Money, reserves and the transmission of monetary policy: Does money multiplier hold in Pacific Island countries? The case of Papua New Guinea

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Contents

Abstract

This is the first study to systematically assess the significance of the standard money multiplier vis-à-vis bank credit transmission channel in the case of Pacific Island Economies, focussing on Papua New Guinea. Results suggest that the money multiplier does not hold and that the transmission to bank credit appears weak. It seems that the ability of the central bank to make available loanable funds through its conduct of monetary policy may not enhance private sector credit. On the other hand, there appears to be a significant and positive association between bank deposits and credit, suggesting that bank deposits and credit are endogenous and demand driven.

Keywords: monetary policy, money multiplier, bank credit, reserve money

1. Introduction

Literature on monetary policy transmission channels is vast—it is one of the most extensively investigated issues in social sciences. Academics, researchers, and policy-makers alike have been profoundly interested in how monetary policy decisions and actions transmit into anticipated outcomes. Justifiably so—monetary policy, historically and in present day, continues to be one of the most talked about central banking functions and tools—regardless of the exchange rate regime. To exemplify, at the time of drafting this paper, one of the hottest and broadest conversations in Australia has been around the "cash rate"—the central bank's pivotal monetary policy tool. These conversations on the back of softening and worrying inflationary and GDP trends, coupled with public pressure, has recently led to two consecutive cuts to the rate (25 basis points each), bringing it down to historically low levels of 1%[1]. Political and public pressure and expectations have in turn compelled financial institutions to immediately pass on the cut to customers and clients via mostly an equivalent cut to their lending rates such as home loan rates, which is expected to boost private sector credit, investments and employment opportunities, despite some scepticism from some quarters.

Notwithstanding the outcomes, economies like Australia have tools such as the cash rate or other options available to stimulate the economy, including indeed "stimulus" packages. And, generally, they seem to have some desired effects, at least in the past. But, what about the transmission and available options to the open, vulnerable, socio-economically disadvantaged economies of the Pacific island Countries (PICs)? How effective has monetary policy transmission been? What has the influence been on inflation, the supply of loanable funds and indeed on GDP? Despite the vastness of the literature, the relationships in the case of the PICs appear to remain little known. Across Papua New Guinea (PNG), Fiji, Solomon Islands and Vanuatu—the largest of the PICs—monetary policy studies are but only a handful. In the case of PNG for instance, while internal discussion papers by central bank staff are common, discussions on monetary policy that are available to the public are limited. A paper by David and Nants (2006) using bivariate Ordinary Least Squares regressions for the periods 1990 to 2005 found the traditional interest rate channel to be weak while the exchange rate channel was shown to be dominant with respect to its impact on inflation.

In the case of Fiji, Nayara et al (2012) examined the monetary policy transmission mechanism using a structural vector autoregressive (SVAR) model for the period 1975 to 2005, by investigating the impact of short-term interest rate shocks on real output, prices, exchange rates, and money supply. The study found that interest rate shocks reduced output temporarily. The shocks also generate inflationary pressures, which leads to an appreciation of the Fijian dollar and reduces the demand for money. Jayaraman and Choong (2009) using money supply, exchange rate and interest rate found the money channel to be the most effective for Fiji. Looking at studies on the money multiplier for Fiji, Jayaraman and Ward (2004) found the concept to be empirically invalid when examining the long-run relationship between money aggregates and base money. In the case of Solomon Islands, Jayaraman and Choong (2010) examined how the monetary policy tools employed worked to achieve the Central bank's mandated objectives of price and exchange rate stability during a 28-year period (1980-2007). Their findings show that given the undeveloped status of the money market in Solomon Islands, monetary impulses are transmitted to the real sector predominantly through the money channel rather than the interest rate channel.
For studies on PICs in general, Yang et al (2012), found that interest rates and private sector credit channels of monetary policy transmission appears to be weak for the region. This was confirmed by an empirical examination of interest rate pass-through and credit growth. Weak credit demand and under-developed financial markets seem to have limited

the effectiveness of monetary policy. Peiris and Ding (2012) showed that PICs are vulnerable to commodity price shocks, which poses challenges for monetary policy. The high degree of exchange rate pass-through to headline inflation and the weak monetary transmission mechanism in PICs suggest a greater efficacy of exchange rate changes in affecting inflation rather than monetary policy.

Of these PICs, PNG is by far the largest in terms of population, land area and GDP. The country's land area of 462,840 km^2 is equivalent to almost 80 per cent of the PICs total land area; similarly, its 8 million population accounts for over 70 per cent of the PICs total population. PNG's GDP has been in excess of US$20 billion annually. Yet, in the case of PNG, monetary policy transmission and influences appear not at all to be well documented, scientifically. This prohibits the central bank from designing and implementing appropriate policy responses for accomplishing its price stability and other enacted mandates. This study attempts to fill that research gap in the literature. In doing so, the study focusses on the money multiplier as the transmission mechanism and private sector credit as the transmitted outcome. Essentially, we ask if the money multiplier notion holds in the case of PNG and what is the effect on private sector credit. Introduced in 2001, while the nation's central bank (Bank of PNG) does have an official monetary policy tool like Australia's cash rate in the form of Kina Facility Rate (KFR), it has also historically conducted open market operations (OMO) and imposed deposit reserve requirements on commercial banks for managing money supply, enhancing private sector credit, etc. It is in relation to the latter, reserve money, that this study is directed. The notion that monetary authorities are able to exert control over reserve money influencing the supply of loanable funds and subsequently credit is widely expressed in mainstream macroeconomics textbooks using the money multiplier theory first proposed in the 1930s by Keynes (1930) and Robbins (1932). Proponents argue that because reserve money is controlled by the central bank, it is exogenous and as such can impact endogenous money supply (e.g. Moore 1989).

Other studies show that money supply components such as credit are driven by demand-side factors (Arestis and Sawyer 2002). This argument has been widely tested with mixed results, suggesting that there might be merit in revisiting the money targeting monetary policy practices particularly in developing and emerging economies. It is argued that the simplifying assumptions that produced money multipliers are justified in financial systems with administratively controlled interest rates and limited availability of substitutes for money (Baghestani and Mott 1988). On the other hand, advances in payment mechanisms and financial innovations have made interest rates more responsive to asset holding decisions of economic agents (Jha and Rath 2000). In addition, structural changes in the economy as it develops over the years, is bound to create opportunities for other channels of monetary policy to thrive while others subside (Crowe and Meade 2007). The money multiplier has also been widely tested against the concept of money endogeneity where it is argued that the monetary base is endogenous. Hence, it is implied that commercial bank credit causes changes in reserve money balances (Moore 1989; Badarudin et al 2009).

Our paper contributes to the on-going discussion on the validity of the money multiplier theory and its relevance to monetary policy. We follow Carpenter and Demiralp (2011)[2] in examining the relevance of the money multiplier in the framework and conduct of monetary policy in the case of PNG. The paper by Carpenter and Demiraph (2011) was a result of the US Fed's implementation of a range of non-traditional monetary policy measures to stimulate economic recovery at the height of the Global Financial Crisis by hiking reserve balances, which generated renewed interest in the transmission of monetary policy from reserves to bank credit and to the rest of the economy[3]. The literature surrounding the debate on the role and significance of money in the economy is vast with New Keynesian models excluding money in policy analysis, while others leaning on the role of money in policy analysis and discussions (Hafer et al. 2007; Lepper and Roush 2003; Ireland 2004; Meltzer 2001; Nelson 2002).

Although the macroeconomic backdrop differs vastly in testing this assertion, the conceptual framework and the approach adopted is relevant for our study, where the central bank is assumed to have the ability to control reserve money and subsequently bank credit[4]. Similarly, we limit our discussion to the credit channel while extending the paper slightly to examine the impact on interest rates as well. The investigation into this practice is of interest to Bank of PNG's current monetary policy setting, in targeting reserve money, which has been a topic of discussion[5] in recent times. We use a structural vector autoregressive (SVAR) technique comprising six variables (interest rate, inflation, loans, deposits, reserve money and real GDP), using quarterly data covering sample periods beginning 1980q1 to 2017q4, then investigate a more recent sample 2000q1 to 2017q4 to examine the reserve money framework. An adaptation to the model is made using styled facts to capture the relevant policy variables currently in use and the expected chain of causality to test the robustness of the model.

This paper investigates the issue from a quantity-based approach, from the reserve money–money multiplier perspective. If the money multiplier mechanism holds, the current practice may find empirical support to continue; it is expected to have a flow-on effect on the real economy in the long-run. Our paper, however, finds a breakdown in the monetary policy transmission from the money multiplier to bank credit, where credit and bank deposits are seen to be driven by exogenous factors. Importantly for policy implications, these results suggest that a review of the Central Bank's monetary policy framework relating to reserve money targeting may be useful.

The rest of the paper is structured as follows. Section 2 provides the context of the study. Section 3 discusses the data and methodology. Section 4 provides the empirical results. Section 5 concludes with some policy implications.

2. Study context

2.1 Macroeconomic setting

Like most PICs, PNG is a small-open-economy, dependent heavily on the external sector, which makes the country highly susceptible to global macroeconomic conditions, as international commodity prices drive both the business and Government budget cycles. However, unlike most PICs, PNG is not a tourist-dependent economy; its development aspirations are driven by mineral and agriculture sectors. The country's agriculture sector has predominantly been the back-bone of its largely rural-based population, comprising of both corporate estates and smallholder-based plantations. The major agricultural exports include palm oil, cocoa, coffee, tea and copra accounting for over 6 per cent of its annual GDP. The mineral exports include crude oil, gold, copper, nickel and cobalt, account for over 80 per cent of total annual exports of over K20.0 billion.

In the recent times, Liquefied Natural Gas (LNG) has featured prominently, becoming the largest export earner accounting for over 40 per cent of mineral exports and 30 per cent of PNG's total exports in 2017 alone. As a result, its real GDP growth has averaged 7 per cent over the last decade. However, the spill-overs to the rest of its economy has been limited, with the LNG sector largely enclaved, requiring highly specialised-skill sets. The majority of the production and consumption of manufactured goods are imported. PNG has a managed floating exchange rate regime with the Central Bank intervening in the foreign exchange market mainly to smooth volatilities, with inflation largely driven by the exchange rate-pass through. The country's payment system like most PICs is still largely cash-based, having a shallow and less-developed financial market.

2.2 Monetary policy framework

On a weekly basis, the Bank of PNG conducts open market operations (OMO) by either selling or maturing (retiring) its holdings government securities to influence the level of commercial banks Exchange Settlement Accounts (ESA) balances. Except where the Bank buys government bills and on-sells to the public, there are no organised secondary markets for government securities in PNG, with bills held to maturity. More recently, the Bank has made allowance for longer term bills to be redeemed before reaching maturity. The bills are issued to finance the Government's budget deficit. The Bank also issues its own securities (Central Bank Bills-CBB) for liquidity management which is particularly important during boom periods, when Government has less need for treasury bills. The Bank does a set of projections on monetary aggregates in the release of its semi-annual Monetary Policy Statement (MPS). The projections are used as a guide with no explicit target set for the Bank to achieve. The Bank also uses direct monetary policy instruments[6] such as the statutory Cash Reserve Requirements (CRR). At present, the Central bank holds ten per cent of all commercial banks deposits as cash reserve deposits. During periods of high commodity prices, liquidity injections through growth in foreign assets of the banking system make the conduct of monetary operations a challenging one; the bank is faced with the task of diffusing and sterilising excess liquidity and when done exclusively through open market operations, this can be a costly and futile exercise. This is further exacerbated when government spends pro-cyclically from these windfall revenue gains.

The use of direct instruments such as the CRR, while highly effective and at no cost to the central bank, has not been used frequently enough. While money aggregates is seen as the intermediate target variable, explicit targets have not been set on the desired level or rate of growth. The introduction of a policy rate[7] (Kina Facility Rate-KFR) in 2001 while signalling a change to interest rate targeting has not been as effective as anticipated in

aligning market rates to the policy rate[8]. A standing facility (Repo facility) or corridor of 100 basis points above and below the KFR is usually charged on loans and paid to deposits of the commercial banks. This was recently reduced to 75 basis points and the repo loans collateralised. However, the standing facility has also been used only sparingly, particularly for repo deposits. As this is not an automatic standing facility, excess commercial bank deposits allowed to be placed here is at the discretion of the Central Bank, while loans extended are given on demand. In this regard, the bank is faced with the policy dilemma of whether to use some form of interest rate or reserve money target or a combination of both as target policy variable. It would seem that there are subtle operational issues at the Bank that need fine tuning. For instance, how the Central Bank might expect its suite of instruments to transmit its desired stance of monetary policy to achieve its ultimate objective of price stability. This is crucial as any further expansion or structural changes to the banking sector and government's fiscal operations has implications for the effective conduct of monetary policy.

2.3 Conventional notion of the money multiplier

While central banks in advanced and in many emerging economies have moved on from targeting money to using interest rate frameworks (Stauffer 2006), many in developing economies continue to use money-based frameworks, with varying degrees of success with some testing the effects to be weak[9]. Keynes (1930) postulated that through the money multiplier, changes in reserve deposits affect the ability of banks to be able to lend and subsequently impact broad money aggregates. Through the monetary base the central banks control the supply of money in the economy. Central Banks' conduct open market operations to either inject or mop up reserve money balances and so are assumed to have control of loanable funds and consequently banks' ability to lend. The relationship assumes stability and as a result, predictability in the growth in money aggregates.

The reserve money or monetary base (MB) comprises of currency in circulation (C), reserve deposits and exchange settlements account[10] deposits of commercial banks with the central bank (R). The Bank's narrowest definition of money denoted as M1 consists of transferable deposits or demand deposits (D) and cash held with commercial bank (C), while M3 which is broad money consists of M1 plus term deposits. Accordingly, the **money** multiplier (mm) is derived as:

$$MB = C + R; \quad M1 = C + D$$

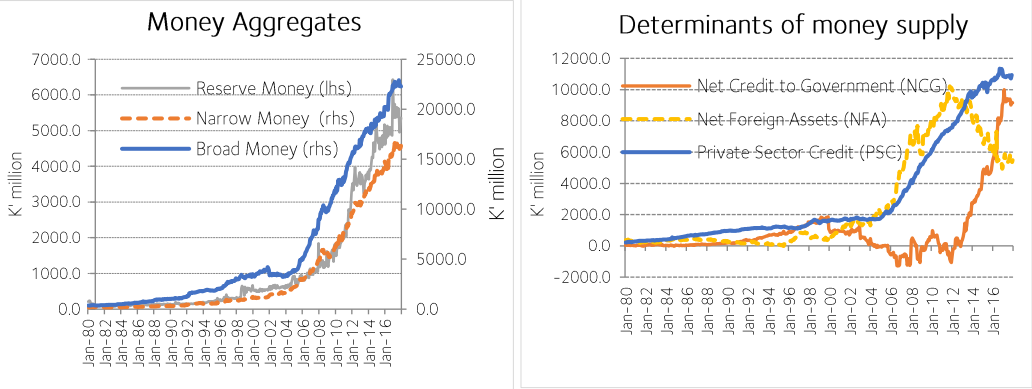
$$\frac{M1}{MB} = mm = \frac{C+D}{C+R} = \frac{\frac{C}{D}+\frac{D}{D}}{\frac{C}{D}+\frac{R}{D}} = \frac{c+1}{c+r}; \text{ where } c = \frac{C}{D}, r = \frac{R}{D}.$$

Assuming there are no excess reserve deposits, if the $\boldsymbol{r}$ (reserve requirement) is 15 per cent and $\boldsymbol{c}$ is 5 per cent, then the $\boldsymbol{money}$ *multiplier* will be $\boldsymbol{mm = \frac{c+1}{c+r} = \frac{1.05}{0.20} = 5.25}$. Hence, if $\boldsymbol{MB}$ increase by K100, then the stock of money would be expected to increase by K525, where banks can lend out extra funds. In essence, the multiplier depends on the reserve requirement decided by the central bank, commercial banks opportunity cost of holdings excess reserves (or ESA) and the private sectors opportunity cost of holding cash instead of deposits.

In our analysis, we look specifically at commercial bank deposits as this serves several purposes; filter the data to capture any significant underlying trends or relationship amongst the variables; gives a longer time series as money market operations of the central bank target commercial banks liabilities (deposits), while examining the narrow bank credit channel, as we look closely at bank deposits with little reference to money supply in our analysis. We first turn to the data to give us a preview of what the trend has been like in PNG for the different money aggregates and the multipliers. From the graphical presentations in Figure 1, there are strong co-movements between the money

aggregates, where between the periods of 2004-2016 we see a surge as all grew strongly. The determinants show of which this was attributed to; in periods of high commodity prices, the build-up in foreign assets contribute strongly to growth in monetary aggregates, while periods of low prices would have net credit to government or domestic borrowings by Government driving growth. Private sector credit growth remains persistent in between these surges. This suggests that deposits maybe driven by external factors outside the central bank's control fuelling credit growth.

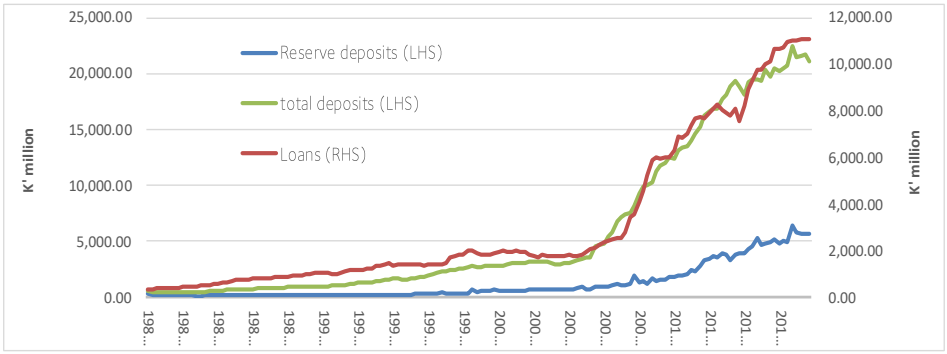
Figure 1: Money aggregates and money supply



Source: Bank of Papua New Guinea

By looking specifically at bank data, this also helps filter the data from any changes in the methodology and compilation of money aggregates[11] over the recent past and importantly examine the narrow bank lending channel. The graphical presentation in Figure 2, show weak co-movements between reserve money and bank loans. On the other hand, loans are seen to move in tandem with changes in bank deposits with the ratio almost constant over the period from 1980q1 to 2017q4, this simple visual inspection gives us an indication of what one would expect from the relationship between the variables.

Figure 2: Bank deposits and loans



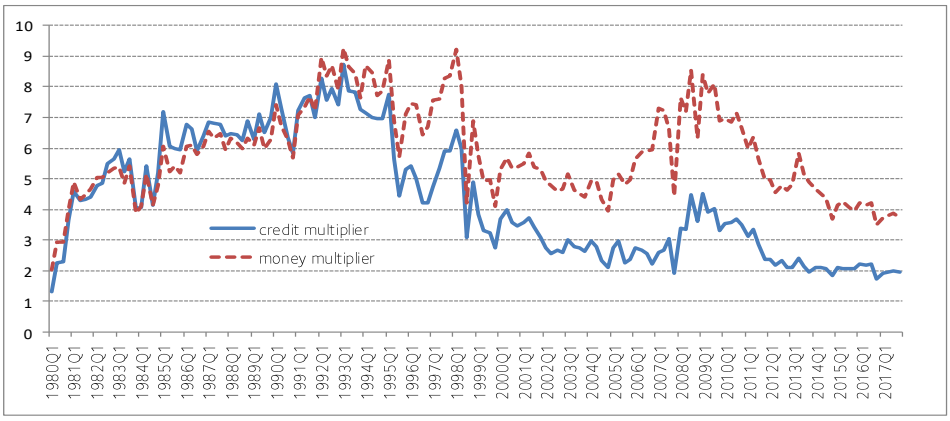
Source: Bank of Papua New Guinea

To put the recent trends into perspective, in 2016 total deposits were around K20.0 billion while reserve deposits just over K5.0[12] billion or around 25 per cent of total deposits. Bank loans were around K11.0 billion. This suggests that reserve deposits alone are not sufficient to fund bank lending. There is a clear trend in the co-movements between loans and total deposits in that both variables tend to track each other fairly closely, over the sample period. Should we take the ratios to measure the standard multipliers, a stable ratio between reserve money and the variables of loans and total deposits would indicate that the money multiplier holds. However, the ratios measured indicate that the relationships are unstable over the sample period as shown in Figure 3.

Prior to 1995, the credit multiplier was around the same size as the money multiplier. Thereafter, the credit multiplier fell below the money multiplier, suggesting that there may have been structural changes in the economy, in which deposits and credit were driven by factors other than changes in the reserve money.

A notable feature in 1994 was the commencement of crude oil exports in PNG and the floating of the local currency (kina), which may have triggered an increase in the size of bank deposits in the banking system, through the expansion of their holdings of foreign assets and liquidity. It is also important to note that in our measurement of money, we include only deposits of commercial banks. Hence, the omission of deposits of other deposit-taking institutions in this analysis makes our definition of money inadequate and as such, our conventional concept of money multiplier is inappropriate. Similar to the approach by Carpenter and Demiralph (2011), we also narrow the focus of our paper by examining the transmission from open market operations to money and bank lending. Hence, if the transmission is weak, we can make the inference that the transmission is ineffective and cannot influence domestic demand and inflation in the long run.

Figure 3: Credit and money multipliers



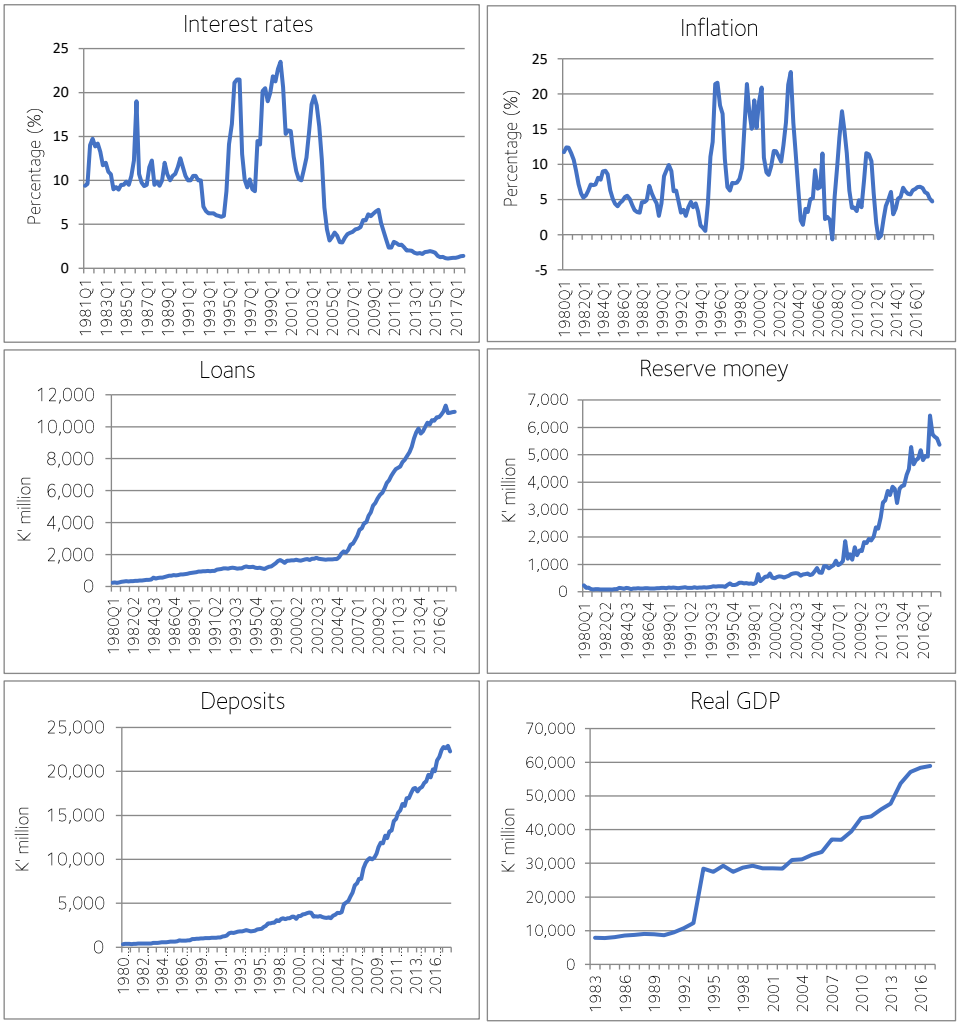
Source: Bank of Papua New Guinea

3. Data and methodology

3.1. Data

We examine the inter-relationship between six variables viz interest rate, inflation, loans, deposits, reserve money and real GDP. All the variables are in quarterly series beginning 1980q1 to 2017q4 and are sourced from various publications of the Bank's Quarterly Economic Bulletin. We use the 28-day Central Bank bill rate as a proxy or indicator for the Central Bank's monetary policy variable[13]. For prices, our model also uses CPI[14] data. For credit, the model uses loans extended by commercial banks, as they make up more than 85 per cent of total loans extended by the financial sector and is the major target for monetary policy operations and conduct. For reserve money, our paper uses reserve money deposits of commercial banks held at the central bank as this is the explicit target variable in the Bank's money market operations (Figure 4). For deposits, we use total deposits of commercial banks. The model uses real GDP[15] as there is no unemployment[16] data available for PNG. Using the quadratic match averaging method of interpolation,[17] we convert annual GDP data into quarterly frequency for the analysis.

Figure 4: Major monetary and macroeconomic aggregates



Source: Bank of Papua New Guinea

3.2. Methodology

We apply Ordinary Least Squares (OLS) to estimate the system of vector autoregressions (VARs). Since we are only interested in the dynamic interrelationship between the variables and not the consistency in the coefficient estimates, stationarity of the variables is not considered. It is assumed that the presence of unit roots should not affect the model selection process as demonstrated by Sims *et al* (1990). Hence, in our analysis the variables enter the VAR system at levels and in natural log form. Consider the multivariate generalisation of an autoregressive process.

$$x_t = A_0 + A_1 x_{t-1} + A_2 x_{t-2} + \cdots A_p x_{t-p} + e_t$$

Where $x_t = (n \times 1)$ vector containing each of the n variables included in the VAR; $A_0 = (n \times 1)$ vector of intercept terms; $A_i = (n \times n)$ matrices of coefficients; and $e_t = (n \times 1)$ vector of error terms. The error terms are assumed to be serially uncorrelated with constant variance.

The variables entering the VAR system are treated as endogenous, which addresses the problem of endogeneity. The variables to be included in the VAR are usually selected according to economic rationale or relevant theory (Enders 2015). For the functional form of the model, we turn to the Cholesky decomposition in propagating the shocks with the following ordering: real GDP; bank deposits; reserve money; loans; inflation and interest rates.

$$\begin{bmatrix} v^{GDP} \\ v^{deposits} \\ v^{reserves} \\ v^{loans} \\ v^{inflation} \\ v^{irates} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \begin{bmatrix} u^{GDP} \\ u^{deposits} \\ u^{reserves} \\ u^{loans} \\ u^{inflation} \\ u^{irates} \end{bmatrix}$$

In the model specification the diagnostic tests, such as the lag length selection criteria, stability of the VAR system for unit roots and the statistical properties of our residuals to ensure white noise, were done to ensure reliability of the model estimates for a parsimonious model.

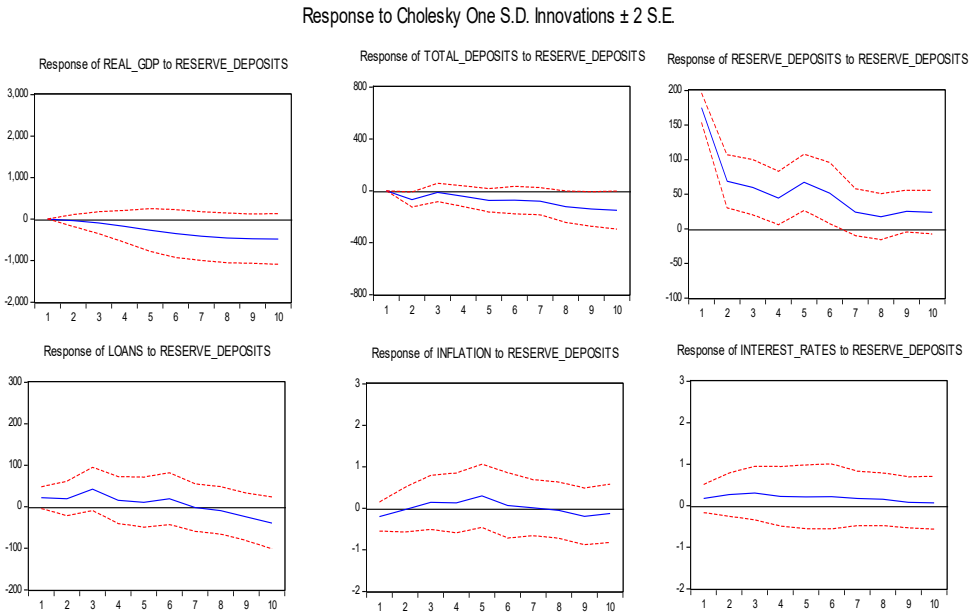
4. Empirical results and analysis

We examine the results generated by the VAR[18] system, which typically includes impulse response function (IRF), Forecast Error Variance Decompositions (FEVD) and historical decompositions. Impulse responses show how the different variables in the system respond to (identified) shocks, i.e., the dynamic interactions between the endogenous variables in the VAR (*p*) process. Since we have 'identified' the structural VAR using the Cholesky ordering, the (IRF) will depict the responses to the structural shocks that have an economic interpretation. The FEVD provides information on the dynamics of the VAR system of equations and how each variable responds and interacts to shocks in the other variables in the system. Seldom used, the historical decomposition[19] estimates the individual contributions of each structural shock to the movements in the variables used over the sample period.

4.1. Impulse response functions– full sample analysis: 1980q1 to 2017q4

Since the focus of our analysis is centred on the dynamic relationship between the variables, this makes the use of the impulse response function appropriate. The use of impulse response functions is to gauge the unanticipated shocks to our monetary policy variables of reserve money and interest rates and the response generated by the variables in the system. Hence, the impulse response functions typically trace the effect of a shock to one endogenous variable onto the other variables in the VAR. In our initial analysis, we examine the data using the full sample period 1980q1 to 2017q4 while analysing the impact of reserve money, interest rates and loans on one standard deviation shocks on the other variables in the VAR system. From the outset, while having a longer time series is advantages for VARs, it is prone to structural changes over longer periods. For instance, there was a change in the exchange rate regime after 19 years from fixed to a managed float in 1994. Also, there were several changes to the Bank's intermediate policy targets coinciding with monetary policy regime changes since the early 1980s shifting from money, to credit growth and after 2001 reserve money targeting and in recent times, mineral resource sector booms. In addition, the Bank of PNG also liberalised its capital controls in 2005 by freeing up restrictions on large capital flows. Hence, the channels of monetary policy are also likely to change over this period and as such, our results may prove counterintuitive with respect to economic rationale and theory that we may attempt to test.

Figure 5: Impulse response to reserve money shocks: credit channel

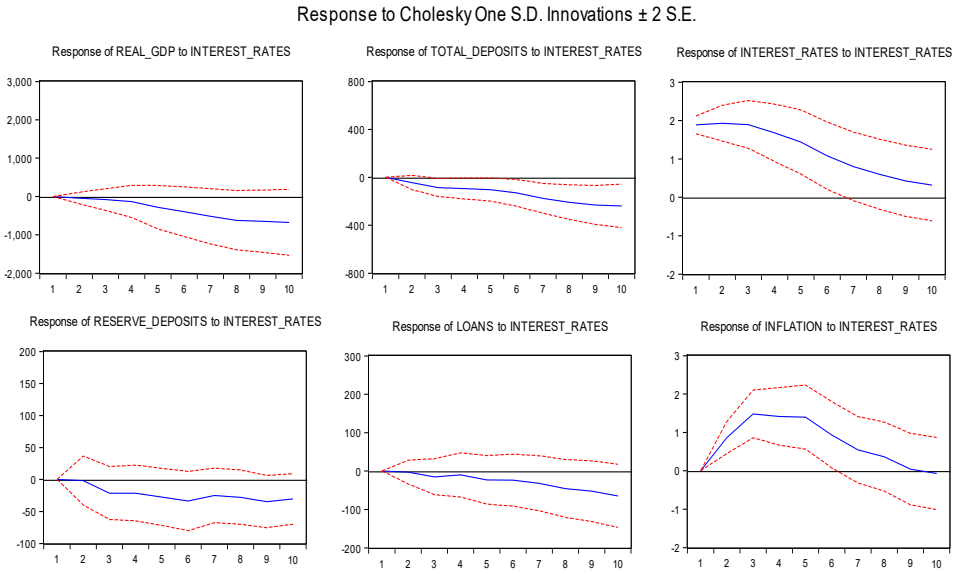


Source: Authors' calculations

For the credit channel, the notion is that the "quantity of loanable funds" transmits monetary policy to the wider economy, otherwise known as the narrow bank lending channel (Meltzer 1995). However, results from our model in Figure 5 show that there is no real impact on loans despite an increase in reserve deposits; i.e., increase in quantity of loanable funds does not induce any increase in bank credit. On the contrary, the results are counterintuitive showing a divergence, such that loans fall over the forecast horizon in response to a positive reserve money shock (bottom left panel). Should the transmission be effective, changes in the quantity of reserves through the Bank's open market operations in the retirement or purchase of government securities should induce an increase in the amount of loanable funds than commercial banks can lend.

There are several plausible explanations, one of which is the exogenous demand-side factors which are not captured in this analysis. These include, government spending and resource sector induced level of economic activity. Hence, while the amount of loanable funds has increased this may not necessarily lead to increase in private sector borrowing. When we further examine the response of interest rates to the reserve money shock, there is no descendible response (bottom right panel). According to Monnet and Webber (2001), central banks do not control interest rates directly, but can adjust instruments that they control such as reserves directly affecting the stock of money and subsequently the price of money which is interest rates, which does not hold for our case. This suggest that the change in the volume of reserve deposits may not be sufficiently large enough to induce a change in the price setting behaviour of commercial banks with respect to changes in interest rates. This break in transmission is further evident in banking deposits lack of response to reserve money shocks (top middle panel). The notion here is that when firms draw down on the increase in the amount of loanable funds, the corresponding increase in loans should lead to a subsequent increase in bank deposits on the liabilities side. Our results suggest that there could be other exogenous factors that may induce changes in the volume of bank deposits and not necessarily reserve money. This is particularly true for small-open-resource-rich economies like PNG.

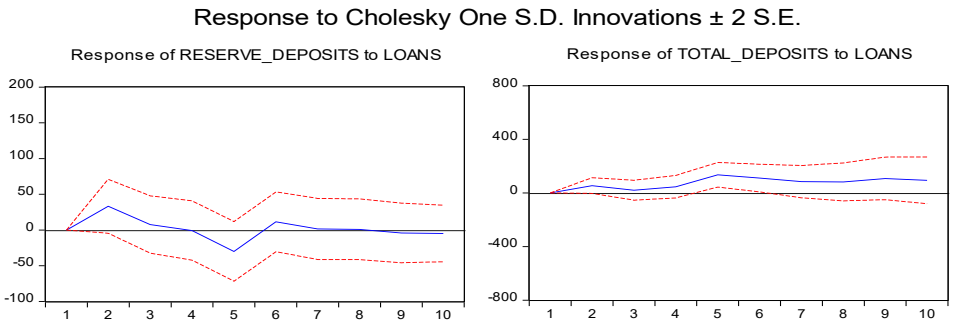
Figure 6: Impulse response to Interest rate shocks: interest rate channel



Source: Authors' calculations

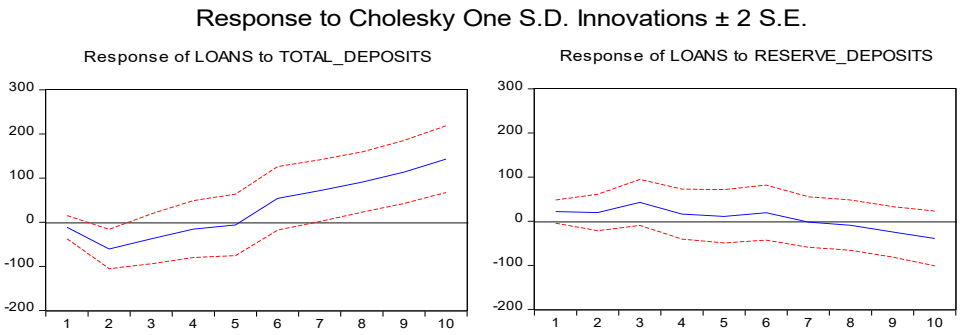
With respect to interest rate shocks, according to economic literature interest rate adjusts to clear markets and influence borrowing and lending behaviour. By influencing the level of interest rates in the economy, monetary policy affects how much firms and households want to borrow (Mishkin 1996). The assumption here is that the interest rate is the exogenous policy variable. From the Cholesky ordering, interest rate affects the domestic variables contemporaneously. The results from the impulse response function in the bottom middle panel in Figure 6 indicate that an increase in interest rates leads to some contraction in bank loans as credit conditions tighten while total deposits also contract. This suggests that interest rates influence borrowing behaviour of economic agents to some degree, as higher interest rates discourage borrowing. However, in the bottom left panel of Figure 6, the impulse response function shows that there is no clear effect on reserve deposits from the interest rate shock. A tighter liquidity condition through increase in interest rates should lead to a fall in reserve deposits. These suggest a breakdown in the behaviour of the two policy variables – that is, the price and volume of loanable funds that the Central Bank is assumed to have some influence over. This may also suggest that there were inconsistencies and variations in the way monetary policy was conducted as well as changes in the intermediate policy target variable over this period. Interestingly enough, we also observe a '*price puzzle*'[20] in our results (bottom right panel) in the response in inflation to the interest rate shock (Eichenbaum and Evans 1995; Cushman and Zha 1997).

Figure 7: Impulse Responses of Liabilities to Loans



Source: Authors' calculations

Figure 8: Impulse Responses of Loans to Liabilities



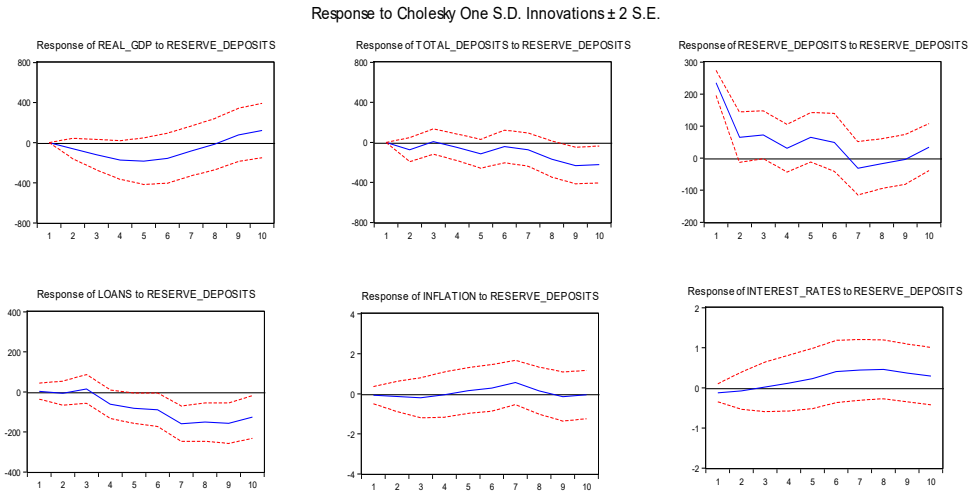
Source: Authors' calculations

In Figures 7 and 8 we investigate bank loans in closer detail by examining the impulse responses of loans to deposits and vice versa. In Figure 7, the right panel shows that total deposits increase in response to a bank loan shock, whereas reserve deposits barely respond to increase in loans (left panel). Figure 8 (left panel) indicates that bank loans increase in response to an increase in total bank deposits; hence there is a clear link between deposits and loans. By contrast, counterintuitively bank loans decrease rather an increase in response to reserve money or loanable funds shocks (right panel). This is in contrast to the money multiplier effect and our priori expectations that bank loans should increase in response to increase in reserve money or amount of loanable funds. These suggest that bank loans are driven by exogenous demand-side factors and not supply-side (reserves).

4.2 Impulse response functions — Sub-sample analysis: 2000q1-2017q4

The Bank moved from using broad money aggregates as intermediate target variables to using reserve money or base money as the policy target variable after 2000 with the introduction of the Central banking Act. This was done consistently with the introduction of price stability as the objective of monetary policy in PNG. A policy interest rate target variable was also adopted as the signalling rate on the stance of policy. In essence, this sample period under analysis is warranted to cover only one policy regime which is the reserve money framework. In this analysis we maintain the same variables used as well as the ordering of the variables as in our full sample period.

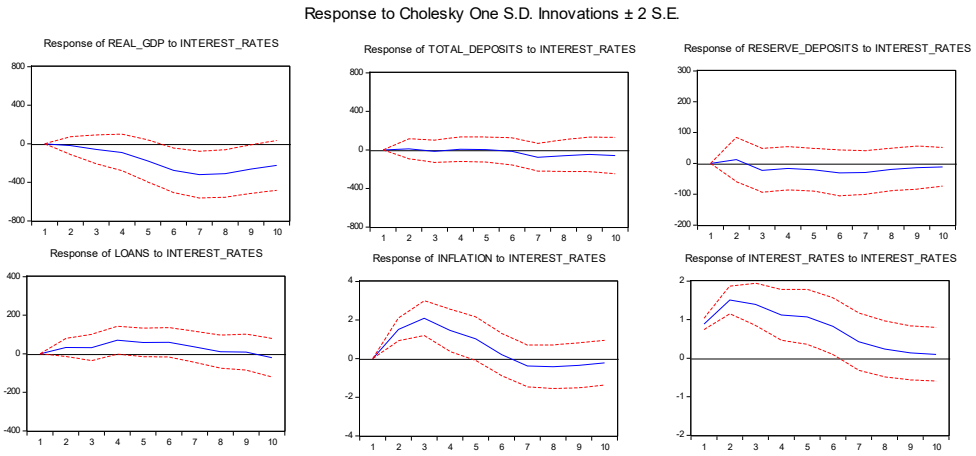
Figure 5: Impulse response to reserve money shocks: Credit Channel



Source: Authors' calculations

When examining the sample periods from 2001q1 to 2017q4 under the reserve money regime, the impulse response function results as shown in the bottom left panel of Figure 5 indicate that loans fall in response to an increase in reserve money, while interest rates increase (bottom right panel). Total deposits also decline (top middle panel). Again, this is in contrast to a priori expectations. i.e., reserve money shock from the viewpoint of the 'loanable funds' theory—i.e., the central bank creates money which then triggers credit and deposit creation which is rejected by our results. So even under the central bank's reserve money regime, there is still lack of transmission from reserve money to total deposits and to loans extended.

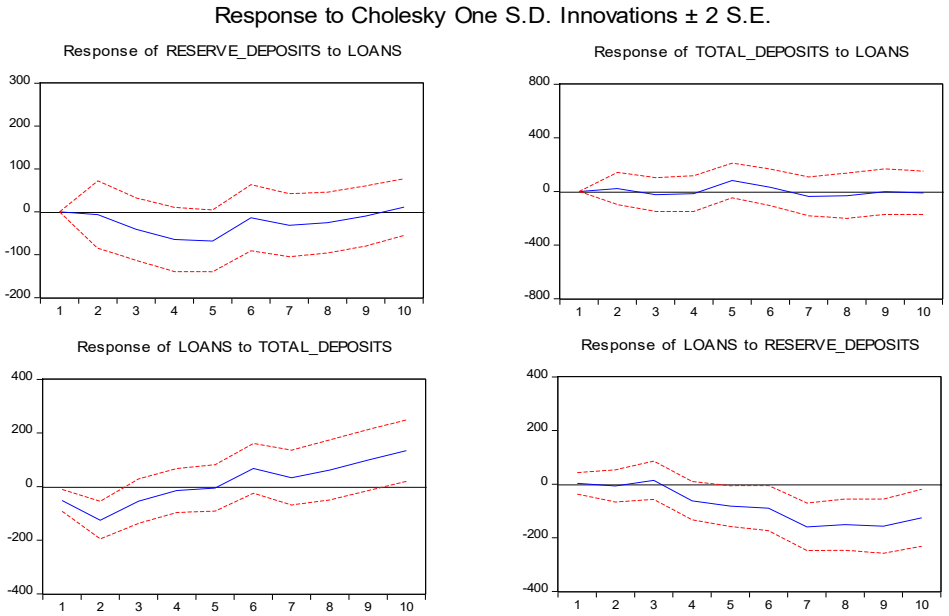
Figure 6: Impulse Response to interest rate shocks: Interest rate channel



Source: Authors' calculations

When examining the interest rate channel, our model results in Figure 6, indicate a breakdown in the interest rate transmission where loans increase slightly in response to an interest rate shock (bottom left panel), while increase in interest rates do not induce any response from total deposits. These suggest that there are other macroeconomic factors driving demand for credit while simultaneously contributing to increase in interest rates. While going beyond the scope of this paper, the key lies in the driver of inflation and how interest rates respond to these shocks[21]. While open market operations have been predominantly used during this period, the use of more direct instruments of monetary policy could have assisted, particularly during periods of high banking system liquidity.

Figure 7: Impulse Response functions: loans to liabilities



Source: authors' calculations

The results from the impulse response functions in Figure 7 do not differ much compared to the full sample period, except that total deposits response to increases in bank credit is weaker (top right panel). There have been several major events[22] or external shocks that occurred during this period which could explain this phenomenon, which may have weakened the demand for loans while impacting bank deposits. It is highly plausible that growth in deposits were driven by these factors that attenuate the response of loans to monetary policy lessening the sensitivity to reserve money and interest rate shocks.

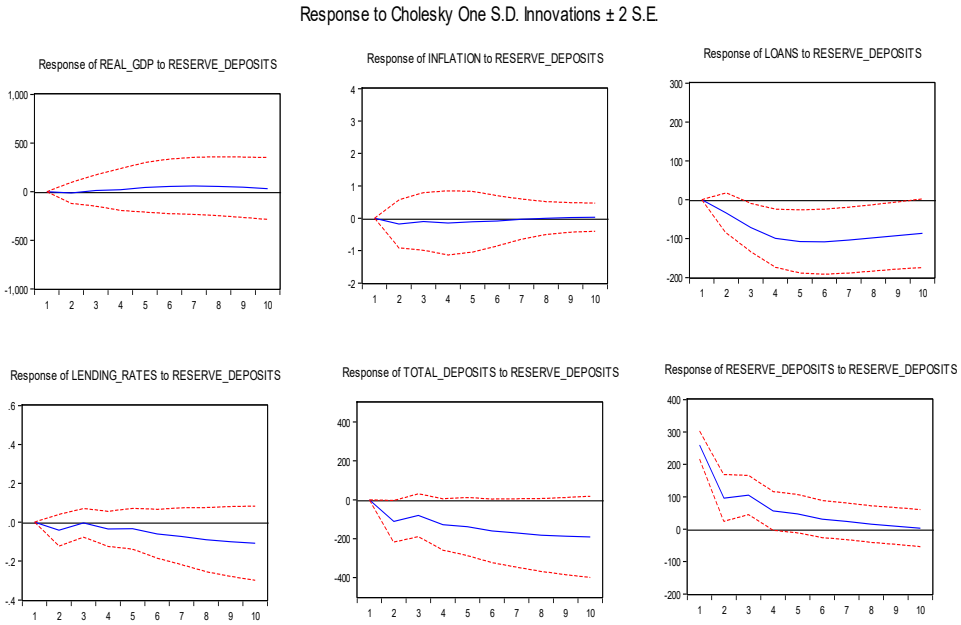
4.3 Robustness check

In this analysis, we make an adaptation to the model by using lending rates replacing the policy rate and reserve money as our explicit target policy variable,[23] while changing the ordering the variables to capture the stylised facts in the Bank's reserve money framework. The supposed direction of the transmission is from reserve money, bank deposits, lending rates, bank loans, inflation and real GDP. Through open market operations the Central Bank controls or targets some level of reserve money influencing stock of deposits and subsequently lending rates, bank loans, inflation and aggregate demand (Monnet and Webber 2001). For the sample period we re-examine the periods 2000q1 to 2017q4. In this analysis, we investigate further using stylised facts with respect to the policy variables of interest, the shock propagation and chain of causality amongst the variables.

$$\begin{bmatrix} v^{GDP} \\ v^{inflation} \\ v^{loans} \\ v^{lrates} \\ v^{deposits} \\ v^{reserves} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} = \begin{bmatrix} u^{GDP} \\ u^{deposits} \\ u^{loans} \\ u^{lrates} \\ u^{deposits} \\ u^{reserves} \end{bmatrix}$$

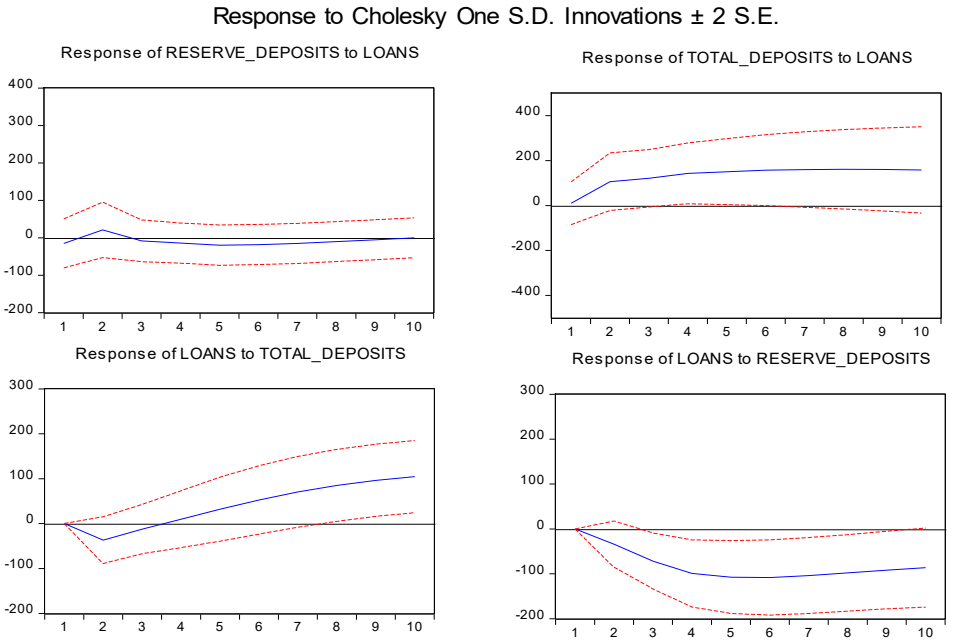
The results show in Figure 8 that a shock to reserve deposits is not consistent with our priori expectations such that total deposits decline (bottom middle panel) followed by a fall in commercial bank loans (top right panel), despite lower lending rates. These further suggest that lending rates are not a major contributing factor with respect to bank borrowing behaviour. While the policy variable of reserve money increases given the positive shock, the impact only extends as far as inducing a fall in lending rates.

Figure 8: Impulse response function: Robustness checking



Source: Authors calculations

Figure 9: Impulse response function: Response of loans to liabilities



Source: Authors calculations

When we take a closer examination at the relationship between the variables, the results as depicted in Figure 9 show that the association between loans and deposits are in

tandem, such that when there is a shock to loans the level of deposits increase and vice versa .i.e., a shock to deposits sees an increase in loans (bottom left and top right panels). On the other hand, a positive shock to reserve deposits sees a fall in commercial bank loans despite a fall in lending rates (bottom right). While a shock to loans does not induce any response from reserve deposits (top left panel). The results in this policy scenario are statistically significant for most, which further suggests that the reserve money transmission to credit does not hold as indicated. In this case, it is plausible that the increase in bank deposits may be driven by exogenous factors, causing an increase in banking system liquidity while fuelling demand for loans. Hence, this may have allowed firms and businesses to use their improved cash balances and profits during the boom periods to offset existing loans while refraining from borrowing from the commercial banks.

5. Conclusion and policy implications

This study investigates the monetary policy mechanisms and transmissions while examining the money multiplier concept and the credit channel in the case of PNG. The VAR model is estimated using quarterly data for the period 1980q1 to 2017q4. The estimation is conducted for the full as well as sub-sample periods. Our results show that the transmission is relatively weak, such that the volume of loans does not always respond to an increase in the supply of loanable funds. On the other hand, loans respond more to increase in bank deposits, suggesting that it might be the demand side of the economy that drives bank credit. There are several plausible explanations that go beyond the scope of this paper, one of which is the openness and vulnerability of the PNG's banking sector to fiscal deficits and external price shocks. The other plausible explanation is that the foreign-owned banks may have access to liquidity and sources of financing from their parent holding companies abroad which might make it challenging for the central bank to influence their lending behaviour. This also includes credit ceilings imposed on certain industries by banks that may be considered as high risk. Overall, there is little evidence to suggest that the traditional monetary transmission mechanism through bank credit works through central bank's control of reserve money.

When examining the interest rates, bank loans decline in response to increase in interest rates; hence, interest rates play some part in influencing borrowing and lending behaviour. This holds for longer time series under the full sample period. However, when we examine a more recent and shorter sample period 2000q1 to 2017q4, the results indicate a breakdown in this relationship in that loans increase rather than decrease in response to increase in interest rates, while total bank deposits do not respond to increases in credit. The results using stylised facts for the same sample periods further suggest a weakness in the money multiplier in that loans are more sensitive to changes in bank deposits than to reserve deposits, despite a fall in lending rates. From the discussion of endogenous money creation viewpoint, credit and deposit growth do move in tandem which maybe a good way to look at the money creation process in PNG. While literature has often pointed to financial innovations and increase in substitutes for money as the major factor in the breakdown in the multiplier, changes in external conditions appear to be an underlying factor as well for PNG.

Some policy implications emerge with respect to the central bank's price stability mandate. If the focus is on interest rates, monetary operations may be centred on providing the liquidity that yields an interest rate that is close to its policy rate. In this case, quantities, including reserve money, become endogenous to the price target. Alternatively, should it seek further refinement to its reserve money framework, for a start, better and tighter control of liquidity conditions may be needed. This may require using a combination of both money market and direct policy instruments. The challenge is doing this consistently over sustained periods before any material outcomes are realised. Further research may include investigating the impact of international oil and commodity price shocks on the conduct of monetary policy to better understand the exogenous shocks not captured in this study. Also, looking at a fiscal-monetary policy mix could be useful in explaining how the budget cycle affects liquidity conditions that have been challenging for the central bank. In the meantime, this study provides systematically gained insights into the important question of whether the money multiplier holds in the case of PNG.

Notes and References

Arby, MF, 2000, 'Predicting money multiplier in Pakistan', *The Pakistan Development Review*, 39(1) pp. 23-35.

Arestis, P and Sawyer, MC, 2002, 'The Bank of England macroeconomic model: Its nature and implications' *Journal of Post Keynesian Economics,* 24 (2) pp. 529-45.

Badarudin, ZE, Ariff, M and Khalid, A, 2009, 'Money supply behaviour in emerging economies: A comparative analysis', *Journal of the Asia Pacific Economy*, 14(4) pp. 331–50.

Baghestani, H and Mott, T, 1988, 'The money supply under alternative Federal Reserve operating procedures: An empirical examination', *Southern Economic Journal*, 55(2) pp. 485-93.

Bernanke, B and Blinder, A, 1992, 'The federal funds rate and the channels of monetary transmission', *American Economic Review,* 82(4) pp. 901–21.

Beveridge, S and Nelson, CR, 1981, 'A new approach to decomposition of economic time series into permanent and transitory components with particular attention to measurement of the business cycle', *Journal of Monetary Economics* 82(4) pp. 151-74.

Carpenter, S and Demiraph, S, 2011, 'Money reserves and the transmission of monetary policy: Does the money multiplier exist?', *Journal of Macroeconomics,* 34 pp. 59-75.

Crowe, C and Meade, EE, 2007, 'The evolution of Central Bank Governance around the world', *The Journal of Economic Perspectives,* 21(4) pp. 69-90.

Cushman, DO and Zha, T, 1997, 'Identifying monetary policy in a small open economy under flexible exchange rates', *Journal of Monetary Economics*, 39(3) pp. 433-48.

David, S and Nants, A, 2006, 'Monetary policy transmission mechanisms in Papua New Guinea', *Bank of Papua New Guinea working paper series* 2006/01 pp. 7-24.

Disyatat, P, 2011, 'The Bank lending Channel revisited', *Journal of Money, Credit and Banking,* 43(9) pp. 713-30.

Eichenbaum, M and Evans, CL, 1995, 'Some empirical evidence on the effects of shocks to monetary policy on exchange rates', *Quarterly Journal of Economics*, 110(4) pp. 975-1010.

Enders, W, 2015, *Applied Econometric Time Series,* Fourth Edition, Wiley.

Goodhart, CAE, 1989, 'Has Moore Become too Horizontal?', *Journal of Post Keynesian Economics*, 12(1) pp. 29-33.

Hafer, R, Haslag, JH and Jones, G, 2007, 'On money and output: Is money redundant?', *Journal of Monetary Economics*, 54(3) pp. 945–54.

Ireland, P, 2004, 'Money's role in the Monetary Business Cycle', *Journal of Money, Credit and Banking,* 36 pp. 969-83.

Jayaraman, TK and Choong, CK, 2009, 'How does monetary policy transmission mechanism work in Fiji?', *International Review of Economics*, 56(2) pp. 145-61.

Jayaraman, TK and Choong, CK, 2010, 'How does monetary policy transmission mechanism work in Solomon Islands?', *Pacific Economic Bulletin,* 25(1) pp. 76-95.

Jayaraman, TK and Ward, BD, 2004, 'Is the money multiplier relevant in a small, open economy? Empirical evidence from Fiji', *Pacific Economic Bulletin,* 19(2) pp. 48-53.

Jha, R and Rath, DP, 2000, *On the endogeneity of money multiplier in India,* Australia South Asia Research Centre, ANU, pp. 4-30.

Keynes, JM, 1930, *A Treaties on Money*, New York, St Martin's Press.

Leeper EM and Roush, JE, 2003, 'Putting "M" Back in Monetary Policy' *Journal of Money, Credit and Banking,* 35 pp.1257-64.

Meltzer, AH, 1995 'Money, credit and (other) transmission process: A monetarist perspective', *The Journal of Economic Perspective,* 9(4) pp. 49-72.

Meltzer, AH, 2001, *The monetary transmission process: Recent developments and lessons for Europe*, Deutsche Bundesbank (edition) Palgrave, London, pp. 112-30.

Mishkin, FS, 1996, 'The channels of monetary transmission: Lessons for monetary policy' *National Bureau of Economic Research (NBER) Working Paper Series* 5464 pp. 4-24.

Monnet, C and Webber, WE, 2001, 'Money and interest rates' *Federal Reserve Bank of Minneapolis Quarterly Review*, Fall 2001, 25(4) pp. 2-13.

Moore, BJ, 1989, *Horizontalists and Verticalists: The Macroeconomics of Credit Money*, Cambridge University Press.

Narayan, PK, Narayan, S, Mishra, S, and Smyth, R, 2012, 'An analysis of Fiji's monetary policy transmission', *Studies in Economics and Finance*, 29(1) pp. 52-70.

Nelson, E, 2002, 'Direct effects of base money on aggregate demand: theory and Evidence', *Journal of Monetary Economics,* 49, pp. 687–708.

Peiris, SJ and Ding, D, 2012, 'Global commodity prices, monetary transmission, and exchange rate pass-through in the Pacific Islands', *IMF Working Paper Series*, WP/12/176, pp. 3-13.

Robbins, L, 1932, *An Essay on the nature and Significance of Economic Science*, London, Macmillan.

Sims, CA, 1980, 'Macroeconomics and reality', *Econometrica,* 48(1) pp. 1-48.

Sims, CA, Stock, JH and Watson MW, 1990, 'Inference in linear time series models with some unit roots', *Econometrica,* 58(1) pp. 113-44.

Stauffer, R, 2006, 'An innovative money multiplier' *The American Economist,* 50(2) pp. 58-64.

Stock, JH and Watson, WM, 2001, 'Vector autoregressions' *Journal of Monetary Economics,* 44 pp. 293-335.

Thenuwara, W and Morgan, B, 2015, 'Monetary targeting in Sri Lanka: how much control does the central bank have over the money supply?', *Journal of Economics and Finance,* 41(2) pp. 276-96.

Tule, KM and Ajilore, OT, 2016 'On the stability of the money multiplier in Nigeria: Co-integration analyses with regime shifts in banking system liquidity' *Cogent Economics & Finance,* pp. 2-16.

Yang, Y, Davies, M, Wang, S, Dunn, J and Wu, Y, 2012 'Monetary policy transmission and macroeconomic policy coordination in Pacific island countries', *Asia Pacific Economic Literature* 13(33) pp. 46-68.

Notes

1 https://www.news.com.au/finance/economy/interest-rates/rba-cuts-cash-rate-to-new-record-low-of-1-per-cent/news-story/19e18ce448046833dbeb2102de008dfd
2 The approach was first developed by Benanke and Blinder (1992).
3 The paper found no association between the increase in reserve balances and bank credit and hence a break down in the standard money multiplier theory in the US.
4 Carpenter and Demiralp (2011) examined the impact of the US Fed's quantitative easing policy in combating the effects of a severe financial crisis and a US recession in 2008 during and after the GFC.
5 Several internal discussion papers have been produced in response to policy questions on the effectiveness of transmission of monetary policy in PNG.
6 The other direct instrument was the Minimum Liquid Assets Ratio (MLAR), a prudential instrument which was reduced from 25 per cent to zero in October 2010.
7 The Bank's policy rate, know is the Kina Facility Rate (KFR) is a signally rate which indicates the bank's stance of monetary policy
8 Series of internal discussion papers and analytical notes point to a clear break in the transmission from the policy to market interest rates.
9 To cite a few, see papers by Thenuwara and Morgan (2015); Tule and Agilore (2016); Arby (2000) and Disyatat (2011).
10 This would comprise of deposits in excess of the reserve requirement (CRR) typical know as excess reserves.

11 In 2008, the coverage on the compilation of monetary aggregates was extended to include non-banks. Prior to that commercial bank deposits were the only source, albeit commercial banks make up over 80 per cent of total deposits at present.

12 Kina (K) is the local currency of PNG, current rate is at around K1 per 0.30 US cents.
13 The central bank targets the 28-day CBB rate through its OMOs to align this with the policy rate (KFR) although this has not been done consistently in recent times.
14 Sourced from the PNG National Statistical Office
15 There is a structural break in 1994/1995 as depicted clearly in the graph.
16 The Bank compiles quarterly formal private sector employment (index), but has a much shorter series.
17 The Eviews software is used in this interpolation exercise.
18 The VAR models first developed by Sims (1980) are typically used to investigate the impact and relationship between monetary variables such as interest rate and money supply and prices and real output (Stock and Watson 2001).
19 Although first developed by Sims (1980), the first study to use the Historical decomposition was by Beveridge and Nelson (1985).
20 Price increases rather than decrease in response to increase in interest rates.
21 This can be view as external drivers that push prices up and subsequently demand for credit.
22 2008 GFC; 2005-2008 commodity price boom; 2009 PNG LNG construction phase
23 While the transmission framework includes interest rate as a policy variable, arguable the practical aspects of the operations are predominantly centred on influencing reserve money through the ESA of commercial banks.

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