Bank rates Measures	Symmetric tests		Asymmetric tests	
	TAR	M-TAR	TAR	M-TAR
Pre-liberalization: 1962M01 – 1987M07				
$LR_t = f(PR_t, D_t)$	23.394	21.398	3.866	0.3640
	[0.0568]	[0.0000]		
$DR_t = f(PR_t, D_t)$	30.462	38.486	19.909	34.142
	[-0.0601]	[0.0000]		
Post- liberalization: 1987M08 – 2020M09				
$LR_t = f(PR_t, DD_t)$	8.696	6.924	5.672	2.230
	[0.1177]	[-0.0194]		
$DR_t = f(PR_t, DD_t)$	7.658	9.743	0.7808	4.802
	[0.2119]	[-0.0339]		
Critical values				
1%	9.18^b	8.84^b	4.61^c	4.61^c
5%	6.93^b	6.63^b	3.00^c	3.00^c
10%	5.92^b	5.57^b	2.30^c	2.30^c

Note: *LR* represents lending/loan rates, *DR* is the deposit rates, *PR* signifies policy rates, D denotes the structural break dummy. and, DD represents the composition of all dummy variables "a" Entries are critical values for EG cointegration tests. Entries of "b" represent the *critical values (*of the null hypothesis $\rho_1 = \rho_2 = 0$) *for the TAR and MTAR cointegration, respectively.* "c" Entries indicate the critical values of the F distribution for symmetric adjustment whose null hypothesis of specified as$\rho_1 = \rho_2$. Lag length for both the TAR and M-TAR were selected by the Akaike information criterion (AIC). The figures in squared brackets represent threshold values.

The strong co-movement between the retail rates and the policy rate may indicate that, in the long run, deposits and lending rates are determined mainly by the policy rate, which also represents the banks' marginal cost of funds. However, as one can also observe, the F-statistic for the joint test is larger in absolute terms for the TAR model for lending rate during the pre-and-post liberalization periods. However, the adjustment process for the deposit rate towards equilibrium appears to exhibit persistence as the M-TAR model seems larger in absolute terms. The results also demonstrate that only the TAR model shows evidence for asymmetric cointegration[13] .

4.6 Asymmetric Error Correction Model Results

The short-run effects and asymmetric error correction for the pre-liberalization period and the post-liberalization sample are reported in Tables 7 and 8, respectively. The diagnostic statistics reported at the bottom of each table indicate the models' suitability (F-statistics) and absence of serial correlations (Breusch-Godfrey serial correlation LM test). The results from the tables further provide us with insights regarding the degree of monetary policy rate pass-through to retail rates in Nigeria. While the estimates of short-term adjustments differ in magnitude and direction, they appear to be slow to adjust to monetary policy actions, with lags ranging from one to six months. Moreover, policy changes did not entirely pass through to retail rates; generally, the response is less than one-to-one (in addition to the incomplete long-term pass-through reported in Table 5) as they are significantly less than unity. Therefore, it is fair to conclude that the retail rates are cointegrated asymmetrically with the policy rate.

This evidence of asymmetric adjustment confirms the possibility that the adjustment process of retail rates to changes in the policy rate may not necessarily be uniform, as assumed by Sanusi (2010) and Kelilume (2014) for positive and negative deviations. The result, therefore, validates findings by Bangura (2011), Mangwengwende (2011), Ogundipe and Alege (2013), Jibrilla and Ismail (2016) and, Mardi et al. (2019), among others. As expected, the asymmetric error correction coefficients indicate the mean-reverting behaviour of the retail rates to their long-run relation. However, the absolute values of the asymmetric error correction coefficients are often considerably less than unity, implying a sluggish speed of adjustment to the cointegration vector(s). In other words, the pass-through approach its long-run equilibrium position slowly. This finding is factual for both the pre-liberalization (except for the lending rate equation for the positive deviation) and the post-liberalization samples.

[13] However, note that the retail rates in Nigeria during the pre-liberalization are a particular case because instead of deposit money banks, the monetary authorities have been exclusively determining the interest rates.

Table 7: Estimated asymmetric error correction models

Pre-liberalization period: 1962M01 to 1987M07			
Lending rate equation		Deposits rate equation	
Variable	Estimated coefficient	Variable	Estimated coefficient
δ_0	-0.0017	δ_0	0.0046
	(0.5752)		(0.3093)
λ^+ coefficient	-1.019	λ^+ coefficient	-0.2316
	(0.0000)		(0.0002)
λ^-coefficient	-0.1165	λ^-coefficient	-0.5140
	(0.0249)		(0.0000)
$\Delta LR(-1)$	-0.1675	$\Delta DR(-1)$	-0.2412
	(0.0062)		(0.0004)
$\Delta LR(-2)$	-0.1847	$\Delta DR(-2)$	0.1536
	(0.0015)		(0.0160)
$\Delta LR(-3)$	-0.1243	$\Delta DR(-3)$	0.1095
	(0.0246)		(0.0529)
$\Delta LR(-6)$	-0.1078	$\Delta PR(-1)$	0.3012
	(0.0362)		(0.0188)
$\Delta PR(-6)$	0.1589	$\Delta PR(-2)$	.-0.2345
	(0.0687)		(0.0652)
		$\Delta PR(-3)$	0.5865
			(0.0000)
		$\Delta PR(-4)$	0.2932
			(0.0317)
R^2	0.34	R^2	0.37
DW-statistic	1.880	DW-statistic	1.97
LM	1.706	LM	1.236
	(0.1916)		(0.2662)
F-stat.	14.662	F-stat.	18.826
	(0.0000)		(0.0000)

Note: LM denotes Breusch-Godfrey Chi-square values for serial correlation. Figures in parentheses are probability values.

Table 8: Estimated asymmetric error correction models

Post-liberalization period: 1987M08 to 2020M09			
Lending rate equation		Deposits rate equation	
Variable	Estimated coefficient	Variable	Estimated coefficient
δ_0	0.0004	δ_0	-0.0015
	(0.8518)		(0.8026)
λ^+ coefficient	-0.6582	λ^+ coefficient	-0.0630
	(0.0046)		(0.0392)
λ^-coefficient	-0.0766	λ^-coefficient	-0.1796
	(0.0002)		(0.0001)
$\Delta LR(-4)$	0.1181	$\Delta DR(-1)$	-0.1087
	(0.0122)		(0.0325)
$\Delta LR(-5)$	0.1320	$\Delta DR(-3)$	0.1016
	(0.0029)		(0.0430)
$\Delta LR(-7)$	0.0689	$\Delta DR(-5)$	-0.0973
	(0.0929)		(0.0491)
$\Delta LR(-8)$	0.0826	$\Delta DR(-8)$	0.0998
	(0.0923)		(0.0440)
$\Delta PR(-8)$	-0.0648	$\Delta PR(-1)$	0.1764
	(0.0922)		(0.0891)
$\Delta REGULAT94(-4)$	0.0534	$\Delta PR(-3)$	0.2628
	(0.0667)		(0.0198)
$\Delta REGULAT94(-5)$	0.0804	$\Delta REGULAT94(-3)$	0.4046
	(0.0053)		(0.0000)
$\Delta REGULAT94(-8)$	-0.0500	$\Delta REGULAT94(-4)$	0.1470
	(0.0948)		(0.0781)
$\Delta BCRISIS(-1)$	0.0354	$\Delta BCRISIS(-7)$	0.1010
	(0.0549)		(0.0905)
R^2	0.47	R^2	0.15
DW-statistic	1.986	DW-statistic	2.032
LM	0.0098	LM	2.411
	(0.9211)		(0.1205)
F-stat.	20.842	F-stat.	5.585
	(0.0000)		(0.0000)

Note: LM denotes Breusch-Godfrey chi-square values for serial correlation. Figures in parentheses are probability values.

The results from the lending rate equation in both Tables 7 and 8 indicate that lending rate adjusts faster after a positive deviation (denoted by λ^+) from long-run equilibrium than after a negative deviation (denoted by λ^-). This suggests that, when exogenous shocks cause disequilibrium, the adjustment of lending rate towards its long-run equilibrium is slower when an upward adjustment is required to regain stability, compared to the event when downward adjustment is needed. This situation could be as a result of upward rigidity in the loan rate behaviour. Interestingly, the finding of upward rigidity during the post-liberalization period (reported in Table 8) contradicted earlier finding by Bangura (2011), Ogundipe and Alege (2013), Jibrilla and Ismail (2016) for the post-consolidation period, possibly because the present analysis considered the interest rate regulation, reintroduced between 1994 through October 1996 and the banking crisis. However, the result corroborates the findings of Payne and Waters (2008) for the US, Scholnick (1996) for Singapore, and Lim (2001) for Australian retail loan rate, which also provides evidence in support of the customer reaction hypothesis. The results may suggest that since banks are aware that the central bank is frequently active in protecting consumers from possible abuse and exploitation of financial service providers, they may not want to face the consequences of violating such[14].

Turning to the deposit side, however, the results indicate that the response of the deposits, λ^{+}, to a decrease in the policy rate is significantly smaller (in absolute terms) than the deposit rate's reaction, λ^{-}, to an increase in the policy rate. This evidence of downward rigidity, which is also consistent with customer reaction hypotheses, suggests that Nigeria's deposit money banks were sensitive to customer reaction. In other words, it may indicate banks' unwillingness to lose customers due to frequent interest rate changes. The results also appeared to support the finding by Mangwengwende (2011) but contradict the result by Lim (2001) for the Australian retail deposit rate and Scholnick (1996) for Malaysia and Singapore deposit interest rates. Overall, one can note that like the estimated coefficients of the policy rate reported in Table 5, the speed of adjustments (in both the lending and deposit rates equations) for the pre-liberalization period seem larger in absolute terms than the post-liberalization era.

Turning to the short-run estimates, the pre-liberalization sample results (Tables 7) indicate that the first, second, third, and sixth autoregressive short-run lending parameters appeared to influence the lending rate in the short-run negatively. Meanwhile, the policy rate also negatively affects the lending rate in the short run (at the sixth

[14]See also Kama (2010)

lag). When we turn to the deposit rate equation, the first, second, and third order short-run autoregressive coefficients of deposit rate are significant in explaining its short-run adjustment towards the long-run equilibrium. Furthermore, change in deposit rate appeared sensitive to the first, second, third, and fourth lags of the policy rate in the short-term for the period under review.

Concerning the post-liberalization sample (Table 8), the short-run results from the lending rate equation indicate that the autoregressive (lags 4, 5, 7 and 8) short-run estimates are significantly positive at either 1%, 5%, or 10% levels of significance. On the other hand, the policy rate appears to have a negative and significant short-run effect (at lag 8) on the lending rate. While the short-run influence of 'the interest rate regulation' re-introduced in 1994 appears to have negative effects on the lending rate at lags 4 and 5, but a negative effect at lag 8. Moreover, the short-run influence of the banking crisis occurred in the early 1990s, and that during the global financial meltdown appears to be negative and significant. From the deposit equation, there appeared an autoregressive negative and significant short-run effect at lags 1 and 5 and positive effects at lags 3 and 8, respectively. Besides, the policy rate seems to have a positive and significant short-run effect (at lags 1 & 3) on the deposit rate. The interest rate regulation re-introduced in 1994 also positively influences the deposit rate at lags 3 and 4. On the other hand, the banking crisis appeared to affect the deposit rate at the 7th lag.

5. Conclusion and Policy Recommendations

Understanding the dynamics of interest rate pass-through is critical for monetary policymakers. Moreover, knowledge on whether the adjustments of banks' retail (deposit & lending) rates are asymmetric or symmetric contributes to the understanding of how the monetary transmission mechanism works. This paper has employed dynamic ordinary least squares (DOLS) and the Enders and Siklos (2001) asymmetric cointegration and threshold adjustment techniques to evaluate the short- and long-run relationship amongst the central bank policy and the commercial banks' retail deposit and loan rates during the pre-and-post interest rate liberalization periods in Nigeria. After accounting for the endogenous structural breaks, results from the empirical analysis using DOLS shows no complete pass-through of central bank's policy rate into lending and deposit rates during both periods, possibly due to market imperfections in the banking sector. The empirical findings also suggest that the banking crisis is associated with rising lending rate, while interest rate regulation has a negative effect. During the consolidation period, most of the central bank's policy seems to favour monetary easing. The results further demonstrate that adjustments towards long-run equilibrium exhibit asymmetric behaviour. From the analysis, new empirical findings on the characteristics of error correction adjustments in the country also emerged.

During both the pre-and post-liberalization periods, the lending rate and deposit rates appeared sticky while adjusting to their long-run equilibrium with the monetary policy rate following any deviation. There is also evidence of asymmetric between monetary easings and tightening during both periods. Precisely, banks in Nigeria, adjust the lending rate in response to negative changes in the monetary policy rate (during monetary easings) faster than positive changes. This evidence suggests that banks are receptive to the adverse reaction of borrowing customers and incline to be rigid in lifting loan rates than reducing them. The deposit rate reaction appeared more quickly during periods of monetary tightening than during easing, also supporting the customer reaction viewpoint. The likely reason for such behaviour is that banks may have been deliberately keeping retail deposit rates relatively attractive to depositors as incentives to prevent them from possible defection.

The findings of this study offer considerable policy relevance. Given the ongoing consolidation of the liberalized banking sector in Nigeria, its continued success in transmitting the monetary impulse over the real sector of the economy depends on the efficiency of the interest rate channel, which appeared weak due to rigidity. The differing degree of this rigidity across the retail rates implies that the speed of monetary transmission is not uniform. Therefore, the monetary authorities need to strengthen monetary operations by factoring in the observed banks' behaviour and deploying all relevant tools necessary in future monetary policy formulation and implementation to ensure efficient transmission. Practical measures that can objectively influence competitiveness in the banking sector and improve the efficacy of the interest rate channel are also desirable. That can be achieved by, for instance, ensuring fair policies for small and big banks to attract new ones. To sustain that, the central bank needs to regulate money deposit banks by ensuring that the failure of any bank would not significantly affect the economy. The apex bank should also provide an enabling environment to ensure an excellent sustainable relationship between banks and their customers. That should include measures to prevent a systemic crisis in the industry and those that can effectively contain unavoidable ones.

Our results must, however, be interpreted with some caution as our analysis does not include detailed explanatory variables that might affect the transmission of the central bank policy rates into commercial bank retail rates, which may be underparameterised in the relationship. As such, our results may not generalise to the monetary policy transmission mechanism through the interest rate channel as there are some possible channels through which CB policy rates can transmit to the retail rates. However, since we considered modelling the relationship endogenously, we believe the past effect of other essential determinants of monetary policy rate pass through to retail rates is captured in the analysis. Nevertheless, future research should consider accounting for factors such as the money supply, inflation rate, the level of insecurity in the country, exchange rate, the rate of non-performing loans, and the foreign interest rate, among others.

References

Asogwa, R. C. (2005). Liberalization, consolidation and market structure in Nigerian banking. *African Review of Money Finance and Banking, 19*(1), 99-127.

Aziakpono, M. J., Manuel, J., & Wilson, M. K. (2007). Adjustment of commercial bank's interest rates and the effectiveness of monetary policy in South Africa. *African Finance Journal, 9*(1), 1-20.

Bangura, L. (2011). *Adjustment of commercial banks' interest rates and the effectiveness of monetary policy: evidence from Anglophone West Africa* (Doctoral dissertation, Rhodes University).

Barro, R. J. (1972). A theory of monopolistic price adjustment. *The Review of Economic Studies, 39*(1), 17-26.

Ben-Zekry, B. (2007). Concentration in the Banking Industry: Good or bad? Retrieved January 22, 2019, from https://are.berkeley.edu/∼sberto/Banks07.pdf

Berger, A. N. (1995). The profit-structure relationship in banking-tests of market-power and efficient-structure hypotheses. *Journal of Money, Credit and Banking, 27*(2), 404-431.

Berger, A., & Hannan, T. (1989). The price-concentration relationship in banking. *The Review of Economics and Statistics, 71*(2), 291-99.

Bloom, N., Bond, S., & Van Reenen, J. (2007). Uncertainty and investment dynamics. *The Review of Economic Studies, 74*(2), 391-415.

Central Bank of Nigeria (n. d.). CBN Monetary Policy Reforms. Retrieved January 21, 2019, from https://www.cbn.gov.ng/supervision/bsdcirculars.asp

Chan, K. S. (1993). Consistency and limiting distribution of the least squares estimator of a threshold autoregressive model. *The Annals of Statistics, 21*(1), 520-533.

Chang, Y. (2002). Nonlinear IV unit root tests in panels with cross-sectional dependency. *Journal of Econometrics, 110*(2), 261-292.

Chong, B. S., Liu, M. H., & Shrestha, K. (2006). Monetary transmission via the administered interest rates channel. *Journal of Banking and Finance, 30*(5), 1467-1484.

Chow, Y. F., Cotsomitis, J. A., & Kwan, A. C. (2002). Multivariate cointegration and causality tests of Wagner's hypothesis: Evidence from the UK. *Applied Economics, 34*(13), 1671-1677.

Cottarelli, C., & Kourelis, A. (1994). Financial structure, bank lending rates, and the transmission mechanism of monetary policy. *Staff Papers, 41*(4), 587-623.

De Bondt, G. (2002). Retail bank interest rate pass-through: New evidence at the euro area level (No. 136). European Central Bank.

De Bondt, G. J. (2005). Interest rate pass-through: Empirical results for the Euro Area. *German Economic Review, 6*(1), 37-78.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association, 74*(366a), 427-431.

Eboreime, M. I., & Egboro, E. M. (2012). Estimation of interest elasticity model for aggregate commercial bank deposits in Nigeria— (1986-2008). *Economic and Financial Review, 50*(1), 59-86.

Enders, W., & Granger, C.W. J. (1998). Unit root test and asymmetric adjustment with an example using the term structure of interest rates. *Journal of Business and Economic Statistics, 16*(3), 304-311.

Enders, W., & Siklos, P. (2001). Cointegration and threshold adjustment. *Journal of Business and Economics Statistics, 19*(2), 304-11.

Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction: Representation, estimation and testing. *Econometrica, 55*(2), 251-276.

Fomum, T. A (2011). Interest rate pass-through in Cameroon and Nigeria: A comparative analysis [Master's Thesis, Rhodes University]. Retrieved September 25, 2021, from https://core.ac.uk/download/pdf/145046277.pdf

Freixas, X., & Rochet, J. C. (1997). Microeconomics of banking (Vol. 2). *MIT press Cambridge,* USA.

Fuertes, A. M., Heffernan, S., & Kalotychou, E. (2010). How do UK banks react to changing central bank rates? *Journal of Financial Services Research, 37*(2-3), 99-130.

Gregory, A. W., & Hansen, B. E. (1996). Residual-based tests for cointegration in models with regime shifts. *Journal of Econometrics, 70*(1), 99-126.

Hannan, T. H. (1991). Bank commercial loan markets and the role of market structure: Evidence from surveys of commercial lending. *Journal of Banking & Finance, 15*(1), 133-149.

Hannan, T. H., & Berger, A. N. (1991). The rigidity of prices: Evidence from the banking industry. *The American Economic Review, 81*(4), 938-945.

Hannoun, H. (2015). Ultra-low or negative interest rates: what they mean for financial stability and growth. Speech given at the BIS Eurofi high-level seminar in Riga on 22 April 2015.

Herrero, A. G., Girardin, E., & González, H. (2017). Analyzing the impact of monetary policy on financial markets in Chile. *Revista de análisiseconómico, 32*(1), 3-22.

Jibrilla, A. A., & Ismail, N. W. (2016). Threshold cointegration and interest rate pass-through during the pre-and post-banking consolidation in Nigeria: are there asymmetries? *International Journal of Banking, Accounting and Finance, 7*(2), 172-193.

Kelilume, I. (2014). Effects of the monetary policy rate on interest rates in Nigeria. *The International Journal of Business and Finance Research*, *8*(1), 45-55.

Khemraj, T. (2010). The simple analytics of oligopoly banking in developing economies. *Journal of Business, Finance & Economics in Emerging Economies, 5*(1), 206-228.

Knell, M., & Stix, H. (2015). Trust in banks during normal and crisis times—evidence from survey data. *Economica*, *82(*S1*)*, 995-1020.

Kopecky, K. J., & Van Hoose, D. D. (2012). Imperfect competition in bank retail markets, deposit and loan rate dynamics, and incomplete pass through. *Journal of Money, Credit and Banking, 44*(6), 1185-1205.

Krstevska, A. (2008). The effectiveness of the transmission channels of the monetary policy in the Republic of Macedonia. *International Journal of Economic Policy in Emerging Economies, 1*(4), 376-387.

Lim, G. C. (2001). Bank interest rate adjustments: are they asymmetric? *Economic Record, 77*(237), 135-147.

Mangwengwende, T. M. (2011) "The Relationship Between Bank Concentration and the Interest Rate Pass Through in Selected African Countries", Unpublished Master of Commerce (Financial Markets) Thesis, Department of Economics and Economic History, Rhodes University, Grahamstown, South Africa.

McMillan, D. G. (2004). Non-Linear Error Correction: Evidence for UK Interest Rates. *The Manchester School, 72*(5), 626-640.

Mark, N., & Moh, Y. K. (2003). Official interventions and occasional violations of uncovered interest party in the Dollar-DM market (No. w9948). National Bureau of Economic Research Inc.

Mishkin, F. S. (1996) The channels of monetary transmission: Lessons for monetary policy No. w5464, Cambridge, MA, National Bureau of Economic Research Inc.

Mishkin, F. S. (2009). Is monetary policy effective during financial crises? *American Economic Review, 99*(2), 573-77.

Mojon, B. (2000). Financial structure and the interest rate channel of ECB monetary policy (European Central Bank, Working Paper 40). Frankfurt am Main Germany.

Mordi, C. N., Adebiyi, M. A., & Omotosho, B. S. (2019). Modelling interest rates passthrough in Nigeria: An error correction approach with asymmetric adjustments and structural breaks. In Contemporary Issues in the Nigerian Economy: A Book of Readings. Central Bank of Nigeria. 3 – 20.

Morgan, D. P. (1993). Asymmetric effects of monetary policy. Economic Review-Federal Reserve Bank of Kansas City, 78, 21-21.

Narayan, P. K. (2005). The saving and investment nexus for China: Evidence from cointegration tests. *Applied Economics, 37*(17), 1979-1990.

Neumark, D., & Sharpe, S. A. (1992). Market structure and the nature of price rigidity: Evidence from the market for consumer deposits. *The Quarterly Journal of Economics, 107*(2), 657-680.

Obstfeld, M., & Taylor, A. M. (1997). Nonlinear aspects of goods-market arbitrage and adjustment: Heckscher's commodity points revisited. *Journal of the Japanese and international economies, 11*(4), 441-479.

Ogundipe, A., & Alege, P. O. (2013). Interest rate pass-through to macroeconomic variables: The Nigerian experience. *International Journal of Economics and Finance*, *5*(10), 18-35.

Ojo, M. O. (1993). A review and appraisal of Nigeria's experience with financial sector reform. Occasional Paper, No. 8, Central Bank of Nigeria, Abuja.

Okpara, G. C. (2010). The effect of financial liberalization on selected macroeconomic variables: Lesson from Nigeria. *The International Journal of Applied Economics and Finance, 4*(2), 53-61.

Olivero, M. P., Li, Y., & Jeon, B. N. (2011). Consolidation in banking and the lending channel of monetary transmission: Evidence from Asia and Latin America. *Journal of International Money and Finance, 30*(6), 1034-1054.

Payne, J. E., & Waters, G.A. (2008): Interest rate pass-through and asymmetric adjustment: Evidence from federal funds rate operating target period. Applied Economics, 40(11), 1355-1362.

Payne, J. E. (2007). Interest rate pass through and asymmetries in adjustable rate mortgages. *Applied Financial Economics, 17*(17), 1369-1376.

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. Econometrica: *Journal of the Econometric Society, 57*(6), 1361-1401.

Phillips, P. C. (1987). Time series regression with a unit root. Econometrica: Journal of the Econometric Society, *55*(2), 277-301.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika, 75*(2), 335-346.

Sander, H., & Kleimeier, S. (2000). Asymmetric adjustment of commercial bank interest rates in the euro area: Implications for monetary policy. In University of Groningen's Conference on "Financial Structure, Bank Behaviour, and Monetary Policy in the EMU", Groningen.

Sanusi, A. (2010). Interest rate pass-through and the efficiency of monetary policy in Nigeria: 2002-2010. In 1st National Conference on State of the Nigerian Economy, Bayero University Kano November 4th-6th.

Scholnick, B. (1996). Asymmetric adjustment of commercial bank interest rates: Evidence from Malaysia and Singapore. *Journal of International Money and Finance, 15*(3), 485-496.

Scholnick, B. (1999). Interest rate asymmetries in long-term loan and deposit markets. *Journal of Financial Services Research, 16*(1), 5-26.

Stiglitz, J. E. (1979). Equilibrium in product markets with imperfect information. *The American Economic Review, 69*(2), 339-345.

Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. *The American economic review*, *71*(3), 393-410.

Tella, S. A., & Okosun, G. (1993). Banking deregulation: the interest rate phenomenon in the Nigerian context. African Review of Money Finance and Banking, *7*(1), 47-56.

The Banker (2021). *The Banker's top 100 African Banks 2021. The Banker - Unrivalled coverage of global finance & banking*.
Retrieved October 4, 2021, from https://www.thebanker.com/Banker-Data/Banker-Rankings /The-Banker-s-Top-100-African-Banks-2021/(language)/eng-GB

Tong, H. (1990). Non-linear time series: A dynamical system approach. Oxford: Oxford University Press.

Udoka, C. O., & Anyingang, R. A. (2012). The effect of interest rate fluctuation on the economic growth of Nigeria, 1970-2010. *International Journal of Business and Social Science*, *3*(20), 295-302.

Worthington, A. C., & Pahlavani, M. (2007). Gold investment as an inflationary hedge: Cointegration evidence with allowance for endogenous structural breaks. *Applied Financial Economics Letters, 3*(4), 259-262.

Zivot, E., & Andrews, D. W. (1992). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business & Economic Statistics, 10* (3), 251-270.