Scientific Research Publishing

Open Journal of Applied Sciences, 2020, 10, 625-653
https://www.scirp.org/journal/ojapps
ISSN Online: 2165-3925
ISSN Print: 2165-3917

Monetary Policy and Profitability of Commercial Banks in Uganda

Robert Ndyanabo Mbabazize[1], Dickson Turyareeba[2], Peter Ainomugisha[3], Peter Rumanzi[1]

[1]Bank of Uganda, Kampala, Uganda
[2]Lecturer, Department of Economics, Makerere University Business School-Kampala and Associate Professor, King Ceasor University-Kampala, Kampala, Uganda
[3]Ministry of Finance, Planning and Economic Development-Uganda, Kampala, Uganda

Email: mbabazize@gmail.com, dturyareba@mubs.ac.ug, ainopeter@yahoo.com, pirumanzi@gmail.com

How to cite this paper: Mbabazize, R.N., Turyareeba, D., Ainomugisha, P. and Rumanzi, P. (2020) Monetary Policy and Profitability of Commercial Banks in Uganda. *Open Journal of Applied Sciences*, **10**, 625-653.
https://doi.org/10.4236/ojapps.2020.1010044

Received: August 13, 2020
Accepted: October 16, 2020
Published: October 19, 2020

Abstract

Background: Economic theory suggests that monetary policy through interest rates affects bank profitability. There is limited empirical evidence on the relationship between monetary policy and profitability of commercial banks in Uganda. **Objective:** This study seeks to examine the effect of monetary policy on the profitability of commercial banks in Uganda. **Methodology:** The study adopts a causal relationship research design. Data, covering 9 years from 2010-2018, was collected from all the registered commercial banks which were in operation over the study period. Various monetary policy variables are included in the empirical model as predictor variables. Return on Assets is used as a measure of bank profitability. A dynamic two-step System Generalized Method of Moments panel estimator is applied to estimate the empirical model. **Findings:** Estimates show that monetary policy in terms of its link to the lending rate has a significant causal effect on Return on Assets, suggesting that interest rate changes predict bank profitability of commercial banks in Uganda. Further, results show that a rise in core inflation has a significant negative causal effect on the banks' profitability and that there is a significant lagged effect of Return on Assets. The 91-day treasury bill rate and money supply were insignificant in predicting bank profitability. **Originality:** Unlike previous related studies which have focused on major advanced economies and a limited number of studies which have considered only a few developing countries like Nigeria and Kenya, the current study provides empirical evidence on the link between monetary policy and commercial bank profitability in Uganda. **Practical Implications:** Policy makers in the financial sector may use the study results as a basis of implementation of appropriate monetary policy actions that enhance the profitability of Uganda's commercial banks. For instance, the central bank should promote low and stable

core inflation in order to enhance bank profitability, and should ensure that the monetary policy transmission to interest rates is efficient.

Keywords

Monetary Policy, Commercial Bank Profitability, Return on Assets, Uganda

1. Introduction

The link between monetary policy and bank profitability has gained prominence of recent, particularly after the financial crisis of 2007. Concerns have emerged that the low interest rate monetary policy stance in the Euro area could be affecting bank profitability [1], although other studies have found that this is not the case [2]. In the same way, concerns have emerged that introduction of inflation targeting monetary policy in developing countries could also affect bank profits [3]. The profitability of banks gives an indication of the health and stability of the financial sector and is important for economic growth [4]. Profits enable banks to effectively undertake financial intermediation in the economy by mobilizing deposits, allocation of credit and price discovery [5]. Profits also add to banks' capital base and liquidity buffers, which act as the banks first line of defense when domestic and exogenous shocks emerge [6]. At the same time, the banking sector and its lending behavior is a keystone for the effectiveness and the transmission process of monetary policy [7]. However, monetary policy can affect the profitability of banks such that bank profits could rise/fall with an increase/reduction in the policy rates [2]. Also, profitability can be affected by bank size and can persist overtime [8].

Monetary policy affects bank profitability by influencing the interest rate [2]. According to the [9] conjecture, when the central bank increases the interest rates, bank profitability also increases. Monetary theory shows that this link can occur through the channels of monetary policy *i.e.* through the credit channel, the interest rate channel and through asset and liability mismatches [10] [6]. For example, under the interest rate channel of monetary policy, the central bank sets the short-term rates such as the central bank rate which influences longer-term rates including the treasury bill rate, interbank rate and lending rate. The question is the extent to which this could feed through to bank profitability [11] [12].

The overall profitability of the Ugandan banking sector, which comprises of 24 commercial banks, has declined over the years to 2018 [13]. The Return on Assets (ROA) and Return on Equity (ROE) declined from 5 percent and 42.1 percent in March 2009 to 2.4 percent and 16.3 percent in December 2018, respectively [13]. In the same period, Bank of Uganda (BOU) implemented several reforms regarding monetary policy and bank size. In July 2011, Bank of Uganda adopted an inflation targeting lite regime in a bid to enhance the transmission of monetary policy and price stability. The operating target of monetary policy is

the short term 7-day interbank money market rate, which is expected to affect other interest rates and real variables such as prices and output [6].

Literature documents several studies that have looked at the effect of interest rates on bank profitability in many countries. For instance, [12] studied 10 industrialized countries and found that changes in the interest rate affect bank earnings. [2] found a significant and positive relationship between the level of short term market rates and ROA for banks in the European Union. In Nigeria, [14] found a significant and positive relationship between monetary policies and banks' profits as proxied by money supply and the interest rate. In Uganda, little is known on the causal connection between monetary policy and profitability of commercial banks. The study attempts to fill this gap.

1.1. Problem Statement

Despite the importance of profits for the health and soundness of commercial banks and in enhancing their role in Uganda's economic growth, indicators show that the average profitability of commercial banks has declined steadily. A number of reforms related to bank to monetary policy have been implemented by government and BOU, which could affect the income earned by banks. For example, in July 2011, Bank of Uganda changed its monetary policy framework from monetary targeting to inflation targeting (IT) lite. In addition, BOU has steadily reduced the central bank rate (CBR) from 23 percent in 2011 to 9.5 percent in 2018 as the banking sector battled high non-performing loans, which ought to have enhanced bank profitability [13]. The central bank also identified and subjected large domestic systemically important banks (DSIBs) to a policy of more intrusive supervision. Notwithstanding these measures, commercial banks' Return on Assets halved to 2.4 percent from 5 percent in 2008. Since 2011, some banks have reduced the number of branches, three banks were closed by Bank of Uganda, while six banks have remained loss making for 5 years. Although extant literature from other countries shows that the financial performance of banks could be related to monetary policy, little is known on this relationship in Uganda. This study therefore seeks to investigate the effect of monetary policy on profitability of commercial banks in Uganda.

1.2. Objective of the Study

The objective of this study is to investigate the effect of monetary policy on profitability of commercial banks in Uganda.

1.3. Research Hypotheses

The study seeks to test the following five (5) hypotheses:

H_{01}: Interbank rate has no effect on bank profitability in Uganda.

H_{02}: Treasury bill rate has no effect on bank profitability in Uganda.

H_{03}: Lending interest rate has no effect on bank profitability in Uganda.

H_{04}: Money supply has no effect on bank profitability in Uganda.

H_{05}: Core inflation rate has no effect on bank profitability in Uganda.

1.4. Scope of the Study

In terms of content, the study investigates the influence of monetary policy on profitability of commercial banks in Uganda. Assessing the effect macroeconomic conditions, managerial/operating efficiency and others which may affect bank profitability has not been within the scope of this study. In terms of geographical scope, the study focuses on the commercial banking sector in Uganda. Commercial banks were studied because they link well with the operationalization of the research problem under study and they are key in the transmission of and could be affected by monetary policy. In terms of time scope, the study covered a period of nine years from 2010 to 2018. This period was selected based on data availability across the units (banks) being studied. This period also covers the change in monetary policy framework in Uganda to inflation targeting in the year 2011.

1.5. Conceptualization of the Relationship between Monetary Policy and Bank Profitability

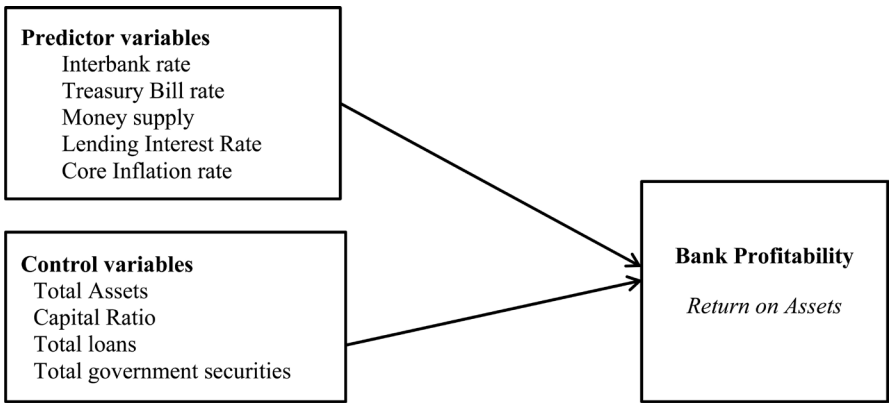
Accordingly, as shown in Figure 1, it is hypothesized that both the selected monetary policy variables and the control variables individually influence the profitability of banks. The left hand side variables in Figure 1 are taken as independent variables. The dependent variable is bank profitability, which is measured by return on assets. It is therefore conceptualized that other factors notwithstanding, the profitability of banks is dependent on monetary policy variables and other control variables.

2. Literature Review

2.1. Review of Theoretical Literature

2.1.1. Monetary Theory

Monetary policy is the framework used by the Central Bank to regulate the



Source: Adapted from [2].

Figure 1. Conceptual framework.

circulation of money, interest rates and credit in order to achieve broad economic objectives [6]. Monetary policy tools include; Central Bank Rate, Money Supply, Cash Reserve Ratio and Open Market Operations among others. Modern monetary theory can be traced back to John Maynard Keynes. Keynesian based theory states that monetary policy is transmitted through interest rates and investment. Thus expansionary monetary policy will decrease interest rates and vice versa, which affects banks in three ways [10]. The first is the *direct effect* on the existing stock of assets and liabilities, where for example, a simple mismatch in the maturity of liabilities and assets can affect bank margins and bank profitability as measured by net interest income (NII) and return on assets (ROA). The second way is the *indirect effect* through the real economy, where under the credit channel, tightening of monetary policy typically leads to an increase in lending rates, which reduces loan demand and growth in the economy, raises default rates and leads banks to increase loan loss provisions to cater for expected losses. These indirect effects impact on bank profitability [2]. The third way is through the endogenous responses of the bank to policy rate changes. For example, under the interest rate channel of monetary policy, the central bank sets the short-term rates such as the central bank rate and the 7-day interbank rate, which influences longer-term rates including the Treasury bill rate and yield curve, that feed through to bank profitability [12].

2.1.2. Bank Profitability

Profit is the driving force of every firm and the main indicator of a firm's performance and in addition, banks are special types of firms, engaged in mobilizing deposits and lending [15]. Bank profitability is not just a performance measure but a necessary condition for the success of banks under competitive conditions as well as successful implementation of monetary policy [16]. The profitability of banks also gives an indication of the health and stability of banking institutions as well as an important predictor of financial crises [17]. Factors affecting bank profitability may be divided into those which are internal to the bank and those which are external [18].

There are three ratios that are typically used to measure the profitability of banks in empirical studies; return on assets (ROA), return on equity (ROE) and net interest margin (NIM) [19]. Return on assets (ROA) is the simplest measure of bank profitability [20] and it reflects the capability of a bank to generate profits from its asset management functions and minimizes differences resulting from differences in the capital structure. It is the most frequently used ratio for evaluation of bank profitability in the literature [2] [16] [20].

2.2. Review of Empirical Literature

***Monetary policy rates* (*Central Bank Rate and Interbank Rate*) *and bank profitability*:** The central bank rate is a key monetary policy variable that a central bank sets as a benchmark for all interest rates in an economy, in an inflation targeting regime [21]. From literature, it is thus expected that a rising interest

rate should lead to overall higher banking sector profitability. Two pioneering works in this field were [9] and [22] for whom the 'Samuelson' conjecture is named, which states that banks benefit from rising interest rates in normal economic conditions. Thus the profitability of banks improves since rising interest rates tend to increase the spread between the saving and the borrowing rates. [23] found that this relationship is particularly apparent for smaller banks in the USA during the 1976-1984 period. Using annual data covering 18 years from 1995 to 2012 for 109 large international banks, [2] conducted a study on the link between monetary policy and bank profitability in developed countries. The study looked at the effect of short term interest rates changes on ROA. The study employed dynamic System Generalized Method of Moments (S-GMM) panel methodology to estimate the underlying model. The study found evidence of a positive and significant relationship between interest rates and profitability of banks and that rising interest rates enhance banks profitability. [17] also noted that there is a positive relationship between interest rates and bank profitability

However, these studies focused on major advanced economies and their findings may not be applicable to a developing market like Uganda. In Kenya, [5], [24] and [25] provided conflicting results on the influence of Central bank rate on bank profitability, with the former two finding a positive effect, while the latter found a negative one. [26] found that interest rate policies have not improved the overall performances of the banks significantly in Nigeria.

Lending rates and bank profitability: A study by [27] in India found that lending rates have a positive relationship with banks' profits which indicates that a rise in lending rates will increase the profitability of the banks. [28] also concluded similarly that the lending rate has significant and positive effects on the performance of Nigerian deposit money banks. The implication is that the lending rate is a good parameter for measuring bank performance. In England, [29] found that following an increase in capital requirements, banks increase lending rates and on average cut loan growth for real estate, other corporates and household secured lending, which affected profitability. In a related study, [30] did a study to examine the relationship between interest rate and bank profitability in Korean. The purpose of the study was to examine the impact of negative policy interest rate (NPIR) on bank profitability. Results indicated that in case of the loan amount exceeding the deposit amount in the low interest rate phase, the bank profitability improves as both deposit and loan rates fall under zero. [31] conducted to check and examine the market interest rate effect on the bank's profitability in public and private sectors of Pakistan. The authors divided the sample into public sector banks and Private sector banks. Bank profitability was measures by Return on Assets (ROA) and Return on equity (ROE). The study employed OLS to estimate simple linear regressions when the dependent variable is ROA and when it is ROE. The regression results for public sector showed that the interest rate has significant effects on the profitability (ROA). In the case of return on equity (ROE) in public sector, estimates showed that the interest

rate had significant effects on profitability by only 14 percent. Another related study conducted by [32] examined the extent to which lending interest rates affect profitability of commercial banks in Kenya. The study utilized secondary data obtained from Central Bank of Kenya for the period of five years from 2010 to 2014. Bank profitability was approximated by return on assets. The author used OLS to estimate the coefficients of the empirical model. The study found that lending interest rates had significant positive effect on financial performance of commercial banks in Kenya at 95 percent confidence level. In another related study, [33] investigated the effect of interest rates on commercial banks profitability and performance in Kenya. The author considered banks which belonged to the first and second tier of the banking industry. The study utilized annual data for the period 2010 to 2015. Return on assets was used to measure commercial bank profitability. The author employed OLS to estimate a linear regression related return on assets to interest rate with cost income ratio, bank size and capital adequacy as control variables. The study reports that interest rates had a positive correlation with bank profitability in Kenya. Using quarterly data covering an unbalanced sample of 288 banks for the period Q1 2000–Q2 2016, [34] analyzed the impact of standard and non-standard monetary policy on bank profitability using data on individual euro area bank balance-sheets and market prices. The authors employed panel-based GMM estimation technique. Results showed that a monetary policy easing, that is, a decrease in short-term interest rates and/or a flattening of the yield curve is not associated with lower bank profits once the endogeneity of the policy measures to expected macroeconomic and financial conditions are controlled.

Treasury bill rate and bank profitability: Treasury bills are particularly important to, and are also popular with commercial banks. Moreover, treasury bills count as liquid assets of commercial banks while at the same time earning handsome interest rate for the holders. Treasury bills dominate the money market in Uganda, accounting for the largest portion of all government domestic debt [35]. Their initiation in Uganda in 1992 through an auction system provided the minimum market base necessary to facilitate the transition from direct to indirect monetary control. According to [36] an increase in bank investment in the government securities and treasury bills, is expected to also affect the bank advances negatively as it curtails the supply of loans. [37] estimated the effect of interest rates on bank profits using the Treasury bill rate as the market rate. The author used data from fifteen U.S banks from 1959 to 1978. Results from the study showed that the Treasury bill rate has no significant effect on net profits for thirteen banks, but a positive effect for the remaining banks. [38] conducted a study on Uganda to analyze the extent to which investment in loans and treasury bills influence the overall profitability of commercial banks. The author used annual data from 15 commercial banks for the study period 1998-2005. The overall profitability was measured using two profitability ratios namely: Return on Assets (ROA) and Return on Equity (ROE) while the independent variables

used in the study were: volume of loans, volume of treasury bills, lending rates and yield on treasury bills. The study used OLS method on pooled data for the fifteen commercial banks to estimate the model. The study found that volume of loans and treasury bills had a positive correlation while lending rates and yield on treasury bills revealed negative correlation with ROA as an element of the dependent variable. Using annual data that covered a period of thirteen years from 1999 to 2012, [39] employed time series multivariate regression analysis under an econometric framework to examine how interest rates (namely: minimum rediscount rate, lending rate, deposit rates, treasury bills rates, as well as interbank rates) affect the profitability of money deposit banks in Nigeria. The study considered return on assets as a measure of the profitability of money deposit banks. Model estimation was done using the OLS methodology. The study found no significant relationship between interest rate variables (minimum rediscount rate, prime lending rate, savings deposit rate, maximum lending rate as well as treasury bills rate) on the profitability of money deposit banks in Nigeria.

Inflation and bank profitability: Empirical literature has documented inflation to be another important determinant of banking performance. However, the findings of the relationship between inflation and bank profitability are mixed. [40] argue that the effect of inflation on financial sector performance depends on the structure and financial pattern in different countries. The mixed effects of inflation on financial sector performance has also been reported by [41] [42] [43] and [44]. [42] in particular state that on one hand, inflation has an adverse effect on banking sector performance and its spillover effect is very harmful to the overall economy, while on the other hand, inflation leads to an increase in bank performance as long as the banks can be able to anticipate future inflation and adjust interest rate to generate higher revenue.The studies of [45] in China and [46] in Malaysia show that a higher inflation rate leads to higher bank profitability. The latter argues that when core inflation is fully anticipated and interest rates are adjusted accordingly, a positive impact on bank profitability will result. A study by [47] on the impact of inflation on the profitability of commercial banks in Rwanda with specific focus on the Bank of Kigali revealed that that cost push inflation had a positive high correlation to the Profitability of Bank of Kigali. The findings of the study further indicated that demand pull inflation and Monetary inflation has also positive high correlation profitability of Bank of Kigali. [48] in their study concluded that the volume of bank lending and profitability tend to decrease as core inflation rises in a given economy. [49] analyzed data on inflation and financial sector performance indicators and the result showed that inflation has a negative effect on financial sector performance even though there was no evidence of thresholds level. [50] in his study concluded that high and uncertain inflation rates tend to be detrimental to stable financial sector performance. [44] used fixed effects estimation using panel data on G20 countries for the period 2013-2015 to analyze the relationship between inflation and bank profitability. The study found that inflation had a

negative impact on banks profitability in the G20 countries.In addition, [17] notice that banks in developing countries tend to be less profitable in inflationary environments, as inflation leads to increase in bank costs faster than bank revenues. Thus, low level of inflation serves as a prerequisite condition for attaining a stable and deep financial sector.

Money Supply and bank profitability: A study by [51] on Jordanian Islamic Banks with Return on Assets (ROA) as measures of profitability found that growth in money supply had a positive effect on the profitability of banks. [52] conducted a study on the main determinants of performance for commercial banks in Japan covering the period of the global financial crisis and adopted Net interest income as a measure of performance. The results of the study revealed that a rise in money supply has a negative and significant impact on performance of commercial banks in Japan. [53] and [54] studied monetary policy and commercial banks performance in Nigeria and Kenya respectively, with ROE as the dependent variable and found significant positive effect of money supply on performance of commercial banks. [55] also conducted a similar study in Ghana on the effects of bank size, inflation and money supply, which revealed that money supply, had a significant negative effect performance of commercial banks in Ghana as measured by on Return on Assets (ROA).

From the empirical literature reviewed, we note that several studies have investigated the link between monetary policy and bank performance by considering various predictor variables, including treasury bill rate, interbank rate, lending rate, money supply, bank capital and assets. Evidence reveals mixed findings, and there is limited empirical evidence on Uganda. This study contributes to the available literature on the related studies by investigating the role of monetary policy on commercial bank profitability in Uganda.

3. Methodology

3.1. Research Design

The study adopts a causal relationship research design. This quantitative approach was chosen because the study used data for individual units (banks) over a period of time. Panel data based multivariate regression analytical procedures are suitable to estimate the effect of common policies and interventions that cut across the units being studied [56].

3.2. Study Population and the Sample Selection

At the time of this study, there were a total of 24 registered commercial banks. These 24 commercial banks formed the study population. Out of the 24 commercial banks, 20 of these have been studied. The sample size considered in this study was therefore 20 commercial banks. This sample was studied because the banks within this sample were the commercial banks registered and were operating over the study period. Banks which opened after 2010 or were closed before 2018 were excluded because they had insufficient data.

As suggested by [57] when the population is small or when it is convenient to include the entire population in the study, then a census is appropriate because it eliminates type I and type II errors which are common in samples.

3.3. Data Type and Data Source

The study used secondary data compiled from published annual financial statements of 20 commercial banks, which constituted the unit of observation for the study, as well as data from the Uganda Bureau of Statistics (UBOS) and reports from Bank of Uganda [13].

3.4. Variable Selection to Include in the Empirical Model

The study relied on related studies by previous scholars and economic theory to identify the independent variables and the expected signs of their respective coefficients. Modifications were made where necessary to suit the study context. Data availability was also put into consideration.

3.4.1. The Dependent Variable

Return on Assets (ROA) was used as a measure of bank profitability, that is, the dependent variable was ROA. ROA was defined as bank profit before tax divided by the total assets, which is in line with Bank of Uganda regulations. It indicates management's ability to utilize banks resources to make profits [2].

3.4.2. The Independent Variables

Various monetary policy variables were included in the empirical model as independent variables. These variables include: natural logarithm of money supply (ms), the 91-day treasury bill rate (tbr), 7-day interbank rate (ibr), core inflation rate (coreinf) and weighted average lending rate (lr). In line with some existing studies (for instance [2] [5], we postulate that inflation and money supply will negatively influence bank profitability, while interbank rate, treasury bill rate and lending rate will positively influence profitability. Central Bank Rate (CBR) had a short time series in Uganda (starting in 2011) and so was excluded from the model. In line with [58] and [59], the 91-day Treasury bill rate, 7-day interbank rate and lending rate were included in the empirical model as independent variables to measure monetary policy pass through.

3.4.3. Control Variables

To guard against the possibility of under fitting the empirical model, the study included control variables in the model, which included: bank total assets (ta), bank capital ratio (capitalr), bank loans (loans) and bank's holdings of government securities (securities). Empirical results on the bearing of bank assets on bank profitability are mixed and therefore, we predict an indeterminate link between bank assets and bank profitability. On the other hand, some studies support a positive link between capitalization, securities, loans and bank profitability [15] [8] and we therefore postulate that these variables have a positive influence on bank profitability.

The model variables and their respective expected signs are summarized in the table below.

3.5. Specification of the Empirical Model

To test the relationship between monetary policy and bank profitability, the study formulated a linear regression model with dynamic specification, considering the dynamic nature of bank variables and the tendency for bank profitability to be serially correlated [2] [20] [63], the study included a lagged dependent variable and the empirical model was specified as a dynamic panel model of the form;

$$y_{it} = \delta + \theta y_{it-1} + \sum_{l=1}^{m} \beta_l Z_{lt} + \sum_{j=1}^{n} \alpha_j X_{jt} + v_i + u_{it} \quad (1)$$

where: y is the variable under study (*i.e.* bank profitability), θy_{it-1} is the lagged dependent variable, Z represents the monetary policy variables, X represents control variables, δ is a constant term, v_i is the unobserved bank-specific effect, u_{it} is the idiosyncratic error and subscript t is the time indicator.

In a typical linear dynamic equation such as (1), y_{it} is a function of μ_i. It immediately follows that y_{it-1} is also a function of μ_i. Additionally, there are some regressors in X_{jt} (for instance banks total assets) which are endogenously determined). The endogeneity of some regress or in (1) as well the correlation between the lagged dependent variable and the time-invariant country-specific

Table 1. Model variables, notations and expected signs.

Variable	Definition	Notation	Expected sign	Reference
Dependent Variable				
Return on Assets	Bank profit before tax divided by the total assets	roa	−/+	[2] [8]
Independent variables				
7 Day Interbank Rate	Weighted Average Rate at which banks borrow in the interbank market	ibr	+	[5] [21]
91 Day Treasury Bill Rate	Weighted Average Rate for treasury Bills of 91 days tenor.	tb	+	[2] [20]
Money supply	Money supply M2 (base money + shilling deposits)	ms	−	[52] [53]
Lending Rate	Weighted Average rate for bank loans.	lr	+	[27] [28]
Core Inflation	Percentage change in CPI	coreinf	−	[16] [8]
Control Variables				
Total Assets	Total assets of each bank in the sample.	ta	+	[8] [16] [60]
Capital/Assets ratio	Total capital as a share of assets of each bank in the sample.	capitalr	+	[15] [61]
Total Loans	Total loans of each bank in the sample.	loans	+	[15] [62]
Total Securities	Total government securities held by each bank in the sample.	securities	+	[20] [2]

Source: Compiled by the authors.

effects renders the OLS estimator biased and inconsistent. We thus estimate the empirical model by the [64] system generalized method of moments (SGMM) estimator which corrects for the endogeneity of regressors and caters for time effects. The SGMM undertakes the difference generalized method of moments (DGMM) and augments it through the introduction of additional assumptions which generate an additional set of moment conditions to leverage.

Consider the following generalised linear dynamic panel model:

$$y_{i,t} = \rho y_{i,t-1} + x'_{i,t}\beta + \mu_{i,t} + \upsilon_{i,t};\ \upsilon_{i,t} \sim iid\left(0, \delta_{\upsilon}^{2}\right) \tag{2}$$

where $y_{i,t}$ is the depedent variable, $y_{i,t-1}$ is the first lag of the dependent variable, μ_i represents the bank-specific effects, γ_t is the time dummy that captures uncertain shocks, $\upsilon_{i,t}$ is the idiosyncratic error term and $x'_{i,t}$ is the vector of predictor variables. In (2), the strict exogeneity assumption of static panel models such as Fixed Effects (RE), Random Effects (FE) and Between Effects (BE) is violated, in a sense that one of the regressors, the lagged dependent variable in is correlated with the past values of the idiosyncratic error term. In other words,

$$E\left(\upsilon_{i,t} \mid \mu_{i,t}, X, y_{i,s-1}, \forall s = 1, \cdots, T\right) \neq 0 \tag{3}$$

In effect, the weaker condition of zero contemporaneous correlation of the regressors with the composite error term ($\mu_{i,t} + \upsilon_{i,t}$) is also violated. The composite error terms are also serially correlated due to time-invariant panel specific unobserved effect. The omission of the unobserved effect in the X-matrix breeds another problem of endogeneity. The SGMM addresses all these problems by use of Instrumental variable (IV) of some form.

First consider the DGMM. The DGMM uses the first difference in (2) to eliminate the unobserved effect as follows:

$$\Delta y_{i,t} = \Delta\rho y_{i,t-1} + \Delta x'_{i,t}\beta + \Delta\varepsilon_{i,t} \tag{4}$$

where $\varepsilon_{i,t} = \left(\mu_{i,t} + \upsilon_{i,t}\right)$. First differencing however results in a negative correlation between the differenced, lagged dependent variable and the differenced idiosyncratic error term. There is thus still a need to use an IV estimation strategy. IV estimators have been earlier proposed by [65] as they are consistent with $N \to \infty$ and finite T. Sequential exogeneity and zero serial and cross-section correlation of $\varepsilon_{i,t}$ implies that the following moment conditions hold:

$$E\left(y_{i,t-s}\Delta\varepsilon_{i,t}\right) = 0,\ \forall i, t \text{ and } s = 2, \cdots, \infty \tag{5}$$

The moment conditions use the properties of the instruments: $y_{i,t-s}; s \geq 2$ to be uncorrelated with the future errors $\varepsilon_{i,t}$ and $\varepsilon_{i,t-1}$. An increasing number of of moment conditions is obtained for $t = 3, 4, \cdots, T$. We then define the $(T-2) \times 1$ vector:

$$\Delta\varepsilon_i = \left[\left(\varepsilon_{i,3} - \varepsilon_{i,2}\right), \cdots, \left(\varepsilon_{i,T} - \varepsilon_{i,T-1}\right)\right]' \tag{6}$$

and a $(T-2) \times (T-2)$ matrix of instruments as:

$$Z_i' = \begin{bmatrix} y_{i,1} & y_{i,1} & y_{i,1} & \cdots & y_{i,1} \\ 0 & y_{i,2} & y_{i,2} & \cdots & y_{i,2} \\ 0 & 0 & y_{i,3} & \cdots & y_{i,3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \cdots & y_{i,T-2} \end{bmatrix} \tag{7}$$

Essentially, the past levels of the dependent variable act as instruments for the current first differences of the dependent variable. Also, the exogenous regressors are included in the model as additional instruments, and the additional moment conditions can be formulated such that:

$$E\left(X_{i,s}\varepsilon_{i,t}\right) = 0; \forall s,t\,; \ \left(X_{i,s}\Delta\varepsilon_{i,t}\right) = 0 \tag{8}$$

for strictly exogenous regressors, and;

$$E\left(X_{i,s}\varepsilon_{i,t}\right) = 0; \forall s \le t\,; \ \left(X_{i,t-j}\Delta\varepsilon_{it}\right) = 0;\ j = 1,2,\cdots,t-1 \tag{9}$$

for predetermined regressors. We can stack these moments up and then apply GMM, which removes the endogeneity bias and omitted variable bias arising from presence of endogenous regressors and omitted variable in the empirical model.

The S-GMM undertakes the D-GMM and augments it through the introduction of additional assumptions which generate an additional set of moment conditions to leverage. The additional assumption is that:

$$E\left[\Delta y_{i,t-s}\left(\mu_{i,t} + \upsilon_{i,t}\right)\right] = 0; \forall i,t \quad \text{and} \quad s = 1,2,\cdots,\infty \tag{10}$$

and the set of instruments to y is composed of blocks that look like:

$$Z_i' = \begin{bmatrix} 0 & \Delta y_{i,2} & 0 & 0 & \cdots \\ 0 & 0 & \Delta y_{i,3} & 0 & \cdots \\ 0 & 0 & 0 & \Delta y_{i,4} & \cdots \\ \vdots & \vdots & \vdots & \vdots & \ddots \end{bmatrix} \tag{11}$$

and only one lag of y is used for each period as instrumenting variable. The S-GMM requires that the lagged changes in the dependent variable are valid instruments in the level equation. If all the assumptions hold, the S-GMM achieves greater efficiency than D-GMM.

In consideration of the models explained in (1)-(11), we specify an empirical model in form of a dynamic panel model that controls for endogeneity bias and time effects as follows:

$$\begin{aligned} roa_{it} = {} & \delta + \theta_1 roa_{it-1} + \alpha_1 ibr_{it} + \alpha_2 tbr_{it} + \alpha_3 logms_{it} + \alpha_4 lr_{it} + \alpha_5 coreinf_{it} \\ & + \alpha_6 logta_{it} + \alpha_7 capitalr_{it} + \alpha_8 logloans_{it} + \alpha_9 logsec_{it} + v_i + \gamma + u_{it} \end{aligned} \tag{12}$$

where: roa_{it} is the return on assets (bank profitability),

δ is a constant term,

$\theta_1 roa_{it-1}$ is the coefficient of the lagged dependent variable,

$\alpha_1 ibr$ is the coefficient of 7-day interbank rate,

$\alpha_2 tbr$ is the coefficient of 91-day treasury bill rate,

$\alpha_3 logms$ is the coefficient of natural logarithm of money supply,

$\alpha_4 lr$ is the coefficient of the lending interest rate,

$\alpha_5 coreinf$ is the coefficient of core inflation rate,

$\alpha_6 logta$ is the coefficient of natural logarithm of bank total assets,

$\alpha_7 capitalr$ is the coefficient of capital ratio of each bank,

$\alpha_8 logloans$ is the coefficient of natural logarithm of bank total loans,

$\alpha_9 logsec$ is the coefficient of natural logarithm of bank's holdings of government securities.

v_i is the unobserved bank-specific effect,

γ is a time dummy that captures shock and time effects, and,

u_{it} is the idiosyncratic error term.

3.6. Data Analysis

The Data was processed and analyzed using STATA statistical package, version 14.

3.6.1. Descriptive Statistics

First, the data were cleaned by checking for missing values and outliers. Descriptive statistics were summarized to provide a general description of the data characteristics. This helped to ensure that the data was good for estimation, otherwise it would produce misleading results. In particular, a summary of the mean, minimum, maximum and standard deviation values was computed.

3.6.2. Diagnostic Tests

Panel regression-based diagnostic tests were conducted to ensure that the data behaves well, and that estimates that are robust are reported. These tests included: panel unit root tests, panel cointegration tests, multicollinearity tests, endogeneity test serial correlation tests and test for validity of instruments.

3.7. Selection of Model Estimation Procedures

Given the dynamic specification of the model in this panel study, estimators like random effect (RE), OLS and fixed effect (FE) could not apply, because these estimators would yield biased and inconsistent estimates. One potential problem is the dynamic effects of bank profitability [8] which implies that the FE estimator would be biased since the lagged variable is correlated with the previous periods' error term. Another potential problem is endogeneity [66], which would make the estimators biased and inconsistent. For example, bank profitability could have an impact on the balance sheet items in the regression as well as on monetary policy decisions.

This study addressed the above problems by implementing a two-step dynamic System Generalized Method of Moments (S-GMM) panel estimator, which adjusts for the endogeneity bias and corrects for omitted variable bias that is usually due to time-invariant heterogeneity effect across banks. S-GMM is more efficient than the one step Difference GMM (DGMM) estimator developed

by [67] (Arellano and Bond, 1991) which is inefficient when applied to panel data with small T and with weak instruments. Moreover, DGMM performs poorly with persistent series, because as persistency increases, lagged levels become less correlated with first differences and thus become weak instruments [68].

As proposed by [69] and [64], S-GMM, estimates two equations, the first equation in first differences in order to eliminate specific effect components and the second in levels where lagged regressors are used as instruments. It is designed for studies with small T and large N panels (i.e studies with few time periods and many individuals), and thus fits well with the current study. It improves the accuracy of the estimates and allows for inclusion of other instruments that are not regressors to improve model estimates. In this study, we use the instruments suggested in [64]: exogenous variables, transformed in first differences, are instrumented by themselves; endogenous variables (also transformed in first differences), by their lags in levels.

3.8. Empirical Tests of Hypotheses

The hypotheses in this study were tested as follows:

H_{01}: ***Interbank rate has no effect on bank profitability in Uganda***: This hypothesis was tested by looking at the p-value associated with $\hat{a}_1$ in Equation (2). The null hypothesis will not be rejected if the associated p-value > 0.05.

H_{02}: ***Treasury bill rate has no effect on bank profitability in Uganda***: This hypothesis was tested by looking at the p-value associated with $\hat{a}_2$ in Equation (2). The null hypothesis will not be rejected if the associated p-value > 0.05.

H_{03}: ***Lending rate has no effect on bank profitability in Uganda***: This hypothesis was tested by looking at the p-value associated with $\hat{a}_4$ in Equation (2). The null hypothesis will not be rejected if the associated p-value > 0.05.

H_{04}: ***Money Supply has no effect on bank profitability in Uganda***: This hypothesis was tested by looking at the p-value associated with $\hat{a}_3$ in Equation (2). The null hypothesis will not be rejected if the associated p-value > 0.05.

H_{05}: ***Core Inflation rate has no effect on bank profitability in Uganda***: This hypothesis was tested by looking at the p-value associated with $\hat{a}_5$ in Equation (2). The null hypothesis will not be rejected if the associated p-value > 0.05.

4. Results

4.1. Descriptive Statistics on all the Variables

Table 2 shows the key descriptive statistics on the variables in the empirical model.

Return on Assets (roa). This is the dependent variable under study. The descriptive statistics in Table 2 indicate that Return on Assets for all the 20 banks over the 9-year period had an average mean of 0.985%. The minimum value for Return on Assets was −12.76%, recorded in 2010, while the maximum was 6.46% in the year 2012. There is a big variance indicating that some banks are highly

Table 2. Descriptive statistics of all variables in the model (variables are in levels).

Explanatory Variables	Obs N = 20, T = 9	Mean	Std. Dev.	Min	Max
return on assets	180	0.985	3.439	−12.758	6.458
lending rate	180	22.449	2.335	19.714	26.706
91-day treasury bill rate	180	12.716	4.968	7.967	22.890
7-day interbank rate	180	13.240	5.844	6.280	27.420
core inflation	180	6.335	5.891	1.970	22.341
money supply	180	11,416.39	3104.0	7397.649	16,621.90
total assets	180	910.40	1023.6	12.840	5423.371
total loans	180	430.81	491.65	3.3	2612.6
total government securities	180	193.65	225.9	0.5	960.1
capital ratio	180	19.435	10.479	6.1	67

Source: Authors' computations and compilation based on raw data.

profitable while others are loss making, which suggests high variability of the data.

Lending rate (lr): The results in Table 2 indicate that the mean value of the lending rate over the 9-year period of study was approximately 22.45%, its minimum value was approximately 19.71% in 2010 and its maximum value was approximately 26.7% recorded in 2011. The variance is small, showing that it is stable and suggesting that the variable exhibits some kind of normal distribution.

91-day Treasury bill rate (tbr): As shown in Table 2 the mean of the variable "tbr" was approximately 12.72% over the 9-year period of study, its minimum value was approximately 7.97% in 2010, with its maximum value of approximately 22.89% in 2011. The small variance from the mean suggests that the variable exhibits normal distribution.

Core Inflation (coreinf): The mean value of "coreinf" over the 9-year period of study was approximately 6.34%, its minimum value was approximately 1.97% recorded in 2010 and its maximum value was approximately 22.34% recorded in 2011. The large variance indicates that core inflation varies widely in some years.

Money supply (ms): The descriptive statistics in Table 2 indicate that the mean value of "ms" over the 9-year period of study was approximately UGX 11,416.39 billion, its minimum value was approximately UGX 7397.649 billion (recorded in the year 2010), its maximum value was approximately UGX 16,621.90 billion in 2018. It has small variance which is less than 0.5 suggesting that it exhibits some normal distribution.

Total Assets (ta): The mean value of "ta" over the 9-year period of study was approximately UGX 910.40 billion, its minimum value was approximately UGX 12.84031 billion in the year 2010 and its maximum value was approximately UGX 5423.371 billion in 2017. The big variance is because some banks are very small in terms of assets while others are very big, with four banks accounting of

50% of the total industry assets [13].

Total Loans (loans): The mean value of "loans" over the 9-year period of study was approximately UGX 430.8 billion, its minimum value was approximately UGX 3.3 billion in the year 2010 and its maximum value was approximately UGX 2612.6 billion in 2018. The large variance points to disparity in bank's loan books and business models.

Total Securities (securities): The mean value of "securities" over the 9-year period of study was approximately UGX 193.6 billion, its minimum value was approximately UGX 0.5 billion in the year 2011 and its maximum value was approximately UGX 960.1 billion in 2017. The large variance indicates the difference in bank's business models with some banks choosing to invest more in securities.

Capital ratio (capitalr): The mean value of "capital" over the 9-year period of study was approximately 19.43%, its minimum value was approximately 6.1% and its maximum value was approximately 67%. The variation in capital indicates differences in funding structures among banks, with risk averse banks having more capital, while loss making banks and risk taking banks having less capital as a share to total assets.

4.2. Diagnostic Tests

4.2.1. Test for Multicollinearity

To test for multicollinearity in the model, the study first generates a correlation matrix between the independent variables and then estimates the variance inflation factor (VIF) for each of the independent variables. The results are indicated Table 3(a) and Table 3(b) respectively.

[70] Gujarati and Porter (2009) suggest that a very high correlation between independent variables is $r = \pm 0.8$. Based on this threshold, the correlation matrix shows that there is strong and statistically significant correlation between "lr" and "IBR" ($r = 0.809$, $p = 0.000$); between "tbr" and "ibr" ($r = 0.942$, $p = 0.000$); between "IBR" and "coreinf" ($r = 0.920$, $p = 0.000$); between "logta" and "logloans" ($r = 0.808$, $p = 0.000$); between "logta" and "logsec" ($r = 0.823$, $p = 0.000$).

To further establish which of these variables may cause a multicollinearity problem in the regression model, the study run the variance inflation factor (VIF) for each independent variable in the empirical model. Table 3(b) and Table 3(c) show the VIF results.

As indicated in Table 3(b), the variables: "IBR", "LOGLOANS", "TBR", "LOGTA", "LOGSECURITIES" and "COREINF" have VIFs in excess of 10. The implication is that if they are included *together* as independent variables in the model, there would be a multicollinearity problem. Among the monetary policy variables, we removed the variable "ibr" on the basis of the highest VIF. We further removed variables "logloans" and "logsecurities" and retained "logta" because "logta" acritical independent variable in the bank profitability model which captures bank size according to [2] and [71]. We estimate the VIFs of the remaining variables in the model and we get the following results.

Table 3. (a) Pairwise correlations between the independent variables; (b) VIFs for the coefficients of independent variables; (c) VIFs for the independent variables without "LOGLOANS", "IBR" and "LOGSECURITIES".

(a)

	1	2	3	4	5	6	7	8	9
1	1								
2	0.762**	1							
3	0.809**	0.942**	1						
4	0.717**	0.726**	0.920***	1					
5	−0.413**	−0.175**	−0.274**	−0.465**	1				
6	−0.201**	−0.034*	−0.058	−0.123**	0.279**	1			
7	0.025	0.023	0.024	−0.008**	0.071	0.210**	1		
8	0.013	−0.012	−0.022	−0.076*	0.206	0.808**	−0.218**	1	
9	−0.531**	−0.065**	−0.111	−0.185**	0.304**	0.803**	−0.178**	0.828**	1

**means that the estimate t is statistically significant at 0.01 level; 1 = lr; 2 = tbr; 3 = ibr; 4 = coreinf; 5 = logms; 6 = logta; 7 = capitalr; 8 = logloans; 9 = logsec.

(b)

Explanatory variables	VIF	1/VIF
interbank rate	115.93	0.0086
logarithm of total assets	44.39	0.0225
treasury bill rate	32.63	0.0306
core inflation	31.02	0.0322
logarithm of total loans	24.18	0.0413
logarithm of total securities	10.18	0.0982
lending rate	7.26	0.1378
logarithm of money supply	5.75	0.1738
First lag of return on assets	2.05	0.4882
Capital ratio	1.20	0.8347
Mean VIF	**27.46**	

Source: Generated by the authors.

(c)

Explanatory variables	VIF	1/VIF
interbank rate	6.84	0.1463
treasury bill rate	5.33	0.1875
core inflation	4.86	0.2056
logarithm of money supply	4.21	0.2372
logarithm of total assets	1.81	0.5511
first laog of return on assets	1.75	0.5707
capital ratio	1.18	0.5844
Mean VIF	**3.71**	

Source: Generated by the authors.

From Table 3(c), all the remaining independent variables have a VIF which is less than 10. The implication is that inclusion of the independent variables: "CAPITALR", "LR", "LOGTA", "TBR", "COREINF", "LOGMS", and "first lag of ROA" in a linear dynamic panel regression model for empirical analysis does not result in a multi-collinearity problem.

4.2.2. Stationarity Tests on all Model Variables

The study conducted stationarity tests on model variables, using the [72] panel unit root test, in order to ascertain the level of integration of the variables. The results are shown in Table 4.

The panel unit root test results in Table 4 show that variables "lr", "capitalr", "tbr" and "coreinf" are stationary in levels, suggesting that they are integrated of order zero I (0). In addition, variables; "roa", "logta" and "logms" have p-values > 0.05 in levels. The implication is that they are non-stationary in levels but become stationary after first differencing. This indicates that they are integrated of order one, I (I).

4.2.3. Panel Cointegration Test

The study employed the [73] co-integration test and the results are shown in Table 5.

The ADF t-statistic of the [73] co-integration test, as shown in Table 5, rejects the null hypothesis of no co-integration at 1 percent level of significance ($p = 0.000 < 0.05$). The co-integration test results therefore suggest that there is sufficient

Table 4. IPS stationarity test results on model variables.

Model Variables	Variable in levels		Variable in first difference		Order of integration
	W-t bar Statistic	*p*-value	W-t-bar Statistic	*p*-value	
return on assets	−1.0368	0.1499	−6.6057 ***	0.0000	I (1)
lending interest rate	−2.2813**	0.0113	-	-	I (0)
treasury bill rate	−7.5633***	0.0000	-	-	I (0)
core inflation	−11.1917***	0.0000	-	-	I (0)
logarithm of money supply	−1.0459	0.1478	−5.3316***	0.0000	I (1)
logarithm of total assets	0.4135	0.1225	−0.012***	0.0000	I (1)
capital ratio	−1.689**	0.035			I (0)

Source: Authors' compilation; **means that the estimate is statistically significant at 5 percent level of significance; ***means that the estimate is statistically significant at 1 percent level of significance.

Table 5. Results of the cointegration test on model variables.

	t-Statistic	Prob.
ADF	−5.044	0.0000
Residual variance	0.478	
HAC variance	0.123	

Source: Generated and compiled by the authors.

evidence of presence of long run equilibrium relationships between return on assets (roa) and its determinants.

4.2.4. Endogeneity Tests on Independent Variables

Following previous studies for instnace [2] [15] that have found that bank specific variables are characterized by endogeneity, the study conducted an endogeneity test for each independent variable in the in the empirical model using the Sargan C-statistic. Table 6 gives a summary of the results.

At 5 percent level of significance, the test does not reject the null hypotheses that variables: "lr", "ibr", "coreinf", "logms" and "logcapital" are exogenous. on the other hand, "logta" has a p value < 0.05, so we reject the null hypothesis and conclude that the variable is endogenous at 5 percent level of significance. This suggests that it is an endogenous regressor in the model.

4.3. The Regression Estimates of the Empirical Model

As previously stated, the study estimated the empirical model using System GMM technique following related studies (such as [2] [74]) that show endogeneity in bank variables and reverse causality between return on assets and bank total assets. Table 7 gives a summary of the results of the empirical model estimates from the current study.

We interpret the estimates in Table 7 following the study hypotheses as follows.

H_{01}: ***Interbank rate has no effect on bank profitability in Uganda:***

The variable "interbank rate" was removed from the empirical model because it had a high variance inflation factor. Its inclusion in the final model would have caused multicollinarity problem in the model. It was therefore not possible to test the hypothesis on its effect on return on assets in the final model.

H_{02}: ***Treasury bill rate has no effect on bank profitability in Uganda*:**

The regression results in Table 7 show that the estimated coefficient on the treasury bill rate (TBR) is positive but statistically insignificant at 5 percent level (coef. = 0.0532; p = 0.260). Thus we accept the hypothesis and conclude that variations in the 91-day treasury bill rate do not have a significant causal effect

Table 6. Results of the endogeneity test.

Null hypothesis being tested	Sargan	*P* > Chi.Sq
Ho: "lr" is exogenous	1.770	0.1834
Ho: "tbr" is exogenous	3.163*	0.0753
Ho: "coreinf" is exogenous	0.126	0.7226
Ho: "logms" is exogenous	0.278	0.5979
Ho: "logta" is exogenous	6.576**	0.0103
Ho: "capitalr" is exogenous	0.094	0.7592

Source: Compiled by the author; *means that the estimate is statistically significant at 10 percent level of significance; **means that the estimate is statistically significant at 5 percent level of significance.

Table 7. Summary of the estimates of the empirical model.

Dependent Variable: Return on Assets **Estimation method: two-step System GMM**			
Independent Variables	**Coef.**	**Corrected/robust Std. Err.**	***p*-value**
First lag of return on assets	0.2780***	0.1173	0.009
Treasury bill rate	0.0532	0.4725	0.260
Lending interest rate	0.3666**	0.1782	0.040
Core inflation	−0.2490**	0.1271	0.050
Logarithm of money supply	−0.3233	1.282	0.801
Logarithm of total assets	1.3917***	0.4373	0.001
Capital ratio	0.0974***	0.0334	0.004
Constant	−4.378	14.330	0.309
Diagnostic tests			
Arellano-Bond test for AR(1) in first differences:	z = −2.87***; Pr > z = 0.004		
Arellano-Bond test for AR(2) in first differences:	z = −1.51; Pr > z = 0.132		
Sargan test of overid. Restrictions:	Chi-Sq. = 108.55*; Prob > chi2 = 0.051		
Hansen test of overid. Restrictions:	Chi-Sq. = 39.85; Prob > chi2 = 0.192		
Difference-in-Hansen (iv):	Chi-Sq. = 12.78; Prob > chi2 = 0.991		
Difference-in-Hansen(gmm):	Chi-Sq. = 9.40; Prob > chi2 = 0.152		
Wald Chi-square = 112.87***; Prob > chi2 = 0.000			
Standard instruments for first differences equation: D. (logcapital logloans logsecurities 2010b. year 2011. year 2012. year 2013. year 2014. year 2015. year 2016. year 2017. year 2018. year) *GMM-type Standard instruments for first differences*: L (1/8). logta *Standard instruments for levels equation*: logcapital logloans logsecurities 2010b. year 2011. year 2012. year 2013. year 2014. year 2015. year 2016. year 2017. year 2018. year *GMM-type for levels equation*: D.logta			

Source: Compiled by the authors. *means that the estimate is statistically significant at 10 percent level of significance; **means that the estimate is statistically significant at 5 percent level of significance; ***means that the estimate is statistically significant at 1 percent level of significance

on returns on assets of commercial banks in Uganda.

H_{03}: *Lending interest rate has no effect on bank profitability in Uganda*:

The regression estimates in Table 7, show that the estimated coefficient on the lending interest rate variable is positive and statistically significant at 5 percent level (coef. = 0.366; $p = 0.040$). Therefore, we conclude that lending interest rates are important predictors of return on assets in Uganda's commercial banks. This indicates that a one percent increase in the lending interest rate increases a bank's return on assets by approximately 0.366 percent, holding other factors constant.

H_{04}: *Money Supply has no effect on bank profitability in Uganda*:

The estimated coefficient on the logarithm of money supply is negative and statistically insignificant at 5 percent level of significance (coef. = −0.323; p = 0.801). Thus we accept the hypothesis, which suggests that changes in money supply do not have a significant causal effect on returns on assets of commercial banks in Uganda.

H_{05}: *Core Inflation rate has no effect on bank profitability in Uganda*:

The regression estimates from Table 7 show that the estimated coefficient on core inflation is statistically significant at 5 percent level of significance (coef. = −0.249; $p = 0.050$). This suggests that rising core inflation has a significant negative causal effect on return on assets in Uganda's commercial banks. This indicates that a one percent increase in core inflation reduces a bank's return on assets by approximately 0.249 percent, holding other factors constant.

Robustness of the Model Estimates

The study checks for the robustness of the regression estimates by performing the following relevant post estimation diagnostic tests after model estimation.

Wald Chi-square statistic: This statistic tests the null hypothesis that all the parameters of the model in Equation (4) are simultaneously equal to zero. The estimated Wald Chi-square statistic of 112.87 with $p = 0.000$) is statistically significant at 5 percent level. Thus we reject the null hypothesis and conclude that the model is well specified and that monetary policy, the included control variables as well as the lag of return on assets, have a combined effect that is non-zero(*i.e.* that is statistically significant) on bank profitability in Uganda.

AR* (1) *and AR* (2) *tests: As shown in Table 7, the hypothesis of non-existence of first-order autocorrelation between first residual differences *AR* (1)) (−1.55, $p = 0.121$) and second order serial correlation *AR* (2) (−1.38, $p = 0.166$) is not rejected (statistically insignificant p-value at 5 percent level). This means that the assumption of independence of residual differences was met and the estimates are free from serial correlation of order one and order two.

Hansen Test: This test verifies the validity of the instruments [68] in both the first difference equation (gmm) and in the levels equation (iv). Table 4.8 shows that the value of the Hansen J test exceeds the threshold ($p > 0.05$), so we conclude that all moment conditions are met and all the instrumental variables are accepted, valid and appropriate. On the basis of the conducted tests it can be concluded that the estimated model satisfies all diagnostic tests.

5. Discussion of Results

Treasury Bill rate and bank profitability: Model estimates showed that there is a positive but statistically insignificant relationship between the 91-day treasury bill rate and profitability of banks in Uganda, implying that changes in the 91-day treasury bill rate are not important predictors of bank profitability. Our study results are consistent with the findings from other related studies on Uganda, for instance, [59] who found that the 91-day Treasury bill rates became less effective in transmitting the pass through of the monetary policy rate to the

economy after Uganda implemented the inflation targeting light (ITL) framework in 2011. However, our findings contradict the findings of other scholars on the related subject, for instance, our study results do not tally with the findings of [2] and [20] to mention but a few, who have established that various short term market rates influence bank profitability.

Core Inflation and bank profitability: Model estimates showed that core inflation exerts a negative and significant causal effect on bank profitability. This result means that as core inflation rises, bank's return on assets reduces in Uganda's commercial banks. This finding is consistent with monetary theory which postulates that rising inflation reduces real interest income, leads to a deterioration in asset quality [16], and erodes inflation adjusted earnings. They are also in agreement with other studies including [49] who found a non-linear, significant negative relationship between inflation and banking sector profitability in the MENA region and [75] who found that the inflation rate negatively affects bank lending in Ghana.

Money supply and bank profitability: The estimated coefficient on money supply variable was statistically insignificant at 5 per cent level. This suggests that changes in money supply do not have a significant causal effect on returns on assets of commercial banks in Uganda. This finding is consistent with monetary theory, whereby as countries move from monetary targeting to inflation targeting, the interest channel of monetary policy becomes more effective relative to the other channels [6]. Our study results in this respect is inconsistent with the results of [51] who showed that in Jordanian Banks, the effect of growth of money supply on Return on Assets was positive and significant.

Lending interest rate: Estimates showed a positive and statistically significant coefficient on lending interest rates. This suggests that variations in lending interest rates have a significant positive causal effect on return on assets in Uganda's commercial banks. The implication of this result is that changes in monetary policy transmitted to lending interest rates influence bank profitability and this suggests the presence of the interest rate channel of the monetary policy transmission mechanism. In Uganda, all loans are on variable interest rates and thus monetary policy changes are passed through to customers. For example, BOU reduced the policy rate from 23 percent in December 2011 to 9.5 percent by December 2018, and correspondingly, the weighted average lending interest rate reduced from 29.5 percent to 19.5 percent [13]. These actions appear to have affected bank profitability. These findings are in agreement with the [9] conjecture/theory which contends that banks benefit from increases in interest rates, as well as [27] in India, [28] in Nigeria who found that lending rates have a positive relationship with banks' profits and [25] who found a positive relationship between the interest rate levels and bank profitability in Kenya.

Bank profitability persistence: The estimated coefficient on the first lag of the dependent variable (coef. = 0.2780; $p = 0.009$) is positive and statistically significant at 5 percent level of significance. This confirms the dynamic character of

the panel model and also indicates that return on assets in the past year has a significant positive causal effect on return on assets of the banks in the current period, and this suggests that there is persistence of profitability among Ugandan banks. The existence of persistence of bank profits indicate that there are some impediments to market competition, which allows abnormal profits to persist over time among a few banks, while convergence has been slow. There is thus a need for policymakers to implement measures to enhance market competition and for small banks to pursue profitability first rather than growth.

6. Conclusion

Overall, the study finds that monetary policy as measured by variables such as lending interest rates and core inflation are significant predictors of commercial bank profitability in Uganda, the former having a positive influence while the latter having a negative influence. Findings from this study further show that the other monetary policy variables such as money supply and treasury bill rate do not influence commercial bank profitability in Uganda. The interbank rate monetary policy variable was removed from the empirical model because its inclusion would cause high multicollinearity. The study results suggest that monetary policy through its link with lending interest rates affects banks' profitability and net interest income as it increases bank interest margins and returns from maturity transformation. It also implies that interest rate pass through to lending rates may be working. However, the pass through of policy rate through the 91-day treasury bill rate appears to have weakened. A more efficient monetary policy transmission will ensure better interest rates pass through to banks and enhance profitability. The findings also show that an increase in inflation will also negatively affect the cost and revenue functions of the bank and therefore low and stable inflation is key for bank profitability.

7. Policy Recommendations

The following are the key policy recommendations the study derives from the analysis:

1) The finding that the 91-day treasury bill rate is not significant in influencing the profitability of banks suggests that the central bank should conduct regular studies to identify other market rates that are effective in transmission of monetary policy.

2) The finding that variations in the lending interest rates affect bank profitability significantly suggests that, to ensure a sustainable strong banking sector, the central bank should ensure that monetary policy transmission is efficient in line with macroeconomic conditions. There is also need for the central bank to monitor the micro-dynamics of individual bank behavior and continuously assess and enhance the efficacy of the interest rate pass through to the lending channel of monetary policy transmission mechanism. This will improve the availability of credit for corporate and private investment and enhance bank

profitability.

3) Rising inflation constraints bank profitability and therefore, to ensure and maintain a sound financial stance in Uganda, the central bank and government should strive to achieve and maintain lower levels of core inflation through credible monetary and fiscal policy interventions.

8. Limitations of the Study and Areas for Further Research

We recognize the fact that the overall effect of monetary policy on bank profits will also depend on the impact of monetary policy on macroeconomic conditions. In particular, it will crucially hinge on the efficacy of monetary policy in boosting aggregate demand. Assessing this relationship has been beyond the scope of this study. In addition, this study considers commercial banks and thus the results from the study may not be used to assess the relationship ship between monetary policy and profitability in other financial institutions such as pension funds. In terms of interest rate pass through, the study only looked at the 91-day treasury bill rate. A look at other money market rates may yield different results. Future studies could also extend the analysis by looking at the effect of interest rate increases on banks by category *i.e.* small, medium and big banks, as well as other financial institutions such as pension funds and microfinance institutions.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Bundesbank, D. (2018) The Importance of Bank Profitability and Bank Capital for Monetary Policy. Deutsche Bundesbank Monthly Report. https://www.bundesbank.de/resource/blob/667588/bf422c75deafad8185444765bf3f722e/mL/2018-01-importance-of-bank-data.pdf

[2] Borio, C., Gambacorta, L. and Hofmann, B. (2015) The Influence of Monetary Policy on Bank Profitability. BIS Working Papers No. 514, Monetary and Economic Department, Bank for International Settlements, Basel.

[3] Fazio, D.M., Silva, T.C. and Tabak, B.M. (2018) Inflation Targeting and Financial Stability: Does the Quality of Institutions Matter? *Economic Modelling*, **71**, 1-15.

[4] Beck, T.R.L. and Loayza, N. (2000) Finance and the Sources of Growth. *Journal of Financial Economics*, **58**, 261-300. https://doi.org/10.1016/S0304-405X(00)00072-6

[5] Meshack, K.M. and Nyamute, W. (2016) The Effect of Monetary Policy on Financial Performance of the Commercial Banks Listed on the Nairobi Securities Exchange. *International Journal of Economics and Financial Issues*, **3**, 237-252.

[6] Mugume, A. (2011) Monetary Transmission Mechanisms in Uganda. BOU Working Paper, BOU, Kampala, Uganda. https://www.bou.or.ug/bou/bouwebsite/bouwebsitecontent/research/BoUworkingPapers/research/BouWorkingPapers/2011/Monetary_Transmission_Mechanisms_in_Uganda_BOU_version.pdf

[7] Bernanke, B. and Gertler, M. (1995) Inside the Black Box: The Credit Channel of Monetray Policy Transmission. *Journal of Economic Perspectives*, **9**, 27-48. https://doi.org/10.1257/jep.9.4.27

[8] Pervan, M., Pelivan, I. and Arnerić, J. (2015) Profit Persistence and Determinants of Bank Profitability in Croatia. *Economic Research-Ekonomska Istraživanja*, **28**, 284-298. https://doi.org/10.1080/1331677X.2015.1041778

[9] Samuelson, P. (1945) The Effect of Interest Rate Increases on the Banking System. *American Economic Review*, **35**, 16-27.

[10] Mishkin, F.S. (2013) The Economics of Money, Banking, and Financial Markets. 10th Edition, Pearson Education, New York.

[11] Bernanke, B. and Blinder, A.S. (2007) The Federal Funds Rate and the Channels of Monetary Transmission. *The American Economic Review*, **82**, 901-921.

[12] English, W.B. (2002) Interest Rate Risk and Bank Net Interest Margins. *BIS Quarterly Review*, **12**, 67-82.

[13] Bank of Uganda (2018) Financial Stability Report for June 2018, No. 10. https://www.bou.or.ug/bou/bouwebsite/bouwebsitecontent/FinancialStability/financial_stability/Rpts/All/Financial_Stability_Report_June-2018_final.pdf

[14] Udeh, S.N. (2015) Impact of Monetary Policy Instruments on Profitability of Commercial Banks in Nigeria : Zenith Bank Experience. *Research Journal of Finance and Accounting*, **6**, 190-206.

[15] Laeven, L., Ratnovski, L. and Tong, H. (2014) Bank Size and Systemic Risk. IMF Staff Paper, Washington DC. https://doi.org/10.2139/ssrn.2437729

[16] Abel, S., Hlalefang, K., Roux, P. and Mutandwa, L. (2018) A Review of the Banking Sector Profit Persistence. *International Journal of Economics and Financial Issues*, **8**, 54-63.

[17] Demirguc-Kunt, A. and Huizinga, H. (1999) Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence. World Bank Policy Research Working Paper No. 1900, World Bank Group, Washington DC. https://doi.org/10.1596/1813-9450-1900

[18] Bourke, P. (1989) Concentration and Other Determinants of Bank Profitability in Europe, North America and Australia. *Journal of Banking and Finance*, **13**, 65-79. https://doi.org/10.1016/0378-4266(89)90020-4

[19] Tan, Y.A. (2018) Bank Profitability and Bank Competition: Review of Literature and Directions of Future Research. https://ssrn.com/abstract=3258031 https://doi.org/10.2139/ssrn.3258031

[20] Kohlscheen, E., Murcia, A. and Contreras, J. (2018) Determinants of Bank Profitability in Emerging Markets. (BIS Working Paper No. 686), BIS, Basel.

[21] Nagayasu, J. (2003) The Term Structure of Interest Rates and Monetary Policy During a Zero Interest-Rate Period. IMF Working Paper, WP/03/208, IMF, Washington DC, 31 p. https://doi.org/10.5089/9781451874723.001

[22] Hancock, D. (1985) Bank Profitability, Interest Rates and Monetary Policy. *Journal of Money, Credit and Banking*, **17**, 189-202. https://doi.org/10.2307/1992333

[23] Hanweck, G. and Kilcollin T. (1984) Bank Profitability and Interest Rate Risk. *Journal of Economics and Business*, Elsevier, **36**, 77-84. https://doi.org/10.1016/0148-6195(84)90013-4

[24] Waweru, E. (2013) The Effect of Monetary Policy on Financial Performance of Commercial Banks in Kenya. Dissertation for Master of Business Administration Degree, University of Nairobi, Nairobi.

[25] Ngugi, R. and Kabubo, J.W. (1998) Financial Sector Reforms and Interest Rate Liberalization: The Kenya Experience. ERC Research Paper 72, African Economic Research Consortium, Nairobi.

[26] Enyioko, N. (2012) Impact of Interest Rate Policy and Performance of Deposit Money Banks in Nigeria. *Global Journal of Management and Business Research*, **12**, 1-9.

[27] Rao, P. (2006) Monetary Policy: Its Impact on the Profitability of Banks in India. *International Business & Economics Research Journal*, **5**, 15-22. https://doi.org/10.19030/iber.v5i3.3465

[28] Okoye, V. and Eze, R. (2013) Effect of Bank Lending Rate on the Performance of Nigerian Deposit Money Banks. *International Journal of Business and Management Review*, **1**, 34-43.

[29] Bridges, J.D., Gregory, M., Nielsen, S., Pezzini, A., Radia, A. and Spaltro, M. (2014) The Impact of Capital Requirements on Bank Lending. Bank of England Working Papers, Bank of England, London, 486. https://doi.org/10.2139/ssrn.2388773

[30] Jae-Joon, H. and Inhawn, S. (2017) Analysis of the Relationship between Interest Rate and Bank Profitability (in Korean). Working Papers 2017-32, Economic Research Institute, Bank of Korea, Seoul.

[31] Malik, M.F., Khan, S., Khan, M.I. and Khan, F. (2014) Interest rate and its effects on Bank's profitability. *Journal of Applied Environment and Biological Sciences*, **4**, 41-52.

[32] Obillo, A.M. (2015) The Relationship between Lending Interest Rate and Profitability of Commercial Banks in Kenya. Masters Dissertation, University of Nairobi, Nairobi.

[33] Mugabi, S.P. (2017) Interest Rate and Commercial Bank Profitability in Kenya. Masters Dissertation, University of Nairobi, Nairobi.

[34] Altavilla, C., Boucinha, M. and Peydró, J. (2018) Monetary Policy and Bank Profitability in a Low Interest Rate Environment. *Economic Policy*, **33**, 531-586. https://doi.org/10.1093/epolic/eiy013

[35] Katarikawe, M. and Musinguzi, P. (2000) Monetary Policy Frameworks in Africa: The Case of Uganda. Bank of Uganda Staff Papers, Kampala.

[36] Rehana, S. and Rizwana, S. (1998) The Profitability of the Banking Sector of Pakistan. PIDE-Working Papers, Pakistan Institute of Development Economics, Islamabad, Islamabad, 162. https://doi.org/10.1111/j.1540-6261.1981.tb01078.x

[37] Flannery, M.J. (1981) Market Interest Rates and Commercial Bank Profitability: An Empirical Investigation. *Journal of Finance*, **36**, 1085-1101.

[38] Ndagire, M.K. (2012) Investment in Loans and Treasury Bills and the Overall Profitability of Commercial Banks. Masters Dissertation, Makerere University, Kampala.

[39] Ogunbiyi, S.S. and Ihejirika, P.O. (2014) Interest Rates and Deposit Money Banks' Profitability Nexus: The Nigerian Experience. *Arabian Journal of Business and Management Review*, **3**, 133-140. https://doi.org/10.12816/0016525

[40] Rahman, S. and Serletis, A. (2009) The Effect of Inflation Uncertainty, Some International Evidence. *Journal of Economic Studies*, **36**, 541-550. https://doi.org/10.1108/01443580910992438

[41] Kim, D.H. and Lin, S.C. (2010) Dynamic Relationship between Inflation and Financial Development. *Macroeconomic Dynamics*, **14**, 343-364. https://doi.org/10.1017/S1365100509090312

[42] Mohammed, U., Danjuma M. and Mohammad, A. (2014) Conceptual Exposition of

the Effect of Inflation on Bank Performance. *Journal of World Economic Research*, **3**, 55-59.

[43] Miguel, A.T.Z., Martinez, F.V. and Preciado, V.H. (2018) Effects of Inflation on Financial Sector Performance: New Evidence from Panel Quantile Regressions. *Investigación Económica*, **77**, 94-129. https://doi.org/10.22201/fe.01851667p.2018.303.64156

[44] Cetin, H. (2019) Inflation and Bank Profitability: G20 countries Banks Panel Data Analysis. *MSIE Proceedings of the* 2019 *International Conference on Management Science and Industrial Engineering*, Phuket, May 2019,168-172.

[45] Tan, Y. and Floros, C. (2012) Bank Profitability and Inflation: The Case of China. *Journal of Economics Studies*, **39**, 675-696. https://doi.org/10.1108/01443581211274610

[46] Guru, B., Staunton, J. and Balashanmugam, B. (2002) Determinant of Commercial Bank Profitability in Malaysia. 12*th Annual Australian Finance and Banking Conference*, Sydney, 16-17 December 2002.

[47] Batsinda, G. and Shukla, J. (2019) Iinflation and Profitability of Commercial Banks in Rwanda: A Case Study of Bank of Kigali. *International Journal of Business and Management*, **14**, 35. https://doi.org/10.5539/ijbm.v14n10p35

[48] Huybens, E. and Smith, B. (1999) Inflation, Financial Markets and Long Run Real Activity. *Journal of Monetary Economics*, **43**, 283-315. https://doi.org/10.1016/S0304-3932(98)00060-9

[49] Ghazouani, S. (2004) Does Inflation Impact on Financial Performance in the MENA Region? *Journal of Banking and Finance*, **28**, 423-442.

[50] Bettencourt, M. (2010) Inflation and Financial Development: Evidence from Brazil. *Economic Modelling*, **28**, 91-99. https://doi.org/10.1016/j.econmod.2010.09.021

[51] Al-Qudah, A.M. and Jaradat, M.A. (2013) The Impact of Macroeconomic Variables and Banks Characteristics on Jordanian Islamic Banks Profitability: Empirical Evidence. *Journal of International Business Research*, **6**, 153-162. https://doi.org/10.5539/ibr.v6n10p153

[52] Nasserinia, A., Ariff, N. and Fan-Fah, C. (2014) Key Determinants of Japanese Commercial Banks Performance, *Pertanika Journal of Social Sciences & Humanities*, **22**, 17-38.

[53] Kimani, J. (2013) Assessment of Effect of Monetary Policies on Lending Behavior of Commercial Banks in Kenya. Masters Research Project, School of Business, Kenyatta University, Nairobi.

[54] Otalu, J.A., Aladesanmi, K.A. and Olufayo, M.B. (2014) Monetary Policy and Commercial Banks Performance in Nigeria: An Assessment of Credit Creation Role. *The International Journal of Business Management*, **2**, 45-51.

[55] Kwakwa, O.M (2014) Determinants of Performance of Commercial Banks in Ghana. Master's Thesis, Department of Mathematics Institute of Distance Learning, Kwame Nkrumah University of Science and Technology, Kabwe.

[56] Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research Methods for Business Students*. 5th Ed., Prentice Hall Pearsons, Education Ltd., Upper Saddle River.

[57] Kumar, R. (2012) Research Methodology: A Step by Step Guide. 3rd Edition, Sage, New Delhi.

[58] Opolot, J. (2013) Bank Lending Channel of Monetary Policy Transmission Mechanism in Uganda. Evidence from Panel Data Analysis. BOU Working Paper No. 01/2013, BOU, Kampla.

[59] Apaa, J. (2014) Interest Rate Pass through in Uganda. Bank of Uganda Working

Paper Series No. 02/2014, BOU, Kampala.

[60] Javaid, S., Anwar, J., Zaman, K. and Ghafoor, A. (2011) Determinants of Bank Profitability in Pakistan: Internal Factor Analysis. *Journal of Yasar University*, **23**, 3794-3804.

[61] Onuonga, S. (2014) The Analysis of Profitability of Kenya's Top Six Commercial Banks: Internal Factor Analysis. *American International Journal of Social Science*, **3**, 94-103.

[62] Kagecha, P. (2014) Bank performance: Does Bank Size Matter*?* Masters Dissertation, University of Nairobi, Nairobi.

[63] Garcia-Herrero, Gavila, A.S. and Santabarbara, D. (2009) What Explains the Low Profitability of Chinese Banks? *Journal of Banking and Finance*, **33**, 2080-2092. https://doi.org/10.1016/j.jbankfin.2009.05.005

[64] Blundell, R. and Bond, S. (1998) Initial Conditions and Moment Restrictions Dynamic Panel Data Models. *Journal of Econometrics*, **87**, 115-143. https://doi.org/10.1016/S0304-4076(98)00009-8

[65] Anderson, T.W. and Hsiao, C. (1982) Formulation and Estimation of Dynamic Models Using Panel Data. *Journal of Econometrics*, **18**, 570-606. https://doi.org/10.1016/0304-4076(82)90095-1

[66] Hasanov, F.J., Bayramli, N. and Al-Musehel, N. (2018) Bank-Specific and Macroeconomic Determinants of Bank Profitability: Evidence from an Oil-Dependent Economy. *International Journal of Financial Studies*, **6**, 78. https://doi.org/10.3390/ijfs6030078

[67] Arellano, M. and Bond, S. (1991) Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, **58**, 277-297. https://doi.org/10.2307/2297968

[68] Roodman, D. (2009) How to do xtabond2: An Introduction to Difference and System GMM in Stata. *The Stata Journal*, **9**, 86-136. https://doi.org/10.1177/1536867X0900900106

[69] Arellano, M. and Bover, O. (1995) Another Look at the Instrumental Variables Estimation of Error-Component Models. *Journal of Econometrics*, **68**, 29-51. https://doi.org/10.1016/0304-4076(94)01642-D

[70] Gujarati, D.N. and Porter, D.C. (2009) Basic Econometrics. 5th Edition, McGraw-Hill Irwin, Boston.

[71] Leaven, L., Ratnovski, L. and Tong, H. (2014) Bank Size and Systemic Risk. International Monetary Fund., Washington DC. https://doi.org/10.5089/9781484363720.006

[72] Im, K.S., Pesaran, M.H. and Shin, Y. (2003) Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics*, **115**, 53-74. https://doi.org/10.1016/S0304-4076(03)00092-7

[73] Kao, C.D. (1999) Spurious Regression and Residual-Based Tests for Cointegration in Panel Data. *Journal of Econometrics*, **90**, 1-44. https://doi.org/10.1016/S0304-4076(98)00023-2

[74] Goddard, J., Liu H., Molyneux, P. and Wilson, J. (2010) The Persistence of Bank Profit. *Journal of Banking and Finance*, **35**, 2881-2890. https://doi.org/10.1016/j.jbankfin.2011.03.015

[75] Okaro, C.S. (2016) Monetary Policy, the Control of Money Supply and Its Effects on the Profitability of Deposit Money Banks in Nigeria (1999-2013). *NG-Journal of Social Development*, **5**, 56-70. https://doi.org/10.12816/0033190