Auto-Regressive Distributed Lag Approach of Financial Intermediation of Commercial Banks and Risk in Nigeria

Dr. IYO Ipeghan*
Department of Banking and Finance, Rivers State University, Port Harcourt, Nigeria
Email: ipeghanyo@yahoo.com

Dr. EKPETE Marshall Simon
Department of Banking and Finance, Rivers State University, Port Harcourt, Nigeria

EKPETE Kinsley Simon
Department of Economics, Ignatius Ajuru University of Education, Rumuolimini, Port Harcourt, Nigeria

Abstract
This study empirically examines the relationship between financial intermediation of commercial banks and risk in Nigeria spanning from 2007-2019 and utilizing the auto-regressive distributed lag (ARDL) approach to co-integration and Granger causality analysis. The result of the ARDL bounds test reveals a stable long run relationship between the dependent and independent variables with greater bound value of 16.02. The ARDL results also reveal the presence of short and long run positive and significant relationship between loans and advances and risk factors. The finding of the Granger causality reveals bidirectional causality between loans and advances and risk factors. The study recommends that commercial banks should continue their short term lending of credit for investment as default has been drastically reduced in lending to customers.

Keywords: Financial intermediation; Loans and advances; Total deposits; Risk factor; Information production; Borrowers and lenders.

1. Introduction

Basically the application of Auto-Regressive Distributed Lag (ARDL) bound testing approach to co-integration for the analysis of long run and short run relationship is necessary as the significant of the variables may not be affected by the order of integration of the series. Thus the ARDL approach avoids problems resulting from non-stationary time series data where series are integrated at different orders (Pesaran et al., 1996).

Banks’ financial intermediation role is associated with how they receive funds from depositors and provide these funds to entities that need it (Bossone, 2001), Fama (1985), Gorton and Winton (2002), Ham et al. (2004). The financial intermediary is a bank that facilitates the transfer of saved funds from surplus units to deficit units through the intermediation function of depository and lending for investment (Ezirim, 2005; Gorton and Winton, 2002). Banks plays an indispensable role of pooling together funds from the savings-surplus unit and channeled these resources to the deficit units (Ezirim, 2005).

The building blocks of financial intermediation roles of banks are associated with the depositors finance, loan and advances and risk factors in banking activities. Banks offers an expanding range of products and services through their intermediation function by borrowing funds from depositors and using same to funds lending activities (Kiser, 2003). The existence of a bank lending channel relies on the premise that banks have no major source of funding other than core deposits and loans (Kiser, 2003). These bank-like financial intermediaries’ have contributed to a deeper appreciation of the role of banks in the savings-investment process and corporate finance (Gorton and Winton, 2002).

The intermediation approach signifies that bank production role is driven by the processes used in the transformation of funds. The intermediation approach of bank production is viewed as a transformation of three input groups such as capital, operating expenses and deposits; into two output groups like loans and investments (Ashton, 1998).

Financial intermediaries are the amalgamation of institutions, tools and markets which are satisfying needs of diverse economic development (Hashmi, 2017). The contemporary literature of financial intermediation view it as a combination of financial institutions like banks, insurance companies, credit associations, leasing companies, stock market, investment banking, pension funds etc. Moreover, the banking industry is a service industry involve in performing direct and indirect financial service.

*Corresponding Author
Figure 1. Financial Intermediation Processes of Intermediaries

The Figure above describes the intermediation processes of financial intermediaries’ role of collecting funds from depositors by financial institutions and lending same to borrowers. It involves the mobilization of financial savings and channeling them to borrowers through specialized institutions known as banks. These specialized institutions are also called financial markets licensed to accept those deposits and lend them to the business and households at given interest rates over a specified period. This process provides the opportunity of maturity-risk match-making. Financial intermediation also cuts across making payments, receivables, transfers and guarantees by the banks on behalf of their customers (Central Bank of Nigeria, 2017).

The growing importance of risk and the growing need of risk absorbing institutions and instruments can explain the growing importance of the financial industry to the national income. The demand for risk covering instruments grows and will continue to grow, under the increasing volatility of interest rates, stock prices and foreign exchange rates (Scholtens and Van Wensveen, 2003).

The rationale for financial risk management is the prevention of bankruptcy of a bank induced by monetary and financial factors. Financial risk management goal is to protect the bank balance sheet against severe losses of a monetary nature e.g. exchange rate shocks and the banks operational cash flow against serious financial uncertainties such as interest rate and exchange rate fluctuations and credit risk (Scholtens and Van Wensveen, 2000).

The building block of the theory of financial intermediation is directed toward understanding the existence and the behaviour of real-life financial intermediaries. The financial intermediation theory is attributed to the early studies of Akerlof (1970); Benston and Smith (1976) of transaction cost reduction, Diamond and Dybvig (1983) of liquidity assurance, Leland and Pyle (1977) of information sharing coalition and Diamond (1984), Diamond (1996) of delegated monitoring. These theories of intermediation are build on the models of resource allocation based on perfect and complete markets by suggesting that it is frictions such as transaction costs and asymmetric information that are important in understanding intermediation.

2. Research Problem

Risk management has become important in the recent past. In contrast, risk is seen as the root of financial intermediation. The banking and insurance is responsible for risk transfer and risk management function (Scholtens and Van Wensveen, 2000). Financial intermediation is in such a constant state of change unlike other areas of finance, there is an almost embarrassing lack of essential information like price data, prices of loans, of secondary loans sales that is not much of an exaggeration to say that many researchers in financial intermediation do not realize they are engaged in economic history instead of empirical study (Gorton and Winton, 2002). It is a challenge to determine whether there is important information in the financial statement which features intermediation that remains constant across time, or whether intermediation is being fundamentally altered by securitization, loan sales, credit derivatives, and other recent innovation (Gorton and Winton, 2002). It’s against this backdrop that the researcher seek to investigate the significance of the banks’ financial intermediation role on risk factors using the data of the ratio of total deposits, loans and advances to total assets and variance of net income as a proxy for risk factors with the intention to bring a clear relief to the tasks face by lending activity of commercial banks’ in Nigeria and making appropriate policy recommendations.

This study aims to examine the effect of risk factors in the intermediation role of Nigerian commercial banks. The research question is to what extent has risk factor affects the intermediation role of commercial bank in Nigeria? Understanding these building blocks of intermediation roles of bank activity is the gap that this study is expected to
fill using the risk factors, depositors finance and loans and advances to customers. However, the study seeks to contribute to the existing studies by examining the case of Nigeria using the auto-regressive distributed lag (ARDL) approach to co-integration and granger causality to examine risk factors in the intermediation role of Nigerian commercial banks. The study also contributes by employing the variability of returns or net income as proxy for risk factor.

The paper is structured into nine sections such as section 1 is the introduction stage, section 2 is research problem while 3 is the model of risk factor, next section 4 is the relationship between financial intermediation and risk factor, furthermore section 5 is the theoretical discussion of banks’ financial intermediation role and risk factor, while section 6 is associated with research data and methodology, again section 7 is estimation procedure and section 8 is the empirical results and finally section 9 is the conclusion of the study.

3. Model of Risk Factor

Financial innovations are centered on risk and risk is a threat, it is the possibility of a loss, but also as an opportunity for profit (Scholtens and Van Wensveen, 2003). This study offers a unique analysis of the risk faced by financial institutions and the strategies for controlling and managing these risks. Risk is associated with default, uncertainty, unpredictability and chance of loss or no loss (Ezirim, 2005).

Consequently, risk is the possibility of an adverse deviation from a desired outcome that is expected or hope for Vaughan and Elliot (1978). Risk is always a natural phenomenon that influences the operations of economic agents such as the banks. Banks had large risk factors in the course of receiving deposits from clients and lending same as loans for investments (Onoh, 2002).

The risk factor associated with this study was derived from the application of risk index system for rating banks based on asset profitability or return on assets (Onoh, 2002). Besides the application of the Capital Adequacy, Asset Quality, Management Quality, Earnings, and Liquidity (CAMEL) system for rating banks, the risk index provides another method for assessing bank risk. The risk index developed by Federal Deposits Insurance Corporation (FDIC) in 1986 from net income and dividends returns of banks. The index (R) of a bank was presented in the following model:

$$R = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6$$

Where: $X_1$ = Primary capital to total assets (%);

$X_2$ = Loans and advances over due by 90 days to total assets (%);

$X_3$ = Non accruing loans and advances to total asset (%);

$X_4$ = Renegotiated loans and advances to total asset (%);

$X_5$ = Net loans charge-offs (annualized) to total asset (%);

$X_6$ = Net income (annualized) to total asset (%).

The measure is supported by three core variables, capital adequacy ($X_1$), loans and advances ($X_2-X_3$) and asset profitability or return on assets ($X_4$). The loan quality of a bank is a major determinant of the risk index. A bank will be regarded as healthy if its risk index lies below unity i.e., $R < 1$. A risk index above unity i.e., $R > 1$ indicates a problem bank (Onoh, 2002).

3.1. Earnings-at-Risk

Earnings at risk are the variance of net income because of changes in interest rates over a specified period. It is useful for investors and risk professionals to recognize the impact that a change in interest rates can make on a company's financial position and cash flow.

The earning at risk model determines the amount of capital of the bank as a whole, and at the level of individual businesses. The economic capital is derived from the observed volatility of earnings. The basic model which underlies earnings-volatility-based approaches is a definition of earnings-at-risk (EAR) using some measure of the extent to which revenues or earnings deviate either side of the mean. It was the absolute value of the change in annual net income was used as a proxy for earnings volatility (Leary and Roberts, 2005).

A generic definition of earning-at-risk is thus:

$$\text{EAR} = \kappa \sigma r$$

where $\kappa$ is a constant, and $\sigma_r$ refers to the standard deviation of the revenues or earnings of the bank.

4. Relation between Financial Intermediation and Risk Factors

According to Sharpe et al. (1998) financial intermediaries are institutions that are responsible for issuing financial obligations and sell them for money as assets. The banks from ancient history take deposits from households and make loans to economic agents requiring capital (Allen and Santomero, 1997). The capital generated through this procedure was further used for buying financial assets of other companies (Hashmi, 2017).

Bank has an incentive to mitigate risks, the higher the amount of capital that will be deductibles in insurance policies the better the bank’s probability of default decreases with the level of capital that is buffer stock effect, and banks’ stability increases with their level of capital. Also, it is arguable that capital is very costly through the issues of information anomaly and transaction cost syndrome (Bichsel and Blum, 2001). The framework of bank intermediation theory suggests that financial intermediaries make risky decision simultaneously with the perception about their expected profits and the level of bank capital and liquidity. On the other hand the more liquid or more capitalized bank will be able to take on higher risk more easily; the less liquid or less capitalized bank will have to lower its risk position (Delis et al., 2014).
The roles of financial intermediaries is expressed in two dimensions as providers of liquidity while the subsequent focuses on intermediaries’ ability to modify the risk related features of financial assets. In both dimensions, the intermediaries help in reduction of charges of allotment of funds between deficit-borrowers and surplus unit-lenders, which will lead to a more proficient allocation of resources (Hashmi, 2017).

Also (Allen and Santomero, 1998) suggest a major role of risk in the intermediation process and proposed that risk management should be identified in the study of financial intermediation. The origins of banking and insurance lie with their risk transfer and risk management function. Banks may also be concerned about volatility of earnings because low level of income may lead to insolvency (Allen and Santomero, 1999). This argument offers significant insight into why banks themselves may choose low risk strategies (Marcus, 1984; Santomero, 1989).

When the intermediation activity was not backed by information asymmetric and their eradication was not the commercial motive for financial intermediaries, the question arises which alternative could better enhance the intermediation process. The value creation has risk and the risk management as its driving force. Both banking and insurance have absorption of risk as the main function. The risk reduction function connects a disparity in between the provision of savings and the demand for investments as savings unit has more risk reluctant attitude than genuine investors. A spread out collection of investment alternatives required to protect savings unit and the policy holders by allowing financial institutions to soak up risk within the market horizon (Allen and Santomero, 1999; Hashmi, 2017; Scholtens and Van Wensveen, 2003).

5. Theoretical Discussion of Banks’ Financial Intermediation Role and Risk Factors

The financial intermediation role of banks’ in a broad sense means to sell financial products to economic agents in surplus and to provide credit for economic agents in deficit. However (Fama, 1985) argues that banks’ can impose higher interest rate than commercial paper interest rates on companies because information can be generated about the companies through monitoring, which cannot be easily done in capital market. Also banks have a comparative advantage in producing information in comparison to the market (James, 1987; Mikkelson and Partch, 1986) found that when companies borrow from banks, their stock prices increase but if they finance in the market by issuing bonds, then stock prices may not rise. If banks’ role of information production about borrowers and monitoring is strengthened, the cost of information production, monitoring and transaction will be lowered and the incentives to extend loans to sectors that have relatively higher risks will become larger. Consequently higher risk is associated with corporate lending rather than household loans.

The traditional theories of banks’ financial intermediation are based on transaction cost, information production, delegated monitoring and liquidity assurance. They are originated to account for institutions which take deposits and channel funds to clients. These attributed performed by the intermediaries are identified below in the light of different theories of financial intermediation.

Accordingly Leland and Pyle (1977) provide justification of financial intermediaries as institutions which share critical information with corporate clients. This information sharing coalition provides informational advantage for corporate decision makers. However Leland and Pyle (1977) suggest that financial intermediaries might efficiently solve the reliability and suitability problems inherent with information production by issuing securities and using the proceeds to invest in a portfolio of securities which the intermediary is privately owned. The information asymmetry theory is based on the notion that the borrower is likely to have more information than the lender about the risks of the project for which they receive funds. These problems reduce the efficiency of the transfer of funds from surplus to deficit units (Gwilym, 2011; Leland and Pyle, 1977). The informational asymmetry theory is grounded on the bank relationship with the borrowers and the surplus unit in particular (Scholtens and Van Wensveen, 2003). Bank lending activity can be distinguish on transactions-based lending (financial statement lending, asset-based lending, credit scoring, etc.) and relationship lending (Berger and Udell, 2002; Kroszner and Strahan, 2001; Lehmann and Neuberger, 2001). The major activity in the borrower relation is the screening and monitoring function of banks vis-à-vis ex ante information asymmetries, the adverse selection problem (Akerlof, 1970), credit rationing (Stiglitz and Weiss, 1981), the moral hazard problem (Stiglitz and Weiss, 1983) and the ex post verification problem (Gale and Hellwig, 1985). While the other foremost activity in the surplus unit relation are bank runs, why they occur, how they can be prevented, and their economic consequences (Bernanke, 1983; Diamond and Dybvig, 1983; Kindleberger, 1989).

Also Benston and Smith (1976) provide argument that the presence of financial intermediaries help reduce the transaction cost. The transaction cost associated with financial intermediation consist of search, verification and enforcement costs (Gwilym, 2011). The transaction cost in financial literature is associated with the functions of financial intermediation in economy was introduced by Benston and Smith (1976), Campbell and Kraaw (1980), Fama (1980). The transaction costs comprise not only exchange or monetary transaction costs (Fischer, 1983; Tobin, 1963; Towey, 1974), but also search costs and monitoring and auditing costs (Benston and Smith, 1976). The transaction cost required the offer of liquidity (Pyle, 1971) and diversification opportunities (Hellwig, 1991). The provision of liquidity is a key function for savers and investors and increasingly for corporate customers, whereas the provision of diversification increasingly is being appreciated in personal and institutional financing.

However Diamond (1984) focuses on the area of delegated monitoring which enable the representatives of financial intermediary board of corporate clients’ better monitor and control mechanism for borrowers. Also (Diamond, 1984) intermediaries “monitor” borrowers on behalf of investors who lend to the intermediary. In (Diamond, 1984) borrowers must be monitored because there is an ex posts information asymmetry in that lenders do not know how much the firm has produced. Monitoring result to increasing returns to scale, which implies that
specializing, may be attractive. He identified the activity of financial intermediary as agents of several investors and delegate authorities on monitoring of credit contracts. This has several advantages for creditors for the reason that otherwise they had exhausted their efforts on monitoring and wasted limited resources. Thus, it is profitable for creditors to use an intermediary that can save their money spent on monitoring in comparison with direct financing (Hashmi, 2017).

Banks as Liquidity providers has been studies by numerous scholars suggesting that one of reasons for banks existence is to supply liquidity to borrowers and lenders (Diamond and Dybving, 1986; Diamond, 2007; Gatev and Strahan, 2006; Gorton and Pennacchi, 1990; Holmstrom and Tirole, 1998; Kashyap et al., 2002; Lewis, 1992; Rajan, 1996; Tirole et al., 2010). Furthermore (Diamond and Dybving, 1986) discuss that the role of banks was to create liquidity, thus banks fulfill valuable activities on both sides of their balance sheets by granting loans to borrowers and providing liquidity on demand to depositors. Banks usually fulfill their liquidity provision function by granting long-term and illiquid loans to borrowers by using short-term and liquid deposits. By offering these services jointly, banks can provide liquidity services to customers and investors who are uncertain about the timing of their future consumption need (Diamond and Dybving, 1986; Lewis, 1992). Also Holmstrom and Tirole (1998) argue that a key function of a financial intermediary is to provide liquidity in the form of loan commitments. As Kashyap et al. (2002) emphasize that banks provide liquidity through loan commitments or credit lines. Loan commitments can give a borrower the option to draw down their loan amount on demand during the period of the contract. These withdrawals are uncertain to the bank. From the perspectives of customers, loan commitments provide liquidity, like demand deposits, whenever they require liquidity unexpectedly.

Deposit insurance is considered the most effective measure to prevent runs without preventing banks from creating liquidity, and, consequently, bank policy issues should be considered in the context of deposit insurance (Diamond and Dybving, 1986). It has been shown that deposit insurance enables banks to meet increased credit demand and synchronized draw-downs during episodes of market stress (Gatev and Strahan, 2006).

Delis et al. (2014), studies on the risk of financial intermediaries and employ bank risk proxy of variability of the profit function where this variability is endogenous to other bank characteristics like capital and liquidity. Other literature employs the variation on returns or profits as a more comprehensive risk metric as 

\[ \sigma(\text{ROA}) \] or the coefficient of variation as a measure of bank risk (Mitchell (1982)). Mitchell (1986) is probably the first to theoretically use the variance of returns or the variance of returns scaled by their mean (i.e., the coefficient of variation) is a valuable risk metric in banking, following directly from the theoretical considerations of (Markowitz, 1952; Roy, 1952).

Most of the empirical studies uses information from a fixed number of periods to calculate the variance of return on assets, \( \sigma(\text{ROA}) \), or the coefficient of variation as a measure of bank risk (Chiorazzo et al., 2008; Delis and Tsionas, 2012; DeYoung and Rice, 2004; Fang and Marton, 2011; Jiménez et al., 2013; Lepeit et al., 2008; Stiroh, 2004; Stiroh and Rumble, 2006).

6. Data and Methodology
6.1. Data Description

The data employed are secondary in nature of 13 commercial banks listed on the Nigerian Stock Exchange published of various issues of annual reports spanning from 2007-2019.

| Table-1. Commercial Banks |
|----------------------------|
| Fidelity Bank Plc |
| First City Monument Bank Plc |
| Ecobank Plc |
| Access Bank Plc |
| First Bank Of Nigeria Plc |
| Guaranty Trust Bank Plc |
| Stanbic IBTC Bank Plc |
| Sterling Bank Plc |
| United Bank For Africa |
| Union Bank Of Nigeria |
| Unity Bank Plc |
| Wema Bank Plc |
| Zenith Bank Plc |

Source: Central Bank of Nigeria (2017) and Nigeria Stock Exchange (NSE) fact book and the World Wide Web – Internet

6.2. Model Specification

The study model was design to illustrate the effect of intermediation role of commercial banks, which classified deposits as bank input and loans as output. In the intermediation approach of modeling bank production, banks depositors’ funds are transformed into loan funds, which form the principal output from banks (Ashton, 1998). Commercial banks risk factor was proxy for earnings volatility (Delis et al., 2014). The researcher adopted and modified the model of Delis et al. (2014), Kiser (2003) to agree with this study.

The equation below shows the functional and econometric relationship between the variables of the study;

\[ \sigma(\text{RF})/\text{RF} = f(\text{TD/TA}, \text{TL/TA}) \] (3)

The econometric equation for the model is specifies as;
Risk factor \( \sigma_{RF} = \beta_0 + \beta_1 \frac{TD}{TA} + \beta_2 \frac{LA}{TA} + \mu \) (4)

Where;
RF: Earnings volatility proxy for Risk Factor for bank \( i \)th in year \( t \).
TD: Total Deposits for bank \( i \)th in year \( t \).
LA: Loan and advances for bank \( i \)th in year \( t \).
TA: Total assets for bank \( i \)th in year \( t \).
\( \beta_0 \) = Constant parameter/Intercept
\( \beta_1 \), \( \beta_2 \) = Coefficients of independent variables
\( \mu \) = Error term

The ‘a priori expectation’ in the model is that all the independent variables are expected to have a positive relationship on risk factor measured by the absolute value of the change in annual net income is used as a proxy for earnings volatility.

The mathematical expression is represented as; \( \beta_0 < 0, \beta_1 > 0, \text{ and } \beta_2 > 0 \) implying that a unit increase in the independent variables will lead to decrease in Risk Factor by a unit.

6.3. Variable Construction

6.3.1. Risk Factor

Bank’s financial intermediation role is affected by business structural factors such as default risks. However, Abbas et al. (2016) state the implication of profit variability, whether it is considered due to the inherent business risk or as a result of inefficient management practices, or earnings volatility is a proxy for the probability of financial losses, and the interest rate paid on loans and advances to banks increase because such banks will have to pay premium in order to minimize the risk of outside funds providers. Higher variability in earnings indicates that the probability of bankruptcy increases; we can expect that banks with higher income variability will be default in supply of loans and advances. Also (Rafiq et al., 2008) used the value of the deviations from mean of net income divided by total number of years for each firm in the given year as a proxy for earnings volatility. However Leary and Roberts (2005) used the absolute value of the change in annual net income as a proxy for earnings volatility. As a result this study used risk factor as the absolute value of the change in annual net income and proxy earnings volatility. Income variability is a measure of business risk.

6.3.2. Loans and Advance

The study employs the ratio of total loans and advances to total assets. The total loans and advances show the percentage of loan and advances in relation to total assets. Total loans and advances show the bank market power in the provision of credits. Increase in total loans and advances will result to risk increases (Moussa, 2015). Loans and advances constitute a major source of income and risk assets to banks. Advances may include loans for a fixed period made to firms and individuals, and overdraft where the borrower can withdraw his account.

6.3.3. Deposits

The bank intermediation roles involve the ratio of total deposits to total assets. Total deposits show the share of deposits relative to total assets. The deposits forms the bulk of the liabilities of commercial banks, they includes demand deposits, time deposits and saving deposits. The deposits are used to finance credit operation (Moussa, 2015). Total customers deposits represent the raw material which banks use for meeting their intermediation function. It is obvious that commercial banks primary business is characterized by securing funds from depositors and using these deposit funds to make commercial and consumer loans.

| Table 2. Definitions of Selected Variables for financial Intermediation roles and Risk Factor |
|--------------------------------|-----------------|---------------------------------------------------------------------------------|-----------------|
| **Variable** | **Symbol** | **Definitions** | **Expected sign** |
| Dependent Variable | | | |
| Risk Factor | RF | Earnings volatility is the absolute value of the change in annual net income is a proxy for Risk factor | (-) |
| Independent Variables | | | |
| Total Deposit | TD | Total deposits to total assets. Total deposits show the share of deposits relative to total assets. The deposits are used to finance credit operation. | (+) |
| Loan and Advance | LA | Total loans and advances to total assets. The total loans and advances show the percentage of loan and advances in relation to total assets. Total loan and advances shows the bank market power in the provision of credits. Increase in total loan and advances, the risk increases. | (+) |

Source: Authors’ Description, 2021
7. Estimation Procedure

The equation (4) forms the basis of our estimation. The econometric analysis of model (4) confronts the following issues: First, we test for stationarity using a unit root test for balanced panel data. Second, we use autoregressive distributed lag (ARDL) techniques to estimate co-integration and error correction mechanism analysis such that the estimation of the long-run variables and then residuals are converted and inserted as an error correction term in the model.

7.1. Unit Root Test

Time-series data is often found to be non-stationary, containing a unit root. Therefore, we start our analysis with unit root testing for all the panel data variables. Augmented Dickey Fuller (ADF) method was used (Heij et al., 2004; Nielsen, 2005) for this purpose. Applying ADF, we have to check whether the particular variables have unit root or not. The hypotheses are as follows:

\[ H_0: \text{variables are not stationary or have unit root; alternative hypothesis } H_1: \text{variables are stationary.} \]

ADF checks the hypothesis about the stationarity of the particular variables at significance levels of 1%, 5% and 10%.

7.2. Auto-Regressive Distributed Lag (ARDL) Technique

This study employs the Autoregressive Distributed Lag (ARDL-Bounds) testing approach to co-integration proposed by Pesaran et al. (2001). The ARDL approach offers some desirable statistical advantages over other co-integration techniques. While other co-integration techniques require all the variables to be integrated of the same order, ARDL test procedure provides valid results whether the variables are I(0) or I(1) or mutually co-integrated and provides very efficient and consistent test results in small and large sample sizes (Pesaran et al., 2001). The small number of observations and the different order of integration make ARDL the preferred approach in this study.

Recall that the basic form of an ARDL model is:

\[ y_t = \beta_0 + \beta_1 y_{t-1} + \ldots + \lambda_t ECM + \epsilon_t \]

Where \( \lambda_t \) is the random disturbance term which is serially independent and assumed to be well behaved or constant.

The Autoregressive Distributive Lag model is considered as an ARDL (p q) model whose reduced form is presented as:

\[ \Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{j=1}^{q} \gamma_j \Delta x_{t-j} + \epsilon_t \]

Where, \( y_t \) is the dependent variable with its lags as independent variables, \( x_t \) is the lagged independent variables and \( \epsilon_t \) being the white noise. Generally, using the lag operator L applied to each component of a vector.

A detail specification of the model with respect to the variables of this study is presented below.

\[ \Delta \text{Risk Factor}_t = \beta_0 + \sum_{i=0}^{p} \beta_i \Delta \text{Risk Factor}_{t-i} + \sum_{i=0}^{q} \lambda_i \Delta y_{t-i} + \epsilon_t \]

Where \( \Delta \) refers to the first difference operator and \( \epsilon_t \) being the error term. The test involves conducting F-test for joint significance of the coefficient of lagged variables for the purpose of examining the existence of a long-run relationship among the variables. The null hypothesis of no long-run relationship existing between the variables (Ho: \( \beta_4 = \beta_5 = \beta_6 = 0 \)) is examined following (Pesaran et al., 2001).

The decision to reject or accept Ho is based on the Following conditions: if F-value \( \geq \) lower bound, then reject Ho and the variables are co-integrated, if F-value \( < \) lower bound, then accept Ho and the variables are not co-integrated, but if F-value \( \geq \) lower bound and \( < \) upper bound, then the decision is inconclusive.

The error correction model for the estimation of the short run relationships is specified as:

\[ \Delta \text{Risk Factor}_t = \beta_0 + \sum_{i=0}^{p} \beta_i \Delta \text{Risk Factor}_{t-i} + \sum_{i=0}^{q} \lambda_i \Delta y_{t-i} + \mu_{it} \]

Where \( \lambda_t \) is the estimated coefficient of ECM and \( \mu_{it} \) is the white noise. Generally, using the lag operator L applied to each component of a vector.

An ADF check is conducted for all the panel data variables. ADF checks the hypothesis about the stationarity of the particular variables at significance levels of 1%, 5% and 10%.

7.3. Granger Causality

The simplest test for Granger causality requires estimating the following two regression equations:

\[ y_t = \beta_{2,0} + \sum_{i=1}^{p} \beta_{2,i} y_{t-i} + \sum_{j=1}^{q} \beta_{2,p+j} x_{t-j} + \epsilon_{it} \]

\[ y_t = \beta_{1,0} + \sum_{i=1}^{p} \beta_{1,i} y_{t-i} + \sum_{j=1}^{q} \beta_{1,p+j} x_{t-j} + \epsilon_{it} \]

where \( p \) is the number of lags that adequately models the dynamic structure so that the coefficients of further lags of variables are not statistically significant and the error terms \( \epsilon \) are white noise. If the p parameters \( \beta_{1,p+j} \) are jointly significant then the null that y does not Granger cause x can be rejected. Similarly, if the p parameters \( \beta_{1,i} \) are jointly significant then the null that y does not Granger cause x can be rejected. This test is usually refereed to as the Granger causality test (Stern, 2011).
8. Empirical Results

In analyzing the relationship between financial intermediation and risk factor in Nigeria, this section begins with preliminary test for stationarity of the variables via Augmented Dickey-Fuller (ADF) unit root test, the result is presented in Table 3 below:

| Variables          | Augmented Dickey Fuller Statistics | Critical level at 0.05 | Decision |
|--------------------|------------------------------------|------------------------|----------|
| Risk factor        | -11.59295                          | -2.878723              | 1(1)     |
| Total Deposit      | -10.80203                          | -2.879045              | 1(1)     |
| Loans and Advances | -11.60747                          | -2.878723              | 1(1)     |

Source: Author’s computation using EVIEWS software

The results above shows all the variables are integrated in the same order. This means that all the variables become stationary at first difference thus, they are integrated of order one i.e. 1(1). It is therefore imperative to test for the presence of co-integration using the bound test.

8.1. Bound F-Test for Co-Integration

After the achievement of stationarity, the next step is to conduct bound F-test for co-integration in equation (7) in order to establish a long-run relationship among the series variables. The results of the bound F-test for co-integration together with the asymptotic critical values are presented below in Table 4.

| ARDL Bounds Test | Date: 07/21/20   Time: 17:26 | Sample: 2 169 |
|------------------|-------------------------------|---------------|
| Null Hypothesis: No long-run relationships exist |                  |               |
| Test Statistic   | Value                         | k             |
| F-statistic      | 16.02242                      | 2             |
| Critical Value Bounds | I0 Bound | I1 Bound |
| Significance     | 10%                           | 4.14          |
|                  | 5%                            | 4.85          |
|                  | 2.5%                          | 5.52          |
|                  | 1%                            | 6.36          |

Source: Author’s computation using EVIEWS software

The decision rule is that if the computed F-statistic falls below the lower bound we would conclude that the variables are 1(0), so no co-integration is possible, by definition. If the F-statistic exceeds the upper bound, we conclude that we have co-integration. Finally, if the F-statistic falls between the bound, the test is inclusive (Pesaran et al., 2001).

From the results since the calculated F-statistic (16.02) is greater than the upper bound (4.85) at 5% level of significance, we reject the hypothesis. We therefore accept the present of long run relationship among the variables.

8.2. Long-Run and Short Run Estimates

The estimated long-run coefficient of the three ARDL specifications is presented in Table 5 below:

| Variables         | Coefficient | Std. Error | T-statistic | Prob.  |
|-------------------|-------------|------------|-------------|--------|
| Total deposits    | -19052.0    | 22859.6    | 0.4058      | 0.4058 |
| Loans and advances| -42885.6    | 36679.0    | 0.2441      | 0.2441 |
| c                 | -42885.6    | 36679.0    | 0.2441      | 0.2441 |

Source: Author’s computation using EVIEWS software 9.0 output

The long run table above shows a negative and insignificant relationship between total deposits and risk factor. The increase of total deposits has a negative effect on risk factors. However, more volatile net income increases the probability of default, implying a negative relationship between total deposits and risk factors. This means that total deposits of banks was affected by risk factors in the mobilization of funds from the surplus to the deficit sector for investment activity. Also the low deposits and risk factors may weaken the intermediation role of banks of lending credit to customers.

The regression table below also reveals a negative and significant relationship between total deposits and risk factors in the short run in Table 6. This shows that the increase in total deposits will negatively impact risk factors. This will strongly result to low deposits ratio that may be available to banks for their intermediation function of lending credits to households and corporate bodies.
From the long run estimates above, there is a positive and significant relationship between loans and advances and risk factors. An increase in loans and advances has a positive effect on risk factors. The high credit growth will increase the number of borrowers default which increasing the bank risk factors. This agree with the study of Salkeld and Shim (2011).

The loans and advances has a positive and significant relationship with risk factor in the short run in table 6, this means that there will be increase in the supply of loan and advances in the intermediation role of banks as this would stimulates the bank market power in the provision of credits. The increase in the supply of loan and advances will result to risk increases (Moussa, 2015).

| Table-6. Short Run Error Correction Estimates |
|-------------------------------|----------------|-------------|-------------|
| **Dependent Variable:** RF(-1) | **Method:** Least Squares |
| **Date:** 07/21/20  **Time:** 17:46 | **Sample (adjusted):** 3 169 |
| **Included observations:** 167 after adjustments | **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | 1.238117 | 1.334954 | 0.927461 | 0.3551 |
| TD(-1) | -3.12E+12 | 0.014039 | -2.22E+14 | 0.0000 |
| LA(-1) | 5.02E+15 | 3.364688 | 1.49E+15 | 0.0000 |
| RF(-2) | -6.61E-15 | 5.36E-16 | -12.33017 | 0.0000 |
| TD(-2) | -0.021016 | 0.014132 | -1.487118 | 0.1390 |
| LA(-2) | -0.733501 | 2.294670 | -0.319654 | 0.7496 |
| ECM(-1) | 1.000000 | 5.56E-16 | 1.80E+15 | 0.0000 |
| **R-squared** | 1.000000 | **Mean dependent var** | 6.01E+15 |
| **Adjusted R-squared** | 1.000000 | S.D. dependent var | 8.11E+15 |
| **S.E. of regression** | **Akaike info criterion** | 7.909107 |
| **Sum squared resid** | **Schwarz criterion** | 8.039802 |
| **Log likelihood** | **Hannan-Quinn criter.** | 7.962153 |
| **F-statistic** | 1.19E+31 | Durbin-Watson stat | 2.220554 |
| **Prob(F-statistic)** | 0.000000 | **Source:** Author’s computation using EViWES software |

The error correction mechanism (ECM) is used to verify the short run relationship between total deposits, loans and advances and risk factor. The rule for the existence of a short run relationship between financial intermediation role of banks and risk factor is that the coefficient of the error correction term should be negative and statistically significant. Our results below do not confirms this, thus we can conclude that the parameter of error correction term as shown in the table is positive and significant. This suggests that long run equilibrium condition does not influence the short run dynamics in Nigeria and that there is not automatic adjustment mechanism that is the intermediation role does not respond to deviations from equilibrium.

The Prob. (F-statistics) is 0.0000, implying that all the variables significantly influence the intermediation role of banks and risk factor. Durbin Watson has a value of 2.22, indicating the absence of auto-correlation.

8.3. Granger Causality Test

This test is employ to ascertain the direction of causality between financial intermediation role of banks and risk factor in Nigeria. Table 7 below presents the results of granger causality test:

| Table-7. Granger Causality Estimates |
|-------------------------------|----------------|-------------|-------------|
| **Pairwise Granger Causality Tests** | **Date:** 07/21/20  **Time:** 18:00 |
| **Sample:** 1 169 | **Lags:** 5 |
| **Null Hypothesis:** | **Obs** | **F-Statistic** | **Prob.** |
| TD does not Granger Cause RF | 164 | 0.03093 | 0.9995 |
| RF does not Granger Cause TD | 0.85040 | 0.5161 |
| LA does not Granger Cause RF | 164 | 18.0813 | 5.14 |
| RF does not Granger Cause LA | 4.02044 | 0.0019 |
| LA does not Granger Cause TD | 164 | 0.05589 | 0.9980 |
| TD does not Granger Cause LA | 0.07723 | 0.9956 |
| **Source:** Author’s computation using EViWES software |

The Granger Causality test results reveals a bidirectional causality between loans and advances and risk factor, with their high F-statistics value of 18.08130 and 4.02044 and low probability of 1% and 5% level of significance respectively. Therefore, the null hypothesis of no causation between loans and advance and risk factor is rejected. This shows the relationship between loans and advances and risk factor as the increase in loans and advances has a
positive effect on risk factor. The credit growth can increase the number of borrowers default which increasing risk factor. This agrees with the result of Salkeld and Shim (2011).

8.4. Diagnostic Test
To verify the presence of serial correlation in the model, the Breusch-Godfrey serial correlation LM test is applied. If the probability is significance at 5% level, the null hypotheses is accepted and conclude that the model has a serial correlation, but if it is not significant at 5% level, the null hypothesis is rejected and concluded that the model has no serial correlation.

| Table 8. Breusch-Godfrey Serial Correlation LM Test |
|----------------------------------------------------|
| F-statistic | 1.087399 | Prob. F(2,160) | 0.3396 |
| Obs*R-squared | 2.252916 | Prob. Chi-Square(2) | 0.3242 |

*Source: Author’s computation using EVIEWS software*

The test for the existence of serial correlation using the Breusch-Godfrey serial correlation LM test in Table 8 above reveals that there is no evidence of serial correlation and that our model is good. Therefore the null hypothesis is rejected and concludes that the model has no presences of serial correlation.

9. Conclusion
This study empirically examined the effect of financial intermediation role of commercial banks and risk factors in Nigeria over the period 2007-2019 using the unit root, auto-regressive distributed lag (ARDL) approach to co-integration and granger causality analysis, controlling for the possible effects of loans and advances, total deposits and bank risk factors in Nigeria. The results from this study shows that all variables, included in the model were integrated in their first difference that is 1(1). It equally shows that there exist co-integration between financial intermediation function and bank risk factors; there is both long and short run relationship between loans and advances and bank risk factors in the study. In addition, the Granger causality has bidirectional causality between loans and advances and bank risk factor. This mean that by increasing the supply of loans and advances to customers, the financial intermediation function of lending for investment will be enhance in the economy. The study recommends that commercial banks should continue their short term lending of credit for investment as default has been drastically reduced in lending to customers.

Competing Interests
The author has declared that no competing interests exist.

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Appendix

| FIDELITY BANK | COMMERCIAL BANKS AND DATA SET |
|----------------|----------------------------------|
| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
| 2007 | 217145 | 70238 | 4160 | 29757 |
| 2008 | 533122 | 230713 | 12987 | 135864 |
| 2009 | 434053 | 176398 | 1414 | 129340 |
| 2010 | 497453 | 207491 | 5828 | 154383 |
| 2011 | 737732 | 280421 | 3911 | 152340 |
| 2012 | 914360 | 345500 | 17924 | 162033 |
| 2013 | 1081217 | 426076 | 7721 | 163455 |
| 2014 | 1187025 | 541686 | 13796 | 173125 |
| 2015 | 1237122 | 578203 | 13904 | 183516 |
| 2016 | 1298141 | 718401 | 9734 | 792971 |
| 2017 | 1379214 | 768737 | 18857 | 773276 |
| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
|-------|--------------|--------------------|------------|---------------|
| 2007  | 467337030    | 381382275          | 15109091   | 277454178     |
| 2008  | 515601585    | 436248852          | 3994543    | 348235220     |
| 2009  | 463641243    | 360518291          | 564338     | 279693815     |
| 2010  | 538590882    | 384211268          | 7934971    | 335401976     |
| 2011  | 601616494    | 323533706          | 7682216    | 71521492      |
| 2012  | 1169364784   | 617979798          | 15121704   | 646268767     |
| 2013  | 1008280170   | 450532965          | 15932899   | 738593548     |
| 2014  | 1159534176   | 592957417          | 4676101    | 705677744     |
| 2015  | 131366185    | 659937             | 3730260    | 682407        |
| 2016  | 131636805    | 649797             | 1524886    | 696216        |
| 2017  | 132792066    | 633034             | 3552392    | 860887        |
| 2018  | 133165561    | 717533             | 3030341    | 1143683       |

| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
|-------|--------------|--------------------|------------|---------------|
| 2007  | 311396       | 200323             | 7450       | 231485        |
| 2008  | 432466       | 307384             | 5          | 334627        |
| 2009  | 355662       | 256980             | 4588       | 260978        |
| 2010  | 10466871     | 5264184            | 131819     | 7924585       |
| 2011  | 17161912     | 7359940            | 206840     | 12076495      |
| 2012  | 19939383     | 11421605           | 286732     | 14620478      |
| 2013  | 22532453     | 11421605           | 147773     | 16489904      |
| 2014  | 24243626     | 12311642           | 394770     | 17436970      |
| 2015  | 25559199     | 11200349           | 1107464    | 16472553      |
| 2016  | 20510974     | 10630703           | 204958     | 15519072      |
| 2017  | 22431604     | 11043670           | 228534     | 16975685      |
| 2018  | 8195043205   | 39356113           | 77463917   | 63373310      |
| 2019  | 8621939805   | 40731508           | 99461946   | 67300691      |

| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
|-------|--------------|--------------------|------------|---------------|
| 2007  | 1031842021   | 244595621          | 16054464   | 423741828     |
| 2008  | 674865041    | 391688687          | 22185794   | 436168354     |
| 2009  | 647574179    | 360387649          | 880752     | 44861775      |
| 2010  | 72690580     | 403178957          | 12931441   | 475285053     |
| 2011  | 949382097    | 491653266          | 5248866    | 65416428      |
| 2012  | 23532453     | 11421605           | 147773     | 16489904      |
| 2013  | 22431604     | 11043670           | 228534     | 16975685      |
| 2014  | 2411944061   | 1303630030         | 65868773   | 591557668     |
| 2015  | 3094961      | 1698569            | 64026      | 1908165       |
| 2016  | 3499684      | 1872712            | 53239      | 2180915       |
| 2017  | 3968115      | 1782755            | 73596      | 2673834       |
| 2018  | 6311041      | 2646037            | 73569      | 4747624       |
| 2019  | 4736805      | 1135036            | 12243      | 3520299       |
| 2020  | 5236537      | 1384810            | 40011      | 3808704       |
| 2021  | 5568909      | 1516770            | 58232      | 4236006       |
| 2022  | 6203526      | 1780235            | 73665      | 4880322       |
| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
|-------|--------------|--------------------|------------|---------------|
| 2007  | 732038458    | 288170430          | 21169477   | 363261237     |
| 2008  | 959183693    | 416342475          | 35820915   | 495851009     |
| 2009  | 1066503718   | 563494234          | 23686843   | 698062607     |
| 2010  | 1152001900   | 593572400          | 38346623   | 779138714     |
| 2011  | 1523527545   | 679517535          | 51653251   | 984122534     |
| 2012  | 1620317223   | 742614929          | 85263826   | 1061292894    |
| 2013  | 1904365795   | 926984069          | 85545510   | 1262815764    |
| 2014  | 2126608312   | 1182424689         | 89170777   | 1439665783    |
| 2015  | 2277629224   | 1265846260         | 94308123   | 1422590066    |
| 2016  | 2613340      | 1447161            | 126837     | 1721623       |
| 2017  | 2824929      | 1309452            | 161285     | 1739921       |
| 2018  | 2712521      | 1114073            | 166753     | 2601745       |
| 2019  | 3097248      | 1373272            | 175125     | 2102010       |

**STANBIC IBTC BANK**

| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
|-------|--------------|--------------------|------------|---------------|
| 2007  | 304394       | 103271             | 6942       | 139307        |
| 2008  | 345206       | 120344             | 9214       | 181116        |
| 2009  | 331000       | 177705             | 6258       | 208745        |
| 2010  | 372612       | 209970             | 7811       | 192350        |
| 2011  | 542272       | 302771             | 4048       | 299787        |
| 2012  | 72508        | 290915             | 1053       | 382051        |
| 2013  | 75401        | 383927             | 8332       | 468038        |
| 2014  | 75671        | 407418             | 13136      | 554056        |
| 2015  | 76210        | 419678             | 14034      | 593261        |
| 2016  | 92857        | 368229             | 609        | 614735        |
| 2017  | 97374        | 381711             | 25165      | 815363        |
| 2018  | 107952       | 441261             | 15499      | 967964        |
| 2019  | 126886       | 535170             | 33727      | 886743        |

**STERLING BANK**

| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
|-------|--------------|--------------------|------------|---------------|
| 2007  | 145974674    | 45957835           | 620658     | 106933727     |
| 2008  | 236302923    | 65787520           | 6523153    | 184730727     |
| 2009  | 205640827    | 78140098           | 6660406    | 160620381     |
| 2010  | 25975923     | 99312070           | 4178493    | 199274284     |
| 2011  | 504048213    | 162063156          | 6908598    | 409794177     |
| 2012  | 580225940    | 229420874          | 6953539    | 466845100     |
| 2013  | 70797181     | 321748748          | 8274864    | 570511097     |
| 2014  | 824539426    | 371246273          | 9004973    | 659441275     |
| 2015  | 799451417    | 338726271          | 10292577   | 590889216     |
| 2016  | 745123       | 468250             | 7295       | 608503        |
| 2017  | 965905       | 898073             | 17210      | 695882        |
| 2018  | 1085876      | 621017             | 6215       | 761013        |
| 2019  | 1165509      | 618732             | 21319      | 892861        |

**UNITED BANK FOR AFRICA**

| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
|-------|--------------|--------------------|------------|---------------|
| 2007  | 1102348      | 320229             | 19831      | 897651        |
| 2008  | 1520091      | 405540             | 40002      | 1290036       |
| 2009  | 1400879      | 543289             | 12889      | 1161166       |
| 2010  | 1432632      | 569312             | 2167       | 1119114       |
| 2011  | 1666053      | 594090             | 7966       | 1239919       |
| 2012  | 1933065      | 598592             | 47375      | 1484006       |
| 2013  | 2217417      | 823193             | 46483      | 1797376       |
| 2014  | 2338858      | 933578             | 40083      | 1813803       |
| 2015  | 2216337      | 837285             | 47642      | 1627410       |
| 2016  | 2539585      | 1114205            | 74437      | 30798         |
| 2017  | 2931826      | 1193188            | 58106      | 15413         |
| 2018  | 3591305      | 1229317            | 29038      | 2454610       |
| 2019  | 4136493      | 1603229            | 110994     | 2857105       |

**UNION BANK**

| Years | Total Assets | Loans and Advances | Net Income | Total Deposits |
|-------|--------------|--------------------|------------|---------------|
| 2007  | 907074       | 244845             | 5009       | 712074        |
| 2008  | 1106779      | 401546             | 4134       | 851603        |
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### UNITY BANK

| Year | Total Assets | Loans and Advances | Net Income | Total Deposits |
|------|--------------|--------------------|------------|---------------|
| 2007 | 203234002    | 84141143           | 720843     | 145793517     |
| 2008 | 364080837    | 208816058          | 13242136   | 320139525     |
| 2009 | 256798086    | 140538178          | 15855855   | 214820710     |
| 2010 | 304044730    | 148410857          | 12415472   | 222145561     |
| 2011 | 372926748    | 178909487          | 2693859    | 266877426     |
| 2012 | 395720179    | 202614700          | 6180061    | 292658311     |
| 2013 | 403629290    | 202614700          | 22582339   | 303270560     |
| 2014 | 413305111    | 235493706          | 10692476   | 277025613     |
| 2015 | 443321012    | 264722475          | 4689157    | 271971983     |
| 2016 | 492681647    | 277214521          | 2183798    | 243962118     |
| 2017 | 35606503     | 8958126            | 1646291    | 295268311     |
| 2018 | 1090505      | 891594             | 4157       | 977658        |
| 2019 | 1222335      | 984044             | 4250       | 1098067       |

### WEMA BANK

| Year | Total Assets | Loans and Advances | Net Income | Total Deposits |
|------|--------------|--------------------|------------|---------------|
| 2007 | 128906575    | 55180566           | 57738739   | 136122027     |
| 2008 | 110981613    | 59229615           | 11668408   | 108907683     |
| 2009 | 142785723    | 87366049           | 2094692    | 95258871      |
| 2010 | 203144627    | 93901057           | 16238533   | 124966118     |
| 2011 | 221157042    | 67236605           | 4228926    | 150045576     |
| 2012 | 245704597    | 73745715           | 5040629    | 175032820     |
| 2013 | 330872475    | 98631825           | 1596531    | 221131929     |
| 2014 | 382562312    | 149293849          | 2372445    | 262199696     |
| 2015 | 396743314    | 185596590          | 2327275    | 284977863     |
| 2016 | 421221       | 227009             | 2437844    | 320762        |
| 2017 | 385388       | 215840             | 2441209    | 281062        |
| 2018 | 477916       | 252190             | 3359259    | 369314        |
| 2019 | 704956       | 289240             | 5210748    | 580922        |

### ZENITH BANK

| Year | Total Assets | Loans and Advances | Net Income | Total Deposits |
|------|--------------|--------------------|------------|---------------|
| 2007 | 883941       | 218306             | 17509      | 568012        |
| 2008 | 1680032      | 417073             | 46524      | 1164460       |
| 2009 | 1573196      | 669261             | 18365      | 1111328       |
| 2010 | 1789458      | 667860             | 33335      | 1289552       |
| 2011 | 2169073      | 827035             | 41301      | 1577290       |
| 2012 | 2436886      | 895354             | 95803      | 1802008       |
| 2013 | 2878693      | 1126559            | 83414      | 2079862       |
| 2014 | 3423819      | 1580250            | 92479      | 2265262       |
| 2015 | 3750327      | 1849225            | 98784      | 233017        |
| 2016 | 4283736      | 2138132            | 119285     | 2552963       |
| 2017 | 4833658      | 1980464            | 157145     | 2744525       |
| 2018 | 4955445      | 1736066            | 166939     | 2821066       |
| 2019 | 5435073      | 2239472            | 191873     | 3486887       |

### Variables Construction

| Risk Factor (Variance of Net Income) | Total Deposit/Total Assets | Loans and Advances/Total Assets |
|-------------------------------------|---------------------------|--------------------------------|
| 1.0875                              | 1.9158                    | 0.3235                         |
| 1.0922                              | 2.4360                    | 0.4328                         |
| 1.0970                              | 0.3258                    | 0.4064                         |
| 1.1018 | 1.1716 | 0.4171 |
| 1.1067 | 0.5301 | 0.3801 |
| 1.1116 | 1.9603 | 0.3779 |
| 1.1165 | 0.7141 | 0.3941 |
| 1.1214 | 1.1622 | 0.4563 |
| 1.1264 | 1.1288 | 0.4694 |
| 1.1315 | 0.7498 | 0.5534 |
| 1.1365 | 1.3672 | 0.5574 |
| 1.1417 | 1.3330 | 0.4941 |
| 1.1468 | 1.3446 | 0.5331 |
| 1.1520 | 3.2330 | 0.8161 |
| 1.1590 | 0.7747 | 0.8461 |
| 1.1648 | 0.1217 | 0.7776 |
| 1.1719 | 1.4733 | 0.7134 |
| 1.1781 | 1.2769 | 0.5375 |
| 1.1825 | 1.6644 | 0.3938 |
| 1.1758 | 1.5802 | 0.4468 |
| 1.1641 | 1.8869 | 0.5285 |
| 1.1502 | 0.4033 | 0.5114 |
| 1.1384 | 2.8396 | 0.0050 |
| 1.1443 | 1.1584 | 0.0049 |
| 1.1503 | 2.6752 | 0.0048 |
| 1.1563 | 2.2756 | 0.0054 |
| 1.1625 | 2.3925 | 0.6433 |
| 1.1686 | 0.0012 | 0.7108 |
| 1.1748 | 1.2900 | 0.7225 |
| 1.1811 | 1.2594 | 0.5029 |
| 1.1876 | 1.2052 | 0.4289 |
| 1.1943 | 1.4380 | 0.4735 |
| 1.2011 | 0.6558 | 0.5069 |
| 1.2080 | 1.6283 | 0.5078 |
| 1.2150 | 0.4562 | 0.4755 |
| 1.2221 | 0.9993 | 0.5204 |
| 1.2292 | 1.0188 | 0.4923 |
| 1.2365 | 0.9453 | 0.0048 |
| 1.2448 | 1.1536 | 0.0047 |
| 1.2534 | 1.5559 | 0.2370 |
| 1.2587 | 3.2874 | 0.5804 |
| 1.2637 | 0.1360 | 0.5565 |
| 1.2682 | 1.7788 | 0.5546 |
| 1.2714 | 0.5529 | 0.5179 |
| 1.2632 | 2.3629 | 0.3679 |
| 1.2018 | 1.5382 | 0.4391 |
| 1.1097 | 2.0152 | 0.5427 |
| 0.7782 | 2.7309 | 0.5405 |
| 8.1082 | 2.0687 | 0.5488 |
| 8.1612 | 1.5213 | 0.5351 |
| 8.2148 | 1.8547 | 0.4493 |
| 8.2692 | 1.1657 | 0.4193 |
| 8.3248 | 1.6161 | 0.3756 |
| 8.3801 | 2.1035 | 0.4103 |
| 8.4361 | 0.0719 | 0.5769 |
| 8.4929 | 1.6369 | 0.5184 |
| 8.5504 | 1.9266 | 0.4582 |
| 8.6087 | 0.3022 | 0.0063 |
| 8.6680 | 22.6519 | 0.0050 |
| 8.7281 | 1.9748 | 0.0116 |
| 8.7890 | 0.7708 | 0.0172 |
| 8.8506 | 0.2585 | 0.2396 |
| 8.9131 | 0.7641 | 0.2645 |
| 8.9766 | 1.0457 | 0.2724 |
| 9.0409 | 1.1875 | 0.2870 |
| 9.1062 | 2.8919 | 0.3937 |
|                  |                  |                  |
|------------------|------------------|------------------|
| 9.1536           | 3.7345           | 0.4341           |
| 9.1267           | 2.2210           | 0.5284           |
| 8.9170           | 3.3287           | 0.5153           |
| 8.5992           | 3.3904           | 0.4460           |
| 7.9533           | 5.2622           | 0.4583           |
| 7.1359           | 4.4921           | 0.4868           |
| 5.8417           | 4.1931           | 0.5560           |
| 4.0248           | 4.1406           | 0.5558           |
| 2.1783           | 4.8534           | 0.5538           |
| 2.1945           | 5.7093           | 0.4635           |
| 2.2110           | 6.1475           | 0.4107           |
| 2.2278           | 5.6542           | 0.4434           |
| 2.2447           | 2.2806           | 0.3393           |
| 2.2615           | 2.6691           | 0.3486           |
| 2.2784           | 1.8906           | 0.5369           |
| 2.2956           | 2.0963           | 0.5635           |
| 2.3129           | 0.7465           | 0.5583           |
| 2.3305           | 1.4523           | 4.0122           |
| 2.3482           | 11.0503          | 5.0918           |
| 2.3661E+16       | 17.3594          | 5.3841           |
| 2.3843E+16       | 18.4149          | 5.5069           |
| 2.4026E+16       | 0.6558           | 3.9655           |
| 2.4212E+16       | 25.8437          | 3.9201           |
| 2.4399E+16       | 14.3573          | 4.0876           |
| 2.4589E+16       | 26.5806          | 4.2177           |
| 2.4780E+16       | 0.4252           | 0.3148           |
| 2.5106E+16       | 2.7605           | 0.2784           |
| 2.5345E+16       | 3.2389           | 0.3800           |
| 2.5637E+16       | 1.6097           | 0.3826           |
| 2.5848E+16       | 1.3706           | 0.3215           |
| 2.4834E+16       | 1.1984           | 0.3954           |
| 2.3190E+16       | 1.1691           | 0.4546           |
| 2.0148E+16       | 1.0921           | 0.4502           |
| 1.5584E+16       | 1.2875           | 0.4237           |
| 1.1812E+16       | 0.9790           | 0.6284           |
| 1.1924E+16       | 1.7817           | 0.9298           |
| 1.2039E+16       | 0.5723           | 0.5719           |
| 1.2154E+16       | 1.8292           | 0.5309           |
| 1.2272E+16       | 1.7990           | 0.2905           |
| 1.2391E+16       | 2.6316           | 0.2668           |
| 1.2512E+16       | 0.9201           | 0.3878           |
| 1.2635E+16       | 0.1513           | 0.3974           |
| 1.2758E+16       | 0.4781           | 0.3566           |
| 1.2883E+16       | 2.4508           | 0.3097           |
| 1.3010E+16       | 2.0963           | 0.3712           |
| 1.3139E+16       | 1.7138           | 0.3992           |
| 1.3269E+16       | 2.1496           | 0.3778           |
| 1.3400E+16       | 2.9311           | 0.4387           |
| 1.3526E+16       | 1.9819           | 0.4070           |
| 1.3652E+16       | 0.8086           | 0.3423           |
| 1.3787E+16       | 2.6833           | 0.3876           |
| 1.3922E+16       | 0.5522           | 0.2699           |
| 1.4051E+16       | 0.3735           | 0.3628           |
| 1.4179E+16       | 0.0866           | 0.3656           |
| 1.4305E+16       | 8.3501           | 0.2114           |
| 1.4429E+16       | 9.2741           | 0.1745           |
| 1.4550E+16       | 0.3576           | 0.1545           |
| 1.4668E+16       | 0.5805           | 0.2382           |
| 1.4782E+16       | 2.2262           | 0.3286           |
| 1.4891E+16       | 1.7754           | 0.3496           |
| 1.4994E+16       | 1.4139           | 0.4360           |
| 1.5091E+16       | 0.9633           | 0.3660           |
| 1.5180E+16       | 1.3923           | 0.3232           |
### ADF Unit Root Test @ Risk Factor First Differencing

**Null Hypothesis:** D(RF) has a unit root

**Exogenous:** Constant

| Lag Length: 0 (Automatic - based on SIC, maxlag=13) | t-Statistic | Prob.* |
|-----------------------------------------------------|-------------|--------|
| Augmented Dickey-Fuller test statistic              | -11.59295   | 0.0000 |
| Test critical values:                                |             |        |
| 1% level                                            | -3.469691   |        |
| 5% level                                            | -2.878723   |        |
| 10% level                                           | -2.576010   |        |

*MacKinnon (1996) one-sided p-values.

**Augmented Dickey-Fuller Test Equation**

**Dependent Variable:** D(RF,2)

**Method:** Least Squares

**Date:** 07/21/20  Time: 17:13

**Sample (adjusted):** 169

**Included observations:** 167 after adjustments

| Variable         | Coefficient | Std. Error | t-Statistic | Prob.  |
|------------------|-------------|------------|-------------|--------|
| D(RF(-1))        | -0.897782   | 0.077442   | -11.59295   | 0.0000 |
| C                | -1.36E+08   | 1.53E+14   | -8.89E-07   | 1.0000 |
| R-squared        | 0.448891    |            |             |        |
| Adjusted R-squared | 0.445551   |            |             | 2.65E+15|
| S.E. of regression | 1.97E+15   |            |             | 73.28661|
## TOTAL DEPOSIT

Null Hypothesis: D(TD) has a unit root  
Exogenous: Constant  
Lag Length: 3 (Automatic - based on SIC, maxlag=13)

| t-Statistic | Prob.* |
|-------------|--------|
| Augmented Dickey-Fuller test statistic | -10.80203 | 0.0000 |

Test critical values:  
1% level: -3.470427  
5% level: -2.879045  
10% level: -2.576182

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
Dependent Variable: D(TD,2)  
Method: Least Squares  
Date: 07/21/20  Time: 17:15  
Sample (adjusted): 6 169  
Included observations: 164 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| D(TD(-1)) | -1.511702 | 0.139946 | -10.80203 | 0.0000 |
| D(TD(-1),2) | 0.508803 | 0.120392 | 4.226222 | 0.0000 |
| D(TD(-2),2) | 0.496246 | 0.098169 | 5.055011 | 0.0000 |
| D(TD(-3),2) | 0.476685 | 0.069715 | 6.837642 | 0.0000 |
| C | 0.020686 | 0.0143962 | 0.004021 | 0.9968 |

R-squared: 0.610597  
Mean dependent var: 0.004896  
S.D. dependent var: 104.2617

## LOANS AND ADVANCES

Null Hypothesis: D(LA) has a unit root  
Exogenous: Constant  
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

| t-Statistic | Prob.* |
|-------------|--------|
| Augmented Dickey-Fuller test statistic | -11.60747 | 0.0000 |

Test critical values:  
1% level: -3.469691  
5% level: -2.878723  
10% level: -2.576010

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
Dependent Variable: D(LA,2)  
Method: Least Squares  
Date: 07/21/20  Time: 17:16  
Sample (adjusted): 3 169  
Included observations: 167 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| D(LA(-1)) | -0.898902 | 0.077446 | -11.60747 | 0.0000 |
| C | -0.000141 | 0.035078 | -0.004013 | 0.9968 |

R-squared: 0.449511  
Mean dependent var: 0.000141  
S.D. dependent var: 0.609122

## Additional Statistics

- Sum squared resid: 6.42E+32
- Schwarz criterion: 73.32396
- Log likelihood: -6117.432
- Hannan-Quinn criter.: 73.30177
- F-statistic: 134.3964
- Durbin-Watson stat: 2.009712
- Prob(F-statistic): 0.000000