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Determinants of commercial bank interest rate spread in Papua New Guinea: An empirical analysis

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Abstract

The paper investigates the determinants of commercial bank interest rate spread in Papua New Guinea using the Autoregressive Distributive Lag bounds test approach for sample period 2004q4 – 2018q4, using both macroeconomic and banking sector variables. The paper finds that in the short run, interest rate spread, government deficits, Treasury-bills rate, real exchange rate, ratio of loans to deposits, liquid asset ratio, external liabilities to assets ratio, administrative expense to revenue ratio are statistically significant in explaining movements in the spread. While in the long run, the Treasury bill rates and liquid assets ratio are statistically significant in explaining movements in interest rate spread in PNG - a rise in both will lead to a widening of interest rate spread. These suggests that Government's fiscal operations and commercial bank's external position, as well as cost of business and liquidity conditions are major determinants of the interest rate spread in PNG.

Key words: interest rate spread, fiscal operations, ARDL bounds test, Error Correction Model, banking variables, weighted average lending rates, weighted average deposit rates

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1. Introduction

The difference between deposits and lending rates generally referred to as the interest rate spread is a concept that is of profound interest to both the financial institutions, particularly financial intermediaries, and the regulatory authorities and policy makers of a country's banking and financial system. It is of interest to the financial intermediaries because of the basic fact that it represents their profit margin[2], while the interest of the second group stems largely from the concern on efficiency of the financial intermediation process, which has bearing on inclusive and overall economic growth, and the transmission[3] of monetary policy. A stable banking system requires sufficient profits while economic efficiency demands that the costs of intermediation in the form of spreads are competitive (Chand 2015). Thus, policymakers have an interest in ensuring that the banks remain profitable but not excessively so. The interest rate spread is also important as the size of the spread indicates the depth, development and the level of liberalization[4] of the financial system – this is an important case in point for PNG, when in 2004, liberalization was done to enhance competition and lower spreads, which on contrary did not, given market rigidities and imperfections. Equally important, the transmission of monetary policy via the interest rate channel can be rendered ineffective, should the spreads remain wide and unresponsive to changes in the stance of policy. However, it can be argued that even if spreads remain unresponsive to the policy rate, the level of bank lending rates would likely not. So the central bank can offset the effect of a change in spreads to ensure it meets its targets. While there would be distributional issues, which would affect the transmission of policy, the central bank may be able to offset any aggregate effect of a change in spreads by changing its policy rate in the opposite direction (assuming no Zero Lower Bounds constraints). There are two generally accepted measures of interest rate spreads and margins: (i) the popularly used difference between the weighted average lending rate and the weighted average deposit rate; and (ii) the ratio of net interest income to total loans (example, Tennant and Folawewo 2009, and Jamaludin *et al*. 2015). The spread is understood conceptually as the cost of intermediation including the operating costs[5], liquidity risk premium, and the fundamental cost of uncertainty generated by the asynchronous nature of deposit supplies and loan demand which is usually

[2] High spread means high profit and vice versa. Banks' profitability in Pacific Island Countries (including PNG) is relatively high, exceeding the range typically observed in advanced economies, and emerging market economies. This reflects the high spread, among others (Jamaludin et al, 2015).

[3] Persistently high spreads could hamper the effectiveness of the credit channel of monetary policy transmission and thus would affect the appropriate monetary policy stance (Rebei, 2014).

[4] Financial liberalization enhances competition and efficiency in the financial sector; a wide IRS indicates financial repression while a narrow IRS indicates financial liberalization (Were and Wambua, 2014).

[5] Include administrative, incidental, security and corporate tax expenses, amongst others.

referred to as the pure spread[6] (Montes-Negret and Papi 1996; and Ho and Saunders 1981). Costs incurred in facilitating the financial intermediation process are often copious and are normally built into the spreads, including the banks mark-up - the pure spread, inflation rate and cost of non-performing loans (NPL) are examples of components of interest rate spread.

It is ideal to have a low or narrow[7] interest rate spread, which stems from either lower lending or higher deposit rates. Both are beneficial as the former leads to lower cost of borrowed fund, and hence stimulation of private investment and economic growth. Whilst the latter is expected to encourage savings and mobilization of funds available at commercial banks and other deposit taking institutions for their liquidity needs, including lending. On the other hand, a high or wide[8] spread has exactly the opposite effect, and reflects possible inefficiencies in the banking sector. There is no common or universally accepted view on the classification of narrow and wide spread, or there is no generally accepted range of interest rate spread that can be defined as narrow and (or) wide. However, most literature that examined interest rate spread considered a spread of 6.0 percent and above to be wide, and below 6.0 percent to be narrow (example, Rebei 2014). This paper adopts the same classification of narrow and wide interest rate spread. As a cautionary note, there may be economies of scale in the banking sector which may imply that perfect competition is not the optimal market structure – which is the case for PNG. Hence, 6.0 percent essentially can be seen as an approximate optimum, as there are costs and benefits of being too low or too high.

The merit of identifying the factors driving the interest rate spread in a designation is unquestionable, especially for developing economies, given its universally accepted relationship with economic growth, through credit (Quaden 2004). Although the relationship is not empirically tested in the case of PNG, a cross-country analysis in identifying the drivers of interest rate spread in the Pacific regions has been done (Jamaludin *et al*. 2015). The paper highlighted the commonalties and differences in policies and other macroeconomic and market aspects that caused the interest rate spread in one country to behave in a similar or different fashion to another; but not so much on country-specific factors. A paper by Chand (2015) acknowledged that the bank spread in PNG is high compared to similar resource endowed developing economies, and attributed the spread to a combination of abnormally high lending rates and abnormally low rates paid on deposits. Furthermore, lending and deposit rates in PNG are weakly affected by monetary policy, leaving margins relatively stable and high. However, Chand (2015)

[6] It is shown that positive spread tends to exist even in a highly competitive market. That is, interest margins cannot disappear, under quite reasonable assumptions, as long as uncertainty is present. This margin, due to transaction uncertainty, is called the *Pure Spread* (Ho and Saunders, 1981).

[7] Low and narrow is used interchangeably throughout the paper.

[8] High and wide is used interchangeably throughout the paper.

was unable to pin down the underlying reasons for PNG's high interest rate spread, which is more than double that of its Pacific island neighbours, while dismissing the mismatch between the term structure of loans and deposits as the potential factor. Chand admitted having data constraints and time limitations and recommended a subsequent detailed investigation be undertaken. Interest rate spread in PNG is currently around 8.0 percent, which is relatively high compared to peer economies and pacific island countries' (PICs) average. This gives the motivation for this study, in addition to the literature gap in PNG. In this respect, it is envisioned that the paper will uncover some of the fundamental drivers of the high interest rate spread in PNG, which can form the basis to help understand this phenomenon and highlight the issues for policy discussions and actions. Despite some data limitations, the paper aims to empirically identify adequately the determinants of interest rate spread in PNG. This is imperative for formulation of sound policies and financial reforms that can help lower the spread and maintain it within a desirable range, amidst the market forces and shocks and a transitioning market environment.

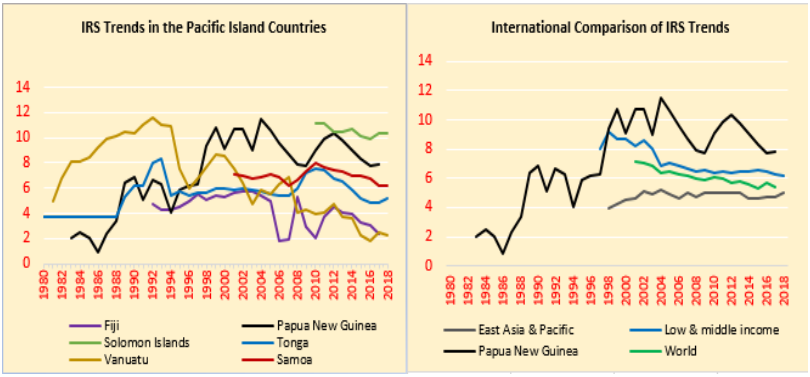
The paper, therefore, attempts to provide an in-depth analysis of the country-specific factors that drive the spreads in PNG, with a view to recommend policy interventions to address the issues. To the authors' knowledge, this is the first paper to systematically review the evidence on the determinants of interest rate spread in PNG. We acknowledged previous work undertaken on this topic, and aspire to complement earlier findings, as well as contributing to literatures on financial sector in the country and within the region. The paper uses the ARDL bounds test approach using 364-day term Treasury bill rate, government fiscal balances, real effective exchange rates and several bank-specific ratios. The paper finds that in the long run, Treasury bill rates and liquid asset ratio are statistically significant in explaining interest rate spreads in PNG, where a rise in both leads to a widening of the spread. While in the short run, interest rate spread (two quarters lag), government deficits, T-bills rate (two, three and four quarter lag), real exchange rate (four quarter lag), ratio of loans to deposits (quarter lag), liquid asset ratio (quarter lag), external liabilities to assets ratio (one and three quarter lag), admin expense to revenue ratio (current and past quarter lag) are statistically significant in explaining interest rate spread. These findings suggest that Government's fiscal operations and commercial bank's external position, as well as cost of business and liquidity conditions play a major role in determining interest rate spreads in PNG.

The paper is structured as follows. Section two delineates the context of the study, followed by a survey of related literatures, both theoretical and empirical in section three. Section four provides description of the data and the methodology engaged. Section five presents the empirical findings, whilst section six provides a conclusion, and some policy implications and way forward.

2. Context of the Study- background

High interest rates on loans have been identified as one of the key challenge encumbering businesses and investments in PNG, according to a report by ADB[9]. On the other hand, the abnormally low interest rates for compensation of deposits, combined with other factors such as high financial illiteracy and excessive transactional fees and charges levied by financial intermediaries, particularly commercial banks, tend to discourage savings culture and mobilization of funds for investment through the credit. The outcome is the persistently wide interest rate spread since 2000. PNG's financial system underwent liberalization in early 2000s, however, the high spread is contrary to the benefit of financial liberalization of narrowing the spread[10]. These raised concerns amongst the policymakers and regulators of financial sector, the business community, and general public. Importantly for monetary policy, the wide spread had led to the misalignment of the central bank's policy rate to market rates, raising questions on the effectiveness of the transmission of monetary policy, and to a larger extent the ability of the central bank to influence the short-term market interest rates. On the other hand, it can be argued that since the Bank can observe any increase in spreads, it can use its policy tools to offset its aggregate effect on the economy. However, this is not the case because of the institutional features specific to PNG, that has exacerbated the inability of policy to respond.

Figure 1: Regional and International Comparison of Interest Rate Spread



Between 1982 and 2000, the interest rate spread in PNG was relatively low averaging around 5.0 percent. However, beginning in 2000, the spread spiked and has remained elevated averaging around 9.0 percent, since. Compared to other PICs, PNG has the second highest interest rate spread, after

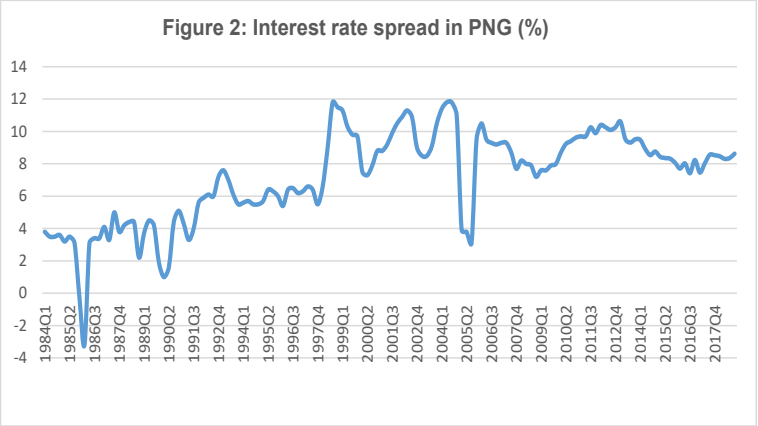
[9] ADB business environment survey, 2002: "The Challenges of doing Business in PNG".
[10] Refer to footnote 3 above.

Solomon Islands whose average spread is around 11.0 percent. PNG is high by both regional and international standards (graph 1.0). The high spread in PNG could be related to several underlying factors including; the higher risk premiums, the oligopolistic nature of the baking sector, and the overall cost of doing business, amongst others that could be driving lending rates upward. On the hand, the very low deposit rates could be partially explained by the liquidity overhang in the banking system and the shallow financial markets with limited options for investment. While the paper has managed to capture some of these features in the empirical analysis, some have been difficult to quantify and assessed and are based purely on anecdotal evidence.

Prior to 2000, financial controls were in place, given the existence of government-owned[11] banks and the central bank's role in administering the market interest rates. In the 1990s, financial liberalization flounced across most developing and transitioning countries. PNG also had its fair share of financial liberalization in late 1990s and early 2000s, marked by major financial sector reforms, bank reconstruction and privatisation, and liberalization toward market oriented setting of interest rates. One of the perceived benefits of financial liberalization is the lowering of the interest rate spread, and is founded on the understanding that liberalization enhances competition and efficiency in the financial sector (Were and Wambua 2014). The effect of financial liberalization in PNG, however, was contrary to expectations as witnessed in the increase in the spread after 2000. It can be argued that liberalization removed regulations that prevented the small number of banks from fully exploiting their market powers. Liberalization works well when the banking sector regulation is stifling competition, but not so, when the regulation is offsetting some form of market failure such as high barriers to entry.

In 2000, the Bank of PNG adopted the Central Banking Act 2000. This change allowed monetary policy to be managed within a reserve money framework with the core objective of price stability. The reserve money framework, using the tools of open market operations allow interest rates for government and central bank securities to be more market oriented. Through a bidding process, this allowed commercial banks, authorised financial institutions and the general public to set the price for these securities. The four commercial banks operating in the country hold almost 80.0 percent of banking sector's total deposits. They are the major market participants in the auction for government and central bank securities and often dictate how the market interest rate moves. The financial market is shallow and less developed, making commercial banks the major provider of loans to the private sector.

[11] The largest commercial bank (PNGBC) at that time was government owned including a rural development bank.



Between 1994 and 2018, PNG's interest rate spread increased by 4.00 percent, although there was high volatility. From 1984q1 to 2001q3, the interest rate spread was on an upward trend. At the end of 2001, the interest rate tends to be declining. It can be argued to be caused by the introduction of the Central Banking Act 2000, as PNG's financial market was liberalised and interest rates become market oriented.

There was a big spike between 1985q2 and 1986q3, where the central bank encountered challenges in pursuing clear monetary targets and managing high fluctuating bank liquidity. In 1997q4, the interest rate spread increased significantly to a record high of 12.0 percent from less than 6.0 percent. This was the indirect effect of the Asian Financial Crisis (Yabom 2004), causing global demand to dampen and commodity price to fall. The fall in external inflow of funds resulted in the exchange rate depreciation (Figure 3) that made external liabilities for financial institutions expensive, and arguably causing these institutions to increase the interest rate spread to make up for the increased cost. The external liabilities to asset ratio of financial institutions spiked in 1997 (Figure 6) which could have explained the impact of depreciating kina and the associated increase in value liabilities.

The big swings in commercial bank's profitability is explained by the high volatility in the interest rate spread starting in 2000, and reflected the change in PNG's financial market price setting mechanism. The fiscal budget surpluses between 2002 and 2010 resulted in the fall of Treasury bill rates from 20.0 percent to 5.0 percent between 2003 and 2004, and had remained steady through to 2011. Over the same period, the interest rate spread declined. With low Government spending and GDP growth, BPNG eased monetary policy stance, reducing its policy signalling rate - the Kina Facility Rate (KFR) - from

14.0 percent to 7.0 percent. The commercial banks responded by lowering their lending rates to lend out surplus funds. With the interest rates charged on deposits already at significantly lower levels, these resulted in the downward spike in the interest rate spread from 12.0 percent to 3.0 percent between 2004 and beginning of 2005. The interest rate spread increased at the end of 2005 to 10.0 percent reflecting normal market conditions. Between 2006 and 2009, the spread generally declined, as BPNG continued its effort to stimulate the economy through monetary policy easing. In 2008, while the world economies and financial systems were hard-hit by the Global Financial Crisis, PNG's financial system appeared one of the few that were relatively resilient. The resilience was attributed to the limited international exposures of PNG commercial banks. However, the economy as a whole suffered from the consequent decline in commodity prices and exchange rate depreciation as kina is a commodity currency. This may have explained the increase in spread between 2008 and 2011, as commercial banks make up extra revenue to cater for additional external liability cost, as well as the heightened risk sensitivity in the wake of the crisis. In 2011, the construction phase of the PNG Liquefied Natural Gas (LNG) project started with high inflow of foreign currency, causing the exchange rate to appreciate, and the interest rate spread to fall through to the end of 2016, as the kina remain relatively stronger at USD0.4800. The spread was on an upward trend in 2017, as the real exchange rate fell sharply, reflecting foreign exchange shortage faced by the economy through to 2018.

3. Survey of Literature

3.1 Theoretical literature

There is sufficient expanse of theoretical models on determination of interest rate spread, each with their respective assumptions and therefore, merits and pitfalls. Perhaps one of the most sighted and dominant model on the interest rate spread determination is by Ho and Saunders (1981) referred to as the bank dealership model. In this model, the bank is seen as a dealer or an intermediary who demands deposits and supplies loan, and is faced with a major challenge of uncertainty that arises from the fact that flows of deposits (primary source of supply for loanable funds) and demands for loans (outflow of deposits) do not synchronise. The concept of uncertainty is central to the bank dealership model, and is in essence a cost to the bank, which cannot be avoided even in a highly competitive banking market, not even under quite reasonable assumptions. The margin due to this uncertainty is therefore called the pure spread. Moreover, the model postulates that the optimal mark-up (sum of fees) for deposit and loan service will depend on four factors: (i) degree of risk aversion by banks; (ii) market structure in which the bank operates; (iii) average size of banks transactions; and (iv) the variance of interest rates. The aforementioned is closely related to the contentious loanable funds theory – where the underlying

issue here is how money is created: do deposits create loans, or do loans create deposits? The first causality corresponds to the loanable funds theory and implies that banks need to mobilize resources through attractive deposit rates in order to be able to make loans; the second causality says that banks can create loans literally out of thin air, and the creation of loans leads to deposits and thereby money creation, in which case (i) loan demand and (ii) the cost of banks to finance themselves matter and this is where monetary policy comes in and is a key factor for interest rates charged on loans – deposits still matter, but more as a cheap financing source. In support of second causality, a paper by the bank of England argued that in modern economies the principle way in which money is created is through commercial banks making loans: Whenever a bank makes a loan, it simultaneously creates a matching deposit in the borrowers' bank account, thereby creating new money.

There are several mechanisms identified in the literature that show how interest rates are passed through in determining interest rates. For instance, the crowding out effect of fiscal policy on interest rate as put forward by the traditional IS-LM model predicts that government spending has a negative effect on private investment, while the Real Business Cycle model suggest that a rise in government spending generates a decline in private consumption. As safe haven or "risk free" assets, interest rates on government bills are driven by government budget cycles – persistent deficits are usually associated with high demand and increased cost of funds. As risk free assets, commercial banks would prefer holding government's securities over lending products, hence a premium is charged. The pass-through costs relate to exchange rates and the administrative costs of doing business and bank competition or lack of it.

3.2 Empirical literature

There is vast literature that examines and empirically tests factors that drive banks' spread. In most of the empirical studies sighted, the variables used are classified into three broad categories: (i) the bank-specific factors such as the bank asset size, return on assets, non-performing loans and bank liquidity; ((example Tarus *et al.*, (2012); Mendes and Abreu, (2003)) (ii) factors specific to banking and financial sector, for example, nature of competition; and (iii) macroeconomic factors such as inflation, gross domestic product (GDP) and exchange rate regime, amongst others (example Brook and Franken (2003) and Chirwa and Mlachila (2004)).

A paper by Were and Wambua (2014) used both exploratory and empirical analyses in their investigation on the determinants of interest rate spread in Kenya. The exploratory analysis used trends

and comparative analysis, while empirically using panel data regression, showing that bank-specific factors are significant in the determination of spreads in Kenya. These factors include bank size, credit risk as measured by non-performing loans to total loans ratio, return on average assets and operating costs–all have a positive relationship with interest rate spread. Bank liquidity ratio, on the contrary, has a negative effect on spread. In terms of bank size, big banks tend have higher spreads than small banks. Macroeconomic factors such as real economic growth have a negative effect on spread while the effect of monetary policy rate is positive but not highly significant. Were and Wambua concluded that the results largely reflect the structure of the banking industry in Kenya where a few banks control a significant share of the market. Kenya's financial sector went through financial liberalization in 1990s to allow market-determined interest rates; however, high interest rates still persist.

Despite Tanzania's financial sector liberalization and reform in 1991, the banks' spread remains wide. Manamba (2014) therefore investigated banks' characteristics and macroeconomic factors responsible for the wide interest rate spread. Manamba covering the sample period 1986q1 – 2013q4, and while employing an Error Correction Model revealed that the interest rate spread is significantly higher after the adoption of financial liberalization. The paper also revealed that interest rate spread is significantly determined by the lack of competition among financial institutions. Moreover, it was shown that as the proportion of liquid assets increases, the bank liquidity risks decreases, leading to lower interest rate spread. Manamba postulates that since high interest rate spread reflects lack of competitiveness and efficiency in the financial system, policies should be directed at improving risk management, building a prudential level of liquid assets, strengthen supportive information and bank supervision, and maintaining macroeconomic stability.

For studies on pacific island countries (PICs), Rebei (2014) examined the determinants of interest rate spreads in the Solomon Islands using bank-specific, sector-specific and macroeconomic data, found that the scale of operation, overhead costs, concentration index, the policy rate and real GDP growth, significantly influence interest rates spreads. The paper particularly focuses on the influence of the banking sector structure and found strong evidence of bank collusion.

4. Data and Methodology approach

4.1 Data – variables of interest

The interest rate spread specifically looked at in this paper is the difference between monthly weighted average lending and deposit rates for commercial banks – i.e., the difference between the interest rate

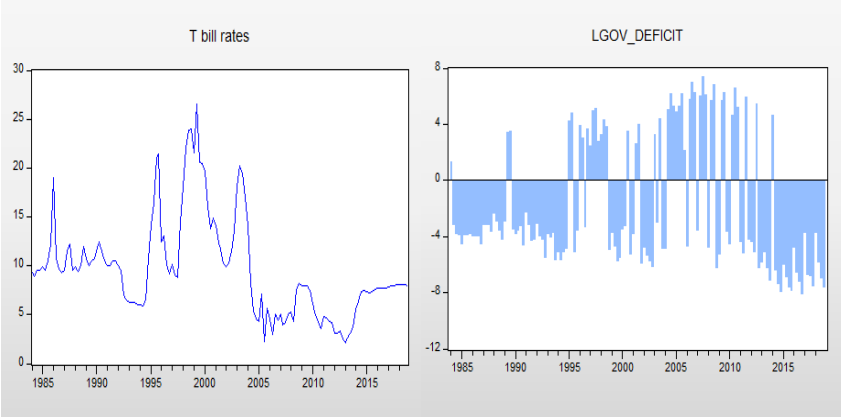
charged on loans to borrowers and that paid on deposits to depositors. Other studies defined interest rate spread differently: For instance, Musah and Anokya (2018) defined interest rate spread as the ratio of net interest income. This measure reflects banks' interest profitability involving the cost of financial intermediation.

The paper uses quarterly time series for both macroeconomic and in-house variables, specific to commercial banks, in the empirical analysis. The commercial bank in-house variables dataset starts from 2004q1 and ends at 2018q3 while the macroeconomic dataset is from 1984q1 to 2018q4. Variables were also selected largely on data availability for the sample size and period under review. The sample size is, therefore, relatively small and only covers 2004q1 to 2018q3), despite having data on the actual spread dating back to 1984q1.

The macroeconomic variables investigated in this study are; government deficits, 365-day (one-year) Treasury bill rate and the real exchange rate. Government's deficit and the 365-day Treasury bill rate are highly correlated and to some extent, can be used interchangeably, since the fiscal deficit impact on the spread works mainly through the channel of Treasury bill auctions and rates. However, the paper investigates them separately because of the direct volume effect on deposits. Fiscal deficits create a competing investment avenue where the commercial banks get to decide whether to lend the limited supply of deposits to other private sector or invest in government securities. Domestic financing of PNG's consecutive fiscal deficits, particularly over the last 8 years, made up almost 72.0 percent of total financing. The 365-day Treasury bill was selected over other terms since the government mainly issues its bills under this term - other terms are not active.

The commercial bank's in-house variables are; ratio of loans to deposits, liquid asset ratio, external liabilities to assets and ratio of admin expense to interest income (see Appendix). Other banking variables such as, ratio of non-performing loans to total loans and net income to equity ratio were considered during the model specification and selection process but were found to be insignificant in explaining the interest rate spread.

Figure 3: time series plots on macroeconomic variables



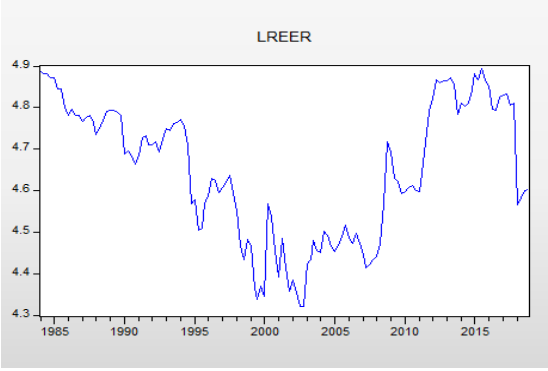
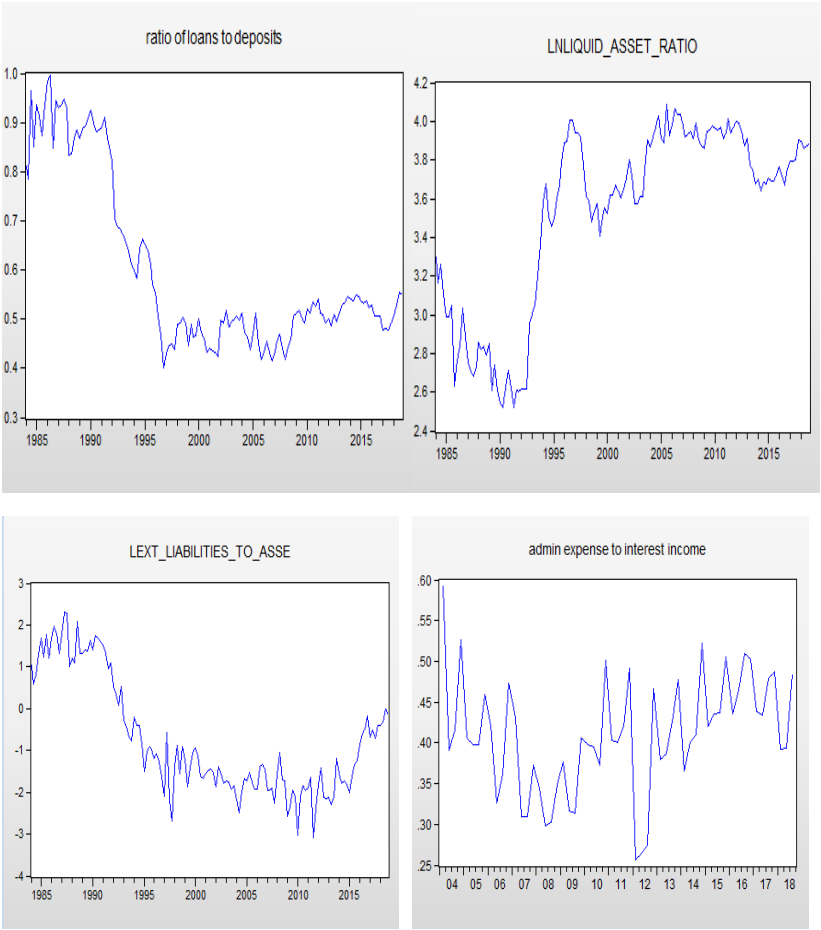


Figure 4: time series plots on banking sector-specific variables



The ratio of loans to deposits remained steady between 1984 and 1991, averaging around 90.0 percent, but fell sharply afterwards to around 40.0 percent in 1996. The drastic fall in the ratio is explained by the change in PNG's exchange rate regime from fixed to floating regime. When kina was floated during that period, it depreciated markedly to find the equilibrium exchange rate. The depreciation increased export earnings (Tumsok 2019) which induced a subsequent increase in deposits at the commercial

banks, causing the ratio of loans to deposits to fall. It remained relatively stable with minor volatility, from 1997 to 2018, averaging around 47.0 percent.

The liquid asset ratio between 1984 and 2018 increased from 3.3 percent to 4.0 percent. It was on a downward trend between 1984 and 1992, then increase rapidly post 1993 from 2.6 percent to 4.0 percent in 1997. From 1995 to 2018, it remained stable (although there was some observed volatility), averaging 3.8 percent. Overall, the external liabilities to asset ratio declined. It declined from less than 1.0 percent in 1984 to 0.1 percent in 2018. A positive trend is observed between 2009 and 2018. The ratio of admin expense and interest income, although high volatility is observed between the full sample periods, it appears to have a stable trend throughout.

4.2 Data description and expected signs

Fiscal balances (budget deficits): Is defined as national Government's budget balance – revenue minus expenditure. The results from the reviewed literatures show that when deficits increase, the spreads should increase as demand for funds crowd-out private sector through increase in lending rates. Consequently, fiscal balance is expected to positive relationship with the spread.

Treasury bill rate: Measured using the 364-day term Treasury bill rate for PNG Government securities. As the need for government financing increases, interest rate on Treasury bills is also expected to increase and vice versa. As banks purchase government securities, the scarcity of loanable funds is expected to drive up lending rates. Consequently, the expected sign of Treasury bill rates in relation to the spread is positive.

Real effective exchange rate: Is defined as the product of the nominal effective exchange rate and domestic consumer price index divided by the foreign consumer price index. An increase in the real effective exchange rate (depreciation) makes the exports competitive in the international market, thereby increasing the exports of the country. The opposite happens when it increases. In this light, the real effective exchange rate is expected have a positive relationship with the spread.

Ratio of total loans to total deposits: This is calculated as commercial banks' total loans over (divided) total deposits. The ratio is a function of both loans and deposits and therefore reflects movements in both items. An increase (or decrease) in this ratio is possible through: (1) Increase (or decrease) in loan volume, which reflected a surge (or decline) in demand for loans and is expected to increase (or decrease) the interest rate spread; and (2) Decrease (or increase) in deposits, which supposedly should increase (or decrease) the spread as supply of loanable funds decrease (or increase).

Ratio of liquid assets to total assets: Defined as commercial banks total liquid assets divided by total assets. An increase in liquid asset ratio leads to a reduction in loanable funds, causing interest rate spread to reduce. Consequently, in this study, the expected sign of the liquid assets to total assets is negative.

Ratio of external liabilities to total assets: Defined as commercial banks total external liabilities divided by total assets. If the level of commercial bank external liabilities goes up, interest rate spread will increase, as lending rates are charged at premium to cover for exposure to exchange rate losses and if total assets decline, interest rate spread will increase. Consequently, in this study, the sign is expected to be positive.

Ratio of admin expense to interest income: Is defined as admin expense divided by total interest income. An increase in Admin expense will cause an increase in interest rate spread, while a decline in interest income will cause an increase in interest rate spread.

As a caveat, the bank-specific variables are 'tricky' because they are potentially endogenous to loan and deposit interest rates and, in addition, there may be exogenous factors influencing both.

4.3 Methodological Approach

The paper models the variables of interest using the Autoregressive Distributive Lag (ARDL) bounds test Approach using Ordinary Least Squares (OLS) estimation. The estimation process used the ARDL bounds test (long run) and error correction form (short run) to understand the determinants of the interest rate spread. The bounds test provides the upper and the lower critical values for evaluating the presence or otherwise of cointegration. The upper bound critical value assumes all variables to be I(1) while the lower bound critical value assumes them to be I(0). There is cointegration when the estimated F-statistic is greater than the upper bound critical value while no cointegration exists when the estimated F-statistic is less than the lower bound critical value. Inconclusive results for cointegration emerge when the estimated F-statistic lies between the upper and lower bound critical values. Long and short-run estimates are obtained provided evidence for cointegration emerges.

This approach is well suited for our analysis because it allows estimation of both the short and long run effect of independent variables on the dependent variable. The model is also appropriate to estimate small sample size (n>30) and estimations cannot be spurious whether data series is in I (0) or I (1).

4.3.1 Specification

The long-run augmented ARDL model (m, n, o, p, q, r, s) is specified as follows: Equation (1)

$$lnIntspread_t = \beta_0 + \sum_{i=0}^{m} \beta_{1i} lnFiscal\_bal_{t-1-i} + \sum_{i=0}^{n} \beta_{2i} Tbill\ rates_{t-i} + \sum_{i=0}^{o} \beta_{3i} lnreer_{t-i} + \sum_{i=0}^{p} \beta_{4i} lnloan\_deposits_{t-i} + \sum_{i=0}^{q} \beta_{5i} lnliquid\_assets_{t-i} + \sum_{i=0}^{r} \beta_{6i} lnliabilities\_assets_{t-i} + \sum_{i=0}^{s} \beta_{7i} lnadminexp\_interestincome_{t-i}$$

While the short-run dynamic coefficients via the Error correction model (ECM) representation is: Equation (2)

$$\Delta lnIntspread_t = \alpha_0 + \sum_{i=0}^{m} \vartheta_i \Delta lnFiscal\_bal_{t-1-i} + \sum_{i=0}^{n} \varphi_i \Delta Tbill\ rates_{t-i} + \sum_{i=0}^{o} \theta_i \Delta lnreer_{t-i} + \sum_{i=0}^{p} \phi_i \Delta lnloan\_deposits_{t-i} + \sum_{i=0}^{q} \psi_i \Delta lnliquid\_assets_{t-i} + \sum_{i=0}^{r} \xi_i \Delta lnliabilities\_assets_{t-i} + \sum_{i=0}^{s} \delta_i \Delta lnadminexp\_interestincome_{t-i} + \lambda ECM_{t-1} + \varepsilon_t$$

The coefficient of the ECM_{t-1}, λ in Equation (2) shows the speed of adjustment parameter, indicating how quickly the series can come back to its long-run equilibrium after a shock. The sign of the coefficient must be negative and statistically significant.

4.3.2 Model Diagnostics

Following standard estimation procedures, the Augmented Dickey-Fuller (ADF) and Philips Perron (PP) tests were conducted for unit roots in the variables. For the ADF test, We conclude that all variables are stationary at first difference or stationary at I(1), with the exception of Treasury bill rate which is stationary at levels or I(0).

Table 1: Augment Dickey-Fuller (ADF) unit root test

Variables	With constant		With constant and trend		With no constant or trend	
	Levels	First difference	Levels	First difference	Levels	First difference
Spread	-2.2322	-9.7569***	-3.0577	-9.7325***	-0.2889	-9.7740***
Budget deficit	-2.1495	-14.9199***	-2.1458	-14.8958***	-1.7850	-14.9717***
T-bill rates	-3.1057**	-10.9394***	-3.4665	-10.9013***	-1.1877	-10.9794***
Real exchange rate	-2.0513	-10.8190***	-1.9997	-10.8046***	-0.5742	-10.8411***
Loan to assets ratio	-1.5521	-13.4626***	-1.4489	-13.4697***	-0.1405	-13.4777***
Liquid assets ratio	-1.0940	-11.9379***	-1.9872	-11.8918***	0.3654	-11.9460***
External liabilities	-1.3648	-12.6969***	0.4806	-8.2420***	-1.0484	-12.7358***
Admin expense to income ratio	-2.1841	-3.8572***	-2.7024	-3.8247**	-0.2618	-3.8984***

Notes: *Indicates significant at the 10%; ** significant at the 5%; *** significant at the 1% percent

For the Philips Perron (PP) test for unit root, we can conclude that all variables are also stationary at I(1), with the exception of the interest rate spread, budget deficit, Treasury bill rates and the admin expense to income ratio which are stationary at levels I(0), as depicted in the results below (Table 2.)

Table 2: Philips Perron (PP) unit root test

Variables	With constant		With constant and trend		With no constant or trend	
	Levels	First difference	Levels	First difference	Levels	First difference
Spread	-3.0742**	-13.7542***	-3.0146	-15.0196***	-0.6702	-12.9012***
Budget deficit	-4.5023***	-19.0936***	-12.4422**	-18.3814***	-4.3500***	-18.8241***
T-bill rates	-4.6876***	-7.3696***	-5.1155***	-7.7626***	-2.3377**	-7.3635***
Real effective exchange rate	-1.5465	-6.4743***	-1.0339	-6.5367***	0.3388	-6.5153***
Loan to assets ratio	-1.9738	-9.3378***	-3.0409	-9.1912***	-0.6279	-8.9456***

Liquid assets ratio	-1.8354	-10.8482***	-2.6304	-10.7321***	-0.1069	-10.9513***
External liabilities	-1.7206	-12.2110***	-3.0780	-26.3104***	-1.1013	-10.9427***
Admin expense to income ratio	-5.0149***	-18.7371***	-5.5525***	-10.9427***	-0.2808	-18.8627***

Notes: *Indicates level of significant at the 10%; ** significant at the 5%; *** significant at the 1% percent

The bounds test result is significant at 1.0 percent: The F-statistic (11.95344) exceeds the upper bound I(1)=3.90 limit. Therefore, we can conclude that the variables are cointegrated. This means that the variables have a long-run relationship; therefore, results for the long and short-run relationships can be estimated using the ARDL bounds test model.

For the residual diagnostics, the LM test for serial correlation and Breusch Pagan Godfrey test for heteroscedasticity is employed. The null hypothesis is p=0, meaning model will suffer from serial correlation and/or heteroscedasticity. The results yielded p-values of 72.0 percent and 100 percent for LM and Breusch Pagan Godfrey, respectively. Therefore, we will reject the null hypothesis. This means that our model suffers neither from serial correlation nor heteroscedasticity. The model also passes the test for stability of the model using the CUSUM and CUSUM sum of squares, which ascertains the constancy of the long run multipliers in the error correction form. For the lag selection criteria both the AIC and HQ selected 5 lags to be used in the model.

5. Model results and discussion

Table 4: short and long-run relationship ARDL (2,1,4,4,1,3,1)

Variables (short run equation)	Results
Δ(spread (-2))	0.10*** (4.24)
Δ(lgovdeficit)	-0.04*** (-2.17)
Δ(tbillsrate (-2))	0.29*** (3.25)
Δ(tbillsrate (-3))	0.54*** (7.14)
Δ(tbillsrate (-4))	0.35*** (4.80)
Δ(lreer (-4))	-5.19** (-2.35)

Δ(ratio of loans to deposits (-1))	-5.7** (-2.36)
Δ(lnliquid asset ratio (-1))	-8.29*** (-4.24)
Δ(lexternal liabilities to assets (-1))	0.79*** (3.43)
Δ(lexternal liabilities to assets (-3))	0.50** (2.28)
Δ(admin expense total revenue)	1.45* (2.10)
Δ(admin expense to total revenue(-1))	-1.35** (-2.16)
CointEq(-1)* F- Statistics: Rsquared Adjusted Rsquared	-0.89*** (-12.5) 11.95*** (3.19) 0.94 0.87

Variables (long-run equation)	Results
Gov fiscal bal	-0.6 (-1.23)
Tbills rates	-0.36* (-1.91)
REER	2.95 (1.02)
Loans to deposits ratio	4.77 (1.26)
Liquid assets ratio	11.69*** (3.13)
External liabilities to assets ratio	-0.13 (-0.23)

Note: * indicates 10%, ** 5% and ** 1% level of significance, figures in brackets indicates t statistics values.

In the long run, results show that the 364-day Treasury bill rate and commercial bank liquid asset ratio are statistically significant in explaining changes in the interest rate spread. A 1.0 percent increase in 364-day Treasury bill rate will reduce the interest rate spread by 0.36 percent and a 1.0 percent increase in the liquid asset ratio will increase the interest rate spread by 11.69 percent.

In the short run, the variables that are statistically significant in explaining interest rate spread are: interest rate spread in past two quarters, government deficit, 364-day Treasury bill rate in the past two, three and four quarters, real exchange rate in the past four quarters, ratio of loans to deposits and liquid

asset ratio in the past quarter, external liabilities to assets in the past one and three quarters, admin expense to revenue in the current and past quarter. From the model results, a 1.0 percent increase in the interest rate spread in the past two quarters will increase the current interest rate spread by 0.10 percent; a 1.0 percent increase in the government deficit will reduce the interest rate spread by 0.04 percent; a 1.0 percent increase in the 364-day Treasury bill rate for the past two quarters will increase the interest rate spread by 0.29 percent; a 1.0 percent increase in the 364-day Treasury bill rate for the past three quarters will increase the interest rate spread by 0.54 percent; a 1.0 percent increase in the 364-day Treasury bill rate for the past four quarters will increase the interest rate spread by 0.35 percent; a 1.0 percent increase in the real exchange rate for the past four quarters will reduce the interest rate spread by 5.19 percent; a 1.0 percent increase in the ratio of loans to deposits in the past one quarter will reduce the interest rate spread by 5.70 percent; a 1.0 percent increase in the liquid asset ratio for the past one quarter will increase the interest rate spread by 8.29 percent; a 1.0 percent increase in the external liabilities to assets for the past one quarter will increase the interest rate spread by 0.79 percent; a 1.0 percent increase in the external liabilities to assets for the past three quarters will increase the interest rate spread by 0.50 percent; a 1.0 percent increase in the ratio of admin expense to total revenue for the current period will increase the interest rate spread by 1.45 percent; and a 1.0 percent increase in the ratio of admin expense to total revenue in the past one quarter will reduce the interest rate spread by 1.35 percent. The variables that are statistically significant at 1.0 percent include interest rate spread in the past two quarters, 364-day Treasury bill rate in the past three and four quarters and liquid asset ratio in the past one quarter. Variables that are statistically significant at 5.0 percent consisted of government deficit, 364-day Treasury bill rate in the past two quarters, real exchange rate, external liabilities to assets in the past three quarters and admin expense to total revenue in the past one quarter. The only variable at the 10.0 percent level of significance is the ratio of admin expense to total revenue. The sign on the coefficient of the error correction term is negative as expect and is statistically significant. Hence, around 89.0 percent of the disequilibrium between the independent variables and the interest rate spread is corrected within one quarter.

6. Conclusion

Using the ARDL bounds testing approach for the sample period 2004q1–2018q4, selected macroeconomic and bank-specific data are used to examine the commercial banks' interest rate spread in PNG, for both the short and long run.

The results indicate that in the short run; past increases in the spread have an effect on current increases in the spreads. An improvement in the government's fiscal position will induce a reduction in

the spread. On the other hand, a tight fiscal position warranting increases in T-bill rates will induce an increase in the spread. The appreciation in the real exchange rate will lead to a reduction, suggesting that as commercial banks' external exposure is reduced, this is passed on by lower lending rates. An increase in the ratio of loans to deposits will also induce a reduction in the interest rate spread suggesting that as the volume of loans in proportion to deposits increases, deposit rates will increase faster than lending rates.

Other variables that will lead to an increase in the interest rate spread are: an increase in the liquid asset ratio (as an increase in commercial bank liquidity will lead to a fall in deposits); an increase in the ratio of external liabilities to total assets (as commercial banks' external exposure increases, this will induce commercial banks to hike lending rates to mitigate associated risks); an increase in the ratio of administrative expenses to income (generally reflecting the increase in cost of doing business).

In the long run, deposit rates are likely to increase in response to an increase in T-bill rates, narrowing the spread, while an increase in commercial banks' liquid assets will lead to a fall in deposit rates, increasing the spread. Overall, the findings from this paper suggest that government's fiscal operations, commercial banks' external positions, as well as the cost of doing business and liquidity conditions are major factors driving interest rate spread in PNG. Some of the more underlying structural factors such as; the ratio of the unbanked to bank population; low level of formal employment; access to basic financial services; high cost of doing business and the risk associated with lending to certain sectors of the economy, are also critical.

Further work in this area include, a survey-based approach where on a periodic basis, banks can provide information on the risks weights on their loan portfolio and the premiums charged on these products. These can be monitored over time with policy measures put in place to ensure the margins are not too high. While it may be argued that the interest rate corridor system PNG practised in the past may be anti-market oriented, given the oligopolistic nature of the banking sector there is scope for further examination and analysis in this area. An experimental approach using policy scenarios could be tested assuming new entrants in the market. It is also worth noting that some of the bank's policy and outreach initiatives such as the drive on financial inclusion - through financial literacy and advancing financial services may assist in mobilization of funds and possibly reduce the spread in future. For the central bank's monetary policy, the transmission from policy to market interest rates will continue to remain a challenge, in the presence of high interest rate spreads.

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Appendix

Bounds test result

Test statistic	Value	k
F-statistic	11.95344	7

Critical value bounds

Significance	I(0)	I(1)
10.0 percent	1.92	2.89
5.0 percent	2.17	3.21
1.0 percent	2.73	3.90

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.098317	Prob. F(2,16)	0.9069
Obs*R-squared	0.667720	Prob. Chi-Square(2)	0.7162

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 01/08/20 Time: 12:29
Sample: 2005Q1 2018Q3
Included observations: 55
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SPREAD(-1)	-0.009064	0.167546	-0.054096	0.9575
SPREAD(-2)	0.003568	0.201309	0.017723	0.9861
SPREAD(-3)	-0.004150	0.131389	-0.031583	0.9752
LGOV_DEFICIT	0.001005	0.035483	0.028327	0.9778
LGOV_DEFICIT(-1)	-0.001584	0.031703	-0.049968	0.9608
T_BILL_RATES	0.007228	0.203507	0.035517	0.9721
T_BILL_RATES(-1)	0.027313	0.194700	0.140284	0.8902
T_BILL_RATES(-2)	-0.002023	0.177891	-0.011373	0.9911
T_BILL_RATES(-3)	-0.006768	0.185449	-0.036498	0.9713

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.560882	Prob. F(36,18)	0.9312
Obs*R-squared	29.07818	Prob. Chi-Square(36)	0.7866
Scaled explained SS	3.000821	Prob. Chi-Square(36)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 01/08/20 Time: 12:31
Sample: 2005Q1 2018Q3
Included observations: 55

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.479046	7.701020	0.321911	0.7512
SPREAD(-1)	0.051161	0.044231	1.156683	0.2625
SPREAD(-2)	-0.020552	0.053346	-0.385253	0.7046
SPREAD(-3)	0.002747	0.037274	0.073696	0.9421
LGOV_DEFICIT	0.006807	0.010108	0.673455	0.5092
LGOV_DEFICIT(-1)	-0.005561	0.009641	-0.576797	0.5712
T_BILL_RATES	-0.008377	0.061429	-0.136363	0.8930

VAR Lag Order Selection Criteria
Endogenous variables: SPREAD LGOV_DEFICIT T_BILL_RATES LREER LRATIO_L...
Exogenous variables: C
Date: 01/08/20 Time: 12:40
Sample: 1984Q1 2018Q4
Included observations: 54

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-206.4501	NA	3.89e-07	7.942595	8.237259	8.056236
1	26.06173	387.5197	7.76e-10	1.701417	4.353396*	2.724182
2	107.2795	111.2984	4.78e-10	1.063722	6.073016	2.995610
3	166.1735	63.25651	8.89e-10	1.252834	8.619441	4.093845
4	273.0902	83.15743	4.85e-10	-0.336674	9.387248	3.413462
5	469.2003	94.42340*	3.19e-11*	-5.229642*	6.851594	-0.570383*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 4: VAR Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-206.4501	NA	3.89e-07	7.942595	8.237259	8.056236
1	26.06173	387.5197	7.76e-10	1.701417	4.353396*	2.724182
2	107.2795	111.2984	4.78e-10	1.063722	6.073016	2.995610
3	166.1735	63.25651	8.89e-10	1.252834	8.619441	4.093845
4	273.0902	83.15743	4.85e-10	-0.336674	9.387248	3.413462
5	469.2003	94.42340*	3.19e-10*	-5.229642*	6.851594	-0.570383*

Figure 1: Stability CUSUM test

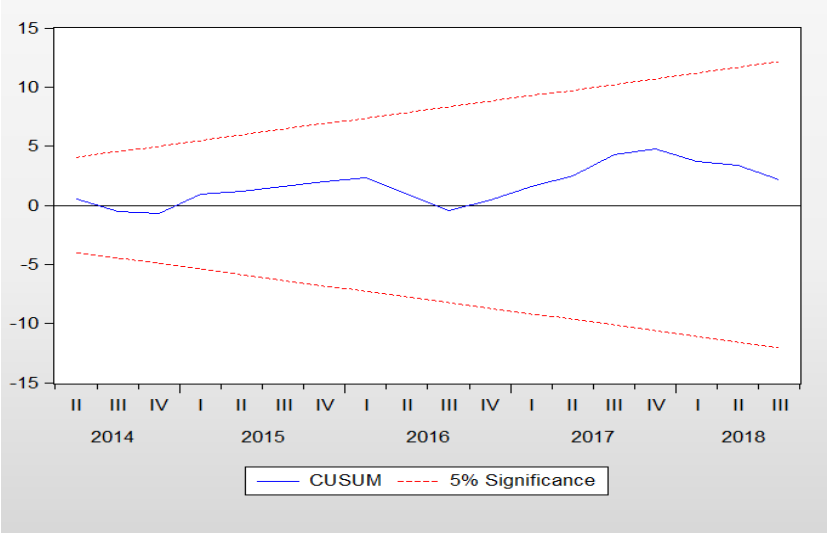

Figure 2: Stability CUSUM of Squares test