Effects of Monetary Policy on Bank's Credit Dynamics in Tanzania*

Lusajo P. Mwankemwa† and Bonaventura Mlamka‡

Abstract

In a similar trend to other East African Community partner states, growth of credit to private sector in Tanzania has been declining in the recent past, despite massive effort by the monetary policy to boost bank's credit extension. Using quarterly data spanning from 2002 to 2019, this paper estimates a structural vector autoregressive model to examine the intertwined relationships between monetary policy and growth of private sector credit, together with other key macroeconomic variables in Tanzania. Estimates from the model shows that the real effect of monetary policy on credit growth is quantitatively small — a 2.5% rise in cash rate leads to a decline in real growth of credit to the private sector by 0.1%. Though, in responding to the macroeconomic consequences of the shock in growth of private sector credit, monetary policy appears to stabilise the economy effectively. At short horizons, shocks to monetary policy found to be a significant driver of credit growth. Over longer horizons, shocks to real output, past shocks to credit growth and external shocks plays a greater role. The contemporaneous effects of external shocks to the growth of private sector credit takes slightly more than two years to disappears, but it would have taken much longer in the absence of a monetary policy response. These findings assert that, bank's capacity to credit extension is vulnerable to both domestic and external shocks, and although it may be unfeasible for the monetary policy to fully caution the banking system from shocks, a quick and appropriate policy response may help banks to quickly recover from unexpected shocks.

Keywords: Bank's private sector credit; Credit channel; Monetary policy; Tanzania
JEL Classification Codes: E31, E52

* Disclaimer: This paper should not be reported as representing the views of the Bank of Tanzania (BOT). The views expressed herein are those of the author(s) and are not necessarily those of the BOT and its Management

†Research department, Bank of Tanzania. Email: lpmwankemwa@bot.go.tz. (corresponding author).
‡Forecasting Unit, Bank of Tanzania. Email: bmmlamka@bot.go.tz

1. Introduction

Since early 2016 growth of credit extension in the East African Community (EAC) partner states — particularly loans made to private sector — has been declining trend wise, despite massive policy effort by respective central banks to boost bank's credit extension. Notable, the growth of bank's credit to private sector in Tanzania declined from an average of 19.5 percent during 2010–2016 to 4.9 percent during 2017–2019, whereas the policy rate declined from the average of 9.0 percent to 4.4 percent in a similar period (BOT, 2019). At roughly the same time, the economy registered a cyclical contraction, followed by a period of unusually sluggish growth[1]. As such, the relationship between the monetary policy response and continued slowdown trend in the growth of private sector credit has recently been the focus of much debate. Is it the sluggish economy causes a slowdown in credit formation via credit demand, or rather the tight monetary conditions that leads to restrictions in credit supply by banks? Are external environment important in explaining this pattern? While such identification questions can rarely be answered definitively, this paper looks at this issue from the supply angle: "a reduced credit supply due to reduced willingness of banks to provide loans, without being followed by an increase in loan interest rates can be attributed to the tight monetary policy stance[2] adopted by the central bank" (Pazarbasioglu, 1997).

The literature emphasises the importance of bank's credit in the transmission mechanism for developing countries, mainly because the economies are dominated by many bank-dependent borrowers especially small businesses rely heavily on banks for financing (Ramlogan, 2004, 2007, Mishra *et al*. 2010, Montiel *et al*. 2012, Moussa & Chedia, 2014; Onyemaechi, 2015, Onoh & Nwachukwu, 2017). The traditional money view attributes the force of monetary policy entirely to changes in the money supply, which change interest rates and spending in turn. If there are substantial information problems in financial markets, the impact of monetary policy will be amplified and distributed across borrowers. However, the credit channel of monetary policy transmission is not one way. First, tight policy[3] may reduce the supply of private sector credit, which reduces spending by bank dependent borrowers [the lending channel (Bernanke and Blinder1988)]. Second, tight policy weakens firms' balance sheets, reducing their ability to borrow from all sources [the balance sheet channel (Bernanke and Gertler1995)]. As much as this may stand to be the case for Tanzania (Montiel *et al* 2012, Mbowe, 2017)[4], different opinions have emerged over time regarding the effectiveness of monetary policy in promoting bank's credit for economic growth in developing countries (Fontana & Palacio-Vera, 2007, Afolabi *et al*., 2018).

Empirically, studies on the effects of monetary policy towards bank's credit extension have shown that the policy rate is a poor tool to deal with excess leverage, risk taking or the apparent deviations of asset prices from fundamentals. This view is also enshrined by the recent practice of central banks in the developing world, to focus on policy rate to spur private sector credit for higher economic growth (Heintz & Ndikumana, 2010). There are also evidence suggesting that the policy rate is a blunt tool — a higher policy rate does reduce some excessively high asset prices but it comes at a cost of a larger output gap (IMF 2013, Gumata & Ndou, 2017). As such, restrictive monetary policy works not only by raising interest rates, but also banks' ability to extend credit through making new loans are constrained directly by monetary tools and consequently, lowers the availability of credit to borrowers who depend on bank's finances, hence low economic growth (Onyeiwu 2012, Wrightman 2012, Ezirim 2015 and Chowdhury *et al*., 2013).

This study therefore, contributes to the debate on whether monetary policy has any influence on bank's credit extension to the private sector. It investigate the dynamic influence of monetary policy on macroeconomic variables in Tanzania, with a particular attention being paid on the

relationship between monetary policy and growth of credit to the private sector — a subject that has received very limited attention in scholarly work on Tanzania. This paper estimates a small structural vector autoregressive (SVAR) model to identify and map real growth of the private sector credit and trajectories (impulse responses) of other key macroeconomic variables, following an unexpected shocks on monetary policy and vice versa. The SVAR methodology is applied as it can account for endogenous relationships, and can summarise the empirical relationships without placing too many restrictions on the data. While the SVAR model is compatible with many different economic theories, the estimates can be sensitive to the set-up of the model. The study uses the overnight interbank cash market rate as monetary policy variable in tandem with monetarist theory and short-term interest rates premised on the Keynesian theory. It also includes CPI inflation to capture the indirect impact of monetary policy on economic growth by maintaining price stability. The impulse response functions of the estimated model show that monetary policy shocks have important but small real effects on the growth of private sector credit as a 2 5% rise in the cash rate causes a 0.1% decrease in the growth of private sector credit. Although the real effect of this mechanism is quantitatively small, in responding to the macroeconomic consequences of a shock in private sector credit, monetary policy appears to stabilise the economy effectively. The other sections of this paper are organized as follows: section 2 presents the stylized facts on Tanzania's private sector credit supply and monetary policy. The review of the literature is presented in section 3, while section 4 gives the details of the methodology employed in the analysis of data. The empirical results are discussed in section 5, and section 6 concludes.

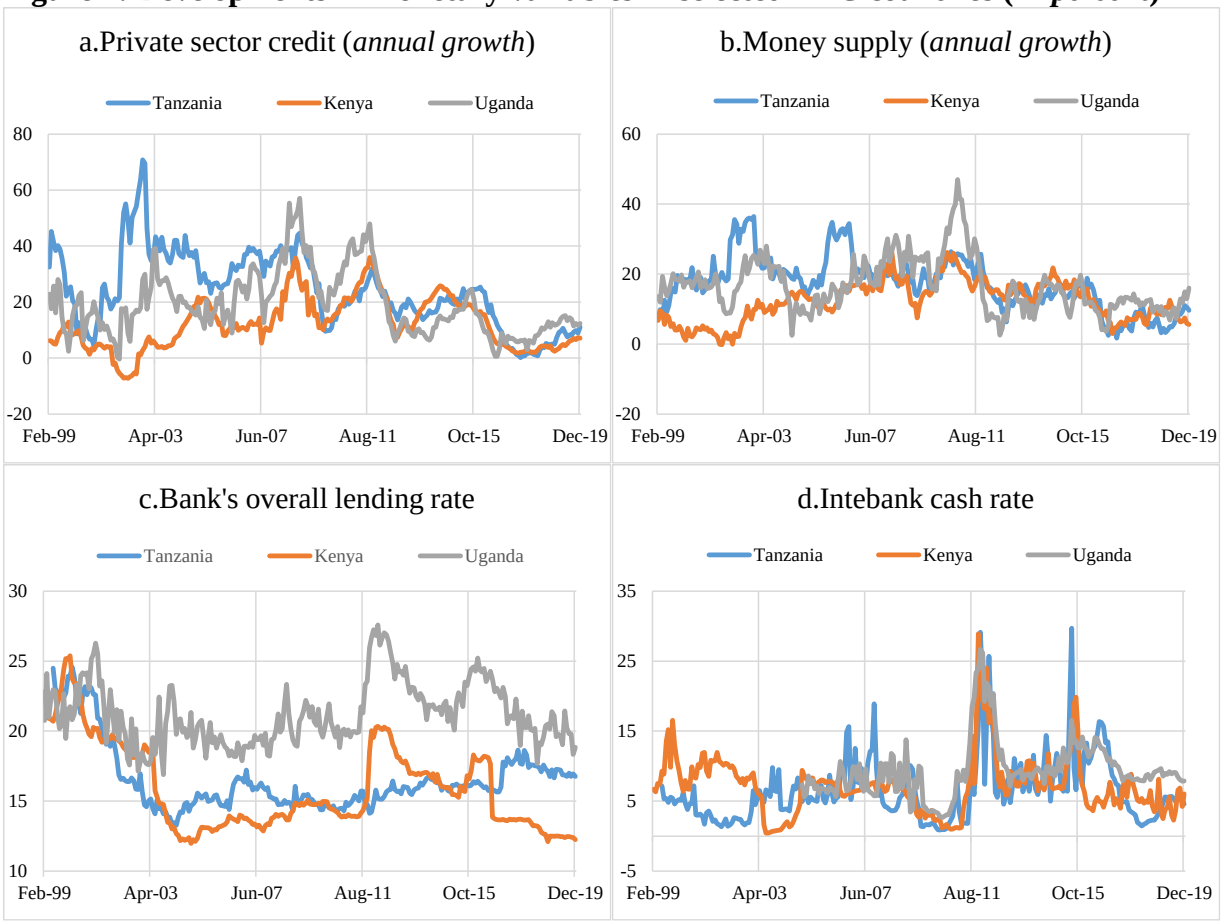
2. Private sector credit and monetary policy in Tanzania

Banks and other financial intermediaries in the formal financial system are the major sources of credit used by private sector to finance consumption and investment expenditures in an economy. In relation, two epochs are identifiable in the supply of credit to the private sector in Tanzania. One, is the 'command economy epoch', and the other is the 'market economy epoch'. The command economy epoch commenced at the launch of the Arusha Declaration in 1967. The Declaration, first, led to the nationalization of private banks and non-bank financial intermediaries (NBFIs), and in their place established state-owned banks and NBFIs (Kilindo, 2020). Due to inefficiencies associated with the command economy epoch, the Government, in collaboration with the International Monetary Fund (IMF) and World Bank in mid-1980s engineered a number of policy changes (BOT, 2007; 2015), including[5] the enactment of the Banking and Financial Institutions Act (BFIA) in 1991 that lifted entry restrictions to the participation of private financial institutions in the financial sector, and increased the sources and varieties of credit to the private sector at market forces. The discount window, started in 1994 and Open market operations (OMO), introduced in 1993/1994, were the main monetary policy instrument that provides mechanism to achieve monetary policy objectives - through anchoring interest rates, liquidity management and financing of fiscal deficits (Mbowe, 2017). Repurchase agreement (REPO), intraday and Lombard facilities and Repurchase agreement (REPO), were introduced in 2003 and 2007, respectively, influenced banks' supply of credit to private sector and interest rate setting behavior.

Liberalization and reform efforts lead to the expansion of credit supply in the country. Annual growth of the private sector credit grew by 46.4 percent by December 2002, and remained at an average of 33.8 percent between January 2003 and December 2006. During the period, money supply also grew by an average of 19.2 percent annually. In a similar trend to Kenya and Uganda, bank's credit to the private sector in Tanzania slowed down recording a historically low growth of 7.2 percent in December 2016 lower than 9.6 percent recorded in December 2009 when the global financial crisis hit the economy (Figure 1, panel a). During the year ended December 2016, annual change in credit to private sector had reached TZS 1,116.6 billion in December 2016, down from TZS 3,187.1 billion in the year ended December 2015. Equally important, growth of private sector

deposits in banks registered a historical low annual growth of 3.9 percent in December 2016, down from 20.0 percent recorded in December 2015 (BOT, 2018). In response, the statutory minimum reserve (SMR) was 7 percent at end-December 2019, a reduction from 10 percent in 2016 targeted at reversing the general declining trend of the contraction of credit to the private sector, exhibited from 2015. Annual growth of the money supply was 11.2 percent in February 2018, then plunged to 3.3 percent in January 2019, and back to 10.9 percent in November 2019 *(*Figure 1, panel b).
At the beginning of comprehensive financial reforms in 1991, interest rates initially increased until when money markets were introduced in 1993/94, during which interest rates were completely liberalize. Banks' lending overall lending rate rose initially to an average rate of 36 percent in 1995 before taking a downward trend to about 17.8 percent in 2017, whereas average deposits rates edged upward to 27 percent and declined to about 10 percent in the similar period. The developments notwithstanding, interest rate spreads remained much higher during reform period particularly from 1998 and were associated with high and rigid lending interest rates. Compared with other East African Community (EAC) member countries (Burundi, Kenya, Rwanda and Uganda), bank lending rate in Tanzania over ten years to December 2019 was at an average of 16.3 percent, being the second lowest after Kenya's 15.61 percent[6] . However, as portrayed in (Figure 1, panel c), lending rates in Tanzania exhibited an upward shift starting December 2016, while trending above Kenya and but below Uganda. (Mbowe *et al* 2020).

Figure 1: Developments in monetary variables in selected EAC countries (*In percent*)



Source: Bank of Tanzania, Central bank of Kenya and Bank of Uganda.

3. Literature review

The relationship between bank credit and monetary policy has mostly been viewed through the lens of the 'credit channel', whereby on the supply side, monetary policy changes cause financial institutions to alter volume of loans that they issue[7], while the changes in monetary policy also affect the demand for credit. Both sides of the story suggest that tighter monetary policy will be associated with weaker credit growth. The interest rate responds to the macroeconomic consequences of credit growth. Rapid growth of credit could be inflationary, and so elicit a response by the central bank. The money supply theory as originally propounded by Nicolaus Copernicus in 1517, and later popularized by John Locke, David Hume, Milton Friedman, and Anna Schwartz in 1963 posits that the general price level of goods and services is directly proportionate to the cost of money in circulation or money supply, which effect on bank lending behavior (Loayza & Schmidt-hebbel 2012). The role of monetary policy, which is of course controlling the volume, cost and direction of money supply was effectively interchanged by Friedman & Schwartz (2006) who emphasized that money supply is a key factor influencing the inflation, promote growth of credit and wellbeing of the economy (Fontana & Palacio-Vera, 2007; Papademos, 2003; Yilmazkuday, 2013). Poor monetary policies associated with high and volatile inflationary tendencies distort the allocation of productive resources, eventually harming economic growth in the long term (see, among others, Barro, 1997; Fischer, 1993). Essentially, questions have continued to abound, as to how central bank policy actions affect private sector credit dynamics (Lacker, 2014, Berg, *et al* 2013; Papademos, 2003). Studies have revealed mixed findings on the linkage between monetary policy and credit growth. There are aslo studies that discount the negative relationship between inflation and economic growth (Levine & Renelt, 1992; McCandless & Weber, 1995), arguing that monetary policy actions driving steady and stable inflation tend to have a depressing effect on private sector credit growth, resulting in a sacrifice ratio[8](Mankiw, 2010). Many studies have used economy-wide model to investigate the simultaneous relationships of aggregate credit with economic activity and monetary policy. In an early contribution, Bullock, *et al* 1989 examined the ability of various financial indicators to lead real private demand in Australia. They found that credit aggregates appeared to lag rather than lead changes in activity. Stevens &Thorp (1989) used more rigorous statistical techniques largely supported these findings.

In later work, Tallman & Chandra (1996, 1997) argued that financial aggregates held little or no predictive power for other macroeconomic series. However, Blundell-Wignall & Gizycki (1992) suggested that the conclusions of Bullock *et al* (1989) and Stevens & Thorp (1989) may not hold after the Australia financial reforms of the 1980s. For the period 1984–1991, they showed that business credit led business investment, while overall credit was found to have a two-way relationship with GDP. While Bullock *et al* (1989) and Stevens & Thorp (1989) did cover some of the deregulation period, Blundell-Wignall & Gizycki contended that it was not sufficient to fully capture the change in dynamics. Blundell-Wignall & Gizycki additionally argued that credit rationing had not been important in Australia because the supply of loans had consistently exceeded demand. This suggests that a supply-driven credit channel may not have been particularly strong in Australia. Suzuki (2004) supported this view for bank loans using a VAR. In contrast, Tallman & Bharucha (2000) argued that credit supply considerations can be important, at least at a more disaggregated level and during particular episodes. They found that after the distress of the early 1990s recession, the major banks pulled back on risky commercial lending. They noted that this reallocation was more marked in the banks that were under the most financial stress.

Using panel data set consisting of 312 banks, Loupias, *et al* (2011) investigated the impact of monetary policy on bank lending in France from 1993-2003 following McAdam & Morgan,

(2001). The study found that monetary policy tightening decreases bank lending. Some studies suggest that a monetary policy impetus to spur growth is likely to be inflationary, having a countervailing effect (Issing *et al*, 2001). The surge of non-conventional monetary policy in the wake of the global crisis of 2008 highlights the limited role of conventional monetary policy. Moreover, the link between monetary policy, inflation, private sector credit and economic growth has been found to be weak, particularly in developing countries (Al-Mashat & Billmeier, 2008; Mishra, *et al*, 2010; Monteil, *et al*, 2012). For stance, Amidu (2006), examined whether bank lending is constrained by monetary policy in Ghana from 1998 to 2004. Study submitted that Ghanaian banks' lending behavior is controlled significantly by changes in money supply and country's economic activities. Dhungana (2016) studied if bank lending and monetary transmission mechanisms are closely interlinked in Nepal from 1996 to 2015. The study concluded that excessive bank's credit extension will have inflationary impact on the economy. Using the Ordinary Least Square (OLS) method of econometric analysis Agbonkese & Asekome (2013) examined monetary policy on bank credit abilities in Nigeria from 1980 to 2010. Results showed a positive linear relationship between bank's total private sector credits, while the reserve requirement ratio and interest rate had a negative relationship with the private sector credit growth.

A study by Abuka & Egesa (2007) concluded that monetary policy actions, inflation and the monetary market rate were found not to influence the growth of private sector credit. Instead, income was one of the important factors that affects growth of credit to the private sector in the East African Community countries, including Kenya, Tanzania and Uganda. The role of bank's lending rate as one of the factors that determine the growth private sector credit has long been recognized, and empirical evidence has supported that (Ibrahim, 2006; Ndanshau & Kilindo, 2016; Tomak, 2013; Azira, 2018; Moussa & Chedia, 2018). Manamba (2014) focused on co-integration analysis using macro-level quarterly data covering 1986-2013 period and found that, the price of private sector credit in Tanzania (i.e., bank's lending rate) is significantly determined by lack of competition among financial institutions; and not central bank policy actions. Specifically, existence of diseconomies of scale in the financial system; and that, as proportion of liquid assets increases the bank liquidity risk decreases, leading to lower bank's lending interest rate spreads. Aikael *et al*. (2011) also use quarterly macro-level data and a co-integration and error correction model to establish relative importance of macroeconomic and regulatory factors in explaining high bank's lending rates in Tanzania. The results reveal that interest rate spreads in Tanzania are strongly influenced by net government borrowing from commercial banks, development of the banking sector, monetary policy (i.e., statutory minimum reserve requirement and the discount rate). The common measure of inflation is annual change in the CPI. A positive relationship has been established between inflation and credit supply in many studies. Risk-averse consumers may increase their precautionary savings because inflation increases uncertainty regarding future income growth (Harron & Azim, 2006)[9]

To sum up, majority of studies that have considered the relationship between credit and monetary policy have focused on the credit channel, and so have been limited to bank credit or other components of the aggregate. Two notable studies are Romer & Romer (1990) and Bernanke & Blinder (1992). Both found that contractionary monetary policy shocks increase credit prices and reduced the level of US bank loans, albeit with a considerable lag of about 6–12 months. In fact, both studies found that immediately after the shock the level of bank loans actually *increased*. A possible explanation is that firms initially borrowed to smooth the impact of a downturn. A lagged response of credit was also found for the Netherlands by Garretsen & Swank (1998). However, a lagged response is by no means a universal finding. For example, Safaei & Cameron (2003) found an immediate impact of monetary policy on Canadian bank credit. For the US, Gertler & Gilchrist

(1993) found a similar instantaneous response, contrasting with Bernanke & Blinder (1992) and Romer & Romer (1990).

4. Methodology

This paper attempts to estimate the effects of monetary policy on macroeconomic variables, principally growth of credit to private sector in Tanzania. The SVAR model is a multivariate and linear representation of a vector of observable variables on its own lags. All the observable variables are assumed endogenous and interdependent, except for those identified as exogenous. In addition, the model is an economically interpretable simplification of the VAR model, where the structural identification (factorization) restrictions are used in line with some economic theory. The point of departure for a structural analysis is a reduced form model that has to be specified before the SVAR analysis can be entered (Enders, 2004; Sharifi-Renani, 2010; Ngalawa & Viegi 2011). Consider the following reduced-form representation of the system:

$$X_t = C(L)X_t + \varepsilon_t \quad (1)$$

where $E(\varepsilon_t \varepsilon'_t) = \varphi$ and $E(\varepsilon_t \varepsilon'_{t+s}) = 0$ for all s. X_t is a vector of macroeconomic variables, *C* is a polynomial function of order *p* and *L* is the lag operator. Consider T is an invertible (7x7) matrix describing the contemporaneous relationship among variables. Such that: $(T^{-1})(T^{-1})' = \varphi$, so that $T\varphi T^{-1} = I$ – the identity matrix. We define $T = AB$, where *A* is diagonal and *B*'s diagonal contains only ones. The matrix *A* has the same lead diagonal as *T*, but zeros elsewhere, while *B* is formed by dividing each row of *T* by the lead diagonal element of that row. Multiplying equation (1) by *B* gives the structural VAR representation:

$$BX_t = BC(L)X_t + \mu_t \quad (2)$$

where the matrix *B* is the contemporaneous relationships between the variables and $B\varepsilon_t = \mu_t$. The covariance matrix of the errors from equation (2) is given by:

$$E(\mu_t \mu'_t) = E(B\varepsilon_t \varepsilon'_t B') = (A^{-1})(A^{-1})' = D \quad (3)$$

Note that because A is diagonal, so too is D. Therefore, μ_t can be interpreted as a vector of structural shocks, defined as a shock to a particular variable that is orthogonal to other shocks in the economy. In the reduced form, that is equation (1), the disturbances ε_t could be the result of structural shocks to other variables. The matrix B filters the reduced form shocks so that the structural shocks can be identified.

The matrix B can be solved for by first running the VAR represented in equation (1) to obtain an estimate of φ. From this estimate, B and A can be calculated from the equation: $((AB)^{-1})((AB)^{-1})' = (T^{-1})(T^{-1})' = \varphi$ if sufficient restrictions are imposed on these two matrices. Suppose that there are k variables in the system, so there are k^2 degrees of freedom in A and *B*. Because φ is a symmetric matrix, there are only: $k^2 + k/2$, unknowns, so at least $k^2 - k/2$ restrictions need to be imposed. These restrictions typically, but not always, take the form of restricting *B*'s off-diagonal elements to be equal to zero, and as such constitute restrictions on the contemporaneous effect of one variable on another. Choleski decomposition of φ resulting in a temporal ordering of the variables - referred to as a recursive VAR. Alternative is allow for a more elaborate set of restrictions guided by economic theory - referred to as a SVAR.

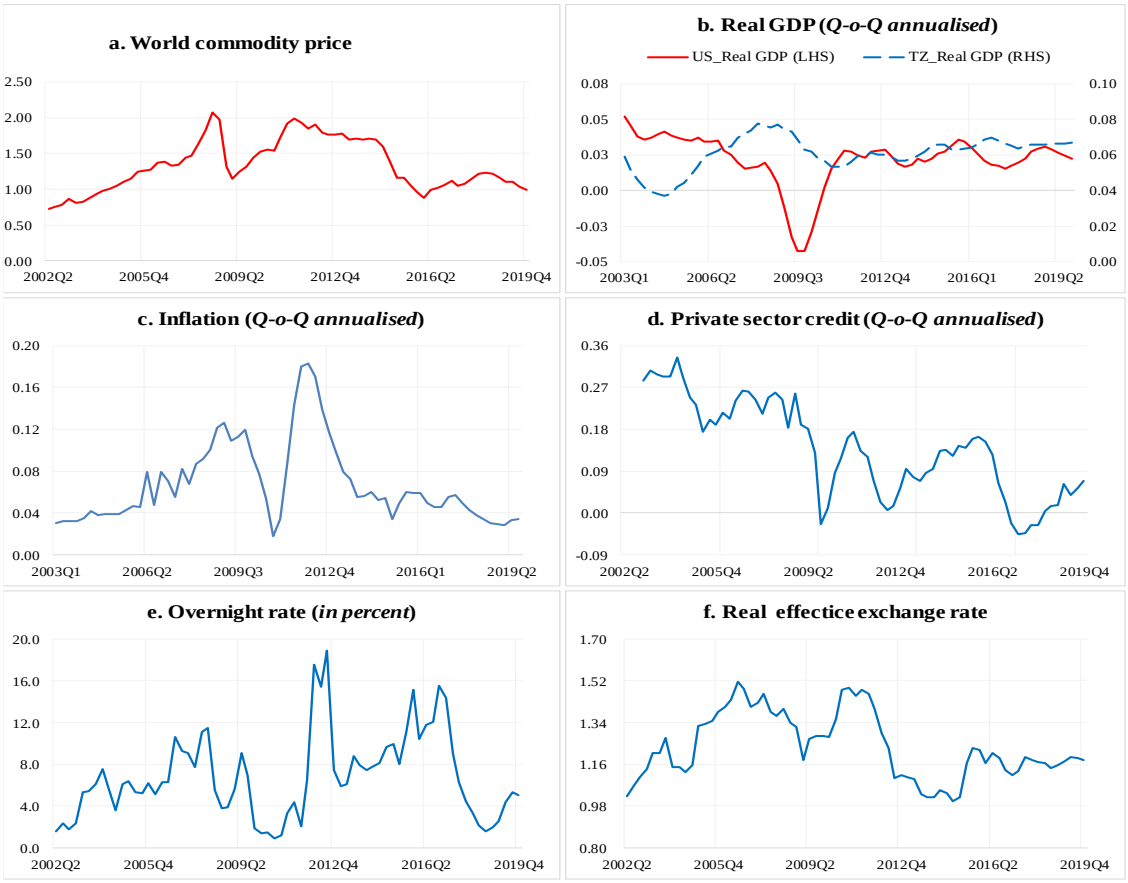
4.1 Variables included in the SVAR

The form of the SVAR model used in this paper reflects the fact that Tanzania is a small, relatively open, economy for which external shocks can be an important driver. A key decision is how many variables to include in the model. This paper follows Brischetto &Voss (1999) in using a small-scale model, including two variable for the external sector, and five for the domestic sector. While a larger SVAR, such as the 11-variable model in Dungey & Pagan (2000), would allow for richer interactions, a more parsimonious model with more degrees of freedom is likely to be easier to estimate and more stable. The 7-variable SVAR used in this paper provides a good compromise between these trades-offs and is still capable of capturing the key macroeconomic interactions. Figure 2 provide a snapshot of variables included in the model. The role of the external sector is captured by world commodity price[10] (*uscpi*) and real US GDP (*usgdp*)[11] collected from Federal Reserve Bank of St. Louis. The domestic sector is captured by the Tanzanian real GDP (*tzgdp*), and inflation (π) collected from National Bureau of Statistics (NBS). Real growth of private sector credit[12] (*rcred*), the cash rate[13] (*i*), and the real effective exchange rate (*reer*) collected from Bank of Tanzania. All data are quarterly.

Many papers have found that the global business cycle is an important driver of domestic activity (Adebayo *et al*, 2016). In this study, the world commodity price is included because it contains information about the world business cycle and is likely to be particularly relevant to a commodity-exporting country such as Tanzania. Commodity price is thought to control for policy-makers' expectations of future inflation, seemingly the missing factor responsible for the 'price puzzle' (Christiano, *et al*, 1998). Many VAR studies captures commodity prices in a number of different ways. Suzuki (2004) includes commodity prices, while in Dungey & Pagan (2000) the terms of trade play a similar role. Brischetto & Voss (1999) include world oil prices.

The inclusion of GDP to represent domestic activity is standard. Similar to Brischetto & Voss (1999), CPI inflation is included domestic price conditions. There are no nominal level variables in the model and so the rate of change of domestic prices seems to be a more logical variable to interact with real variables and the nominal cash rate. Consistent with other studies, the overnight cash rate is included as a measure of monetary conditions. In Dungey & Pagan (2000) and Suzuki (2004) included the cash rate, but Haug, *et al* (2003) use a 90-day interest rate to be consistent with New Zealand, the other country in their study. The real exchange rate is also viewed as an important measure of Tanzanian economic conditions. Sims (1992) suggested that the inclusion of the exchange rate can also help to resolve the price puzzle. Dungey & Pagan (2000) also use this variable, while Brischetto & Voss (1999) and Suzuki (2004) both use the US dollar bilateral exchange rate. The real effective exchange rate used in this paper captures a broader relationship and is more appropriate to interact with other real variables.

Figure 2: Time series of variables included in the model



Source: Bank of Tanzania, National Bureau of Statistics (NBS) and Federal Reserve Bank of St. Louis

4.2 Identification

Structural shocks in a SVAR can be identified by placing some restrictions on contemporaneous and long run relationships. The work of Buckle *et al*. (2007) sets the foundation for the traditional SVAR that forms the hybrid approach to structural identification. The main adjustments to the Buckle *et al*. (2002) model contain the incorporation of identifications to which restrictions' methodology is applied. The restrictions restrict attention to rotations that produces shocks that satisfy an anticipated sign in the responses of key variables (see Dungey & Fry, 2009). There are few simple theoretical macroeconomic models that explicitly include credit, and seemingly none that determine the timing of effects needed for identification in a SVAR. Therefore, previous studies and stylised facts are used to determine the identification restrictions outlined.

According to the AB-model of Amisano & Gianini (1997, 2012), 7x7 matrices are formed to impose short run structural restrictions for the contemporaneous and sluggish lagged relationships. The contemporaneous matrix is the finite-order lag polynomial matrix that clearly demonstrates how the structural restrictions are being estimated with the diagonal constrained to one (4). Twenty - one (21) zero restrictions were therefore imposed on a contemporaneous matrix, which makes the covariance matrix of the reduced-form residuals restricted. The restrictions placed on the contemporaneous relationships among the variables are characterised by equation (4), which is the left-hand side of the standard SVAR representation in equation (2).

$$BX_t \equiv \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & b_{34} & b_{35} & 0 & 0 \\ b_{41} & 0 & b_{43} & 1 & 0 & 0 & 0 \\ b_{51} & b_{52} & b_{53} & b_{54} & 1 & b_{56} & 0 \\ b_{61} & 0 & 0 & 0 & b_{65} & 1 & b_{67} \\ b_{71} & b_{72} & b_{73} & b_{74} & b_{75} & b_{76} & 1 \end{pmatrix} \begin{pmatrix} uscpi \\ usgdp \\ tzgdp \\ \pi \\ rcred \\ i \\ reer \end{pmatrix} \quad (4)$$

The (non-zero) coefficients b_{ij} in equation (4) indicate that the shocks in variable *j* affects variable *i* instantaneously (for example, b_{34} is the impact of π on Tanzanian GDP). The zero coefficients indicate that those entries in the matrix are constrained to be zero, with the assumption that variable *j* does not affects variable *i* in the short run. The assumptions embodied in equation (4) exactly identifies the system. The transmission of international shocks to the domestic economy can be very rapid. For example, shocks in world commodity prices results in an immediate increase in the value of Tanzanian exports (or increases in the import bill), and hence affect domestic income. Therefore, apart from two exceptions, it is assumed that all foreign variables affect all domestic variables contemporaneously. The first exception prevents an immediate effect of US GDP on monetary policy (that is, the cash rate). This assumption reflects the informational lags faced by policy-makers and is also employed in an open-economy SVAR by Kim & Roubini (2000). The second exception prevents an immediate effect of US GDP on inflation, since the domestic inflationary consequences of world economic activity would normally be thought to be transmitted indirectly through domestic activity.

Domestic variables are deemed not to affect the international variable, reflecting the relatively small size of Tanzania's economy. Tanzanian GDP is assumed to be affected by inflation and growth of credit. Output is responding to inflation because nominal incomes, and so spending, may be fixed in the short term, but flexible in the long run. Alternatively, this assumption can be motivated by the Lucas-Phelps imperfect information model, in which producers face a signal extraction problem. Contemporaneously, producers only observe their own price, and so are unsure whether an increase in their price reflects inflationary pressures or an increase in demand. As a result, they increase production, even if the price increase is purely inflationary. This increase in production could occur quite quickly[14] even if the price increase is purely inflationary. The contemporaneous response of output to growth of credit follows Safaei & Cameron (2003) and reflects a quick pass-through of credit to aggregate demand. Given the cost of borrowing, credit will typically be spent as soon as the funds are obtained, immediately adding to aggregate demand. Equation (4) allows for the possibility of a contemporaneous response of inflation to output. This assumption is common in domestic (Brischetto & Voss 1999; Dungey & Pagan 2000) and international (Bernanke & Blinder 1992) studies[15]. Other domestic variables are assumed to affect inflation only with a lag.

Growth of private sector credit is assumed to respond to output, inflation and the monetary policy actions, contemporaneously. The expectation of future activity is an important determinant of credit demand, as noted by Blundell-Wignall & Gizycki (1992). Current activity, as observed by individual agents, and the stance of monetary policy, should give some indication of what future conditions hold. The contemporaneous interaction of credit with the interest rate and inflation is justified by the perception that borrowers and potential borrowers will respond quickly to the real cost of credit (the difference between the lending rate and the inflation rate). Note that these assumptions are in contrast to Safaei & Cameron (2003). The monetary policy is assumed to

respond contemporaneously only to commodity prices, credit, and the exchange rate. This is justified by information lags. Direct information on these variables is available within the quarter, unlike the other domestic variables. The exchange rate is assumed to respond contemporaneously to all variables, as is common in SVAR studies. While this study uses the same number of variables as Brischetto & Voss (1999), and attempts to capture the same key macroeconomic interactions, as noted above, it uses a different set of variables to do so. Of particular note is that the SVAR in this paper includes credit, rather than a monetary aggregate as in Brischetto and Voss, in order to specifically understand the interaction of credit with other key macroeconomic variables. This paper also imposes an important restriction on the lagged structure of the model. Given that the Tanzanian economy is small relative to the global economy, it is assumed that lags of the domestic variables have no effect on the international variables. This restriction was not imposed by Brischetto & Voss (1999) but has been used in other studies (for example, Dungey & Pagan 2000, Berkelmans, 2005). Lags of all variables are included in the equations for the five domestic variables.

5. Estimation and results

In the model, inflation is expressed as a quarterly percentage change and the cash rate is expressed in percentage. All other variables are in logs. The model is estimated for the period covered 2002:Q1, and ends in 2019:Q4. Table 1 provides a short description of the variables.

Table 1: Descriptive Statistics

	uscpi	***usgdp***	***tzgdp***	***π***	***rcred***	***i***	***reer***
Mean	1.318	0.022	0.061	0.067	0.137	6.717	1.233
Max	2.068	0.052	0.077	0.194	0.334	18.881	1.517
Min	0.675	-0.043	0.037	0.004	-0.045	0.927	0.980
Std. Dev.	0.360	0.019	0.010	0.041	0.103	4.105	0.144
Obs	72	68	68	68	68	72	72

Notes: The term "Obs" represents the number of observations, while "Std. Dev" stands for the standard deviation. Min and Max indicate the smallest and largest observation, respectively. World commodity price (*uscpi*), US GDP (*usgdp*), domestic real GDP (*tzgdp*), inflation (π), real credit (*rcred*), the cash rate (*i*), and the real effective exchange rate (*reer*).

5.1 Stationarity and lag length selection

Unit root tests in Table 2 suggest that the variables included in the model are mixed into level stationary, I(0) and non-stationary, I(1), processes. This paper follows the existing literature, which typically estimates standard VARs in first differences, and applies structural restrictions for the SVAR formulation. Table 3 reports different lag lengths of the reduced form VAR. Most studies have tended toward shorter lag lengths; Dungey & Pagan (2000) used three lags and Suzuki (2004) used only two. One exception is Brischetto & Voss (1999), whose model contains six lags. Based on results in Table 2, a lag length of two was chosen as the appropriate lag length for this study, as this provides reasonable dynamics without much shortening the estimation sample. Accordingly, there is weak evidence of first or fourth order serial correlation for almost all lag lengths (Table 4).

Table 2: Stationarity Test

A: Levels

Variable	ADF			PP			KPSS	
	No constant No trend	Constant	Constant and trend	No constant No trend	Constant	Constant and trend	Constant	Constant and trend
uscpi	-0.2451	-2.3649	-2.2001	-0.2810	-2.0214	-1.7712	0.2671	0.2478 ***
usgdp	-1.5450	-3.8927 ***	-3.8773 ***	-1.8770 *	-2.4333	-2.3490	0.1522	0.1490 **
tzgdp	0.2685	-3.7604 ***	-3.6192 **	-0.0745	-1.8403	-2.1997	0.3054	0.1028
π	-0.7842	-1.9722	-2.0178	-1.3172	-2.7582 **	-2.7487	0.2185	0.2133 **
rcred	-1.6404 *	-1.7854	-3.0497	-1.6579 *	-1.9208	-2.9182	0.8451 ***	0.0823
i	-1.4704	-3.2268 **	-3.1722 *	-1.2700	-3.2357 **	-3.1965 *	0.2125	0.0849
reer	0.1679	-2.1309	-2.6992	0.1079	-2.3261	-2.6612	0.2757	0.1495 **

B: First difference

Variable	ADF			PP			KPSS	
	No constant No trend	Constant	Constant and trend	No constant No trend	Constant	Constant and trend	Constant	Constant and trend
uscpi	-6.1186 ***	-6.0794 ***	-6.3133 ***	-5.1243 ***	-5.0703 ***	-5.1475 ***	0.2539	0.0430
usgdp	-5.2090 ***	-5.1802 ***	-5.2096 ***	-3.3370 ***	-3.3165 **	-3.2775 *	0.1030	0.0508
tzgdp	-4.1737 ***	-4.1840 ***	-4.1378 ***	-4.1669 ***	-4.1587 ***	-4.0780 **	0.0609	0.0622
π	-6.2972 ***	-6.2435 ***	-6.3193 ***	-8.1085 ***	-8.0495 ***	-8.0356 ***	0.0737	0.0278
rcred	-7.0210 ***	-7.0246 ***	-7.0057 ***	-7.0198 ***	-7.0237 ***	-7.0045 ***	0.0539	0.0359
i	-8.2655 ***	-8.2078 ***	-8.1775 ***	-9.6934 ***	-9.5952 ***	-10.3165 ***	0.1582	0.1095
reer	-7.0070 ***	-6.9628 ***	-6.9950 ***	-7.0030 ***	-6.9591 ***	-6.9894 ***	0.1885	0.0986

Notes:
a: For the ADF and PP tests indicate that the null hypothesis of a unit root is rejected at 10%; (*), 5% (**) and 1% (***) significance levels, while those for the KPSS test indicate that the null hypothesis of stationarity is rejected at 1% (***), 5% (**), and 10%; (*), significance levels. b. Lag Length based on SIC. c. Probability based on MacKinnon (1996) one-sided p-values. Probability based on Kwiatkowski-Phillips-Schmidt-Shin (199. Table 1). World commodity price (*uscpi*), US GDP (*usgdp*), domestic real GDP (*tzgdp*), inflation (π), real credit (*rcred*), the cash rate (*i*), and the real effective exchange rate (*reer*).

Table 3: VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	597.0107	NA	1.60e-17	-18.8068	-18.3265	-18.6182
1	866.9589	461.5242	1.31e-20	-25.9342	-23.7727*	-25.0855
2	946.9221	118.6551*	5.15e-21*	-26.9330	-23.0904	-25.4243*
3	984.1534	46.8394	8.99e-21	-26.5533	-21.0297	-24.3846
4	1039.2810	56.9056	1.06e-20	-26.7510	-19.5462	-23.9222
5	1109.7800	56.8540	1.02e-20	-27.4445*	-18.5586	-23.9557

Note:
* 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 residual serial correlation LM Tests

Null hypothesis: No serial correlation at lag h				
Lag	**LRE* stat**	**Prob.**	**Rao F-stat**	**Prob.**
1	59.9758	0.1353	1.2581	0.1411
2*	51.3908	0.3802	1.0553	0.3889
3	50.9811	0.3956	1.0458	0.4044
4	63.3351	0.0818	1.3397	0.086
5	62.5363	0.0927	1.3201	0.0972
Null hypothesis: No serial correlation at lags 1 to h				
Lag	**LRE* stat**	**Prob.**	**Rao F-stat**	**Prob.**
1*	59.9758	0.1353	1.2581	0.1411
2*	103.7598	0.3260	1.0596	0.3633
3	169.8277	0.0957	1.1706	0.1654
4	242.0475	0.0140	1.2502	0.0951
5	395.8470	0.0000	1.9624	0.0007

Note :h is the lag selected

Table 5: VAR residual normality tests

Variable	**Jarque-Bera**	**Prob.**
uscpi	14.0700	0.0009
usgdp	0.6113	0.7366
tzgdp	1.6643	0.4351
π	0.1149	0.9441
rcred	1.2623	0.5320
i	1.2960	0.5231
reer	1.4186	0.4920
Joint	**20.4375**	**0.1169**

Note:

a. Orthogonalization: Cholesky (Lutkepohl)
b. Null Hypothesis: Residuals are multivariate normal
c. World commodity price (*uscpi*), US GDP (*usgdp*), domestic real GDP (*tzgdp*), inflation (π), real credit (*rcred*), the cash rate (*i*), and the real effective exchange rate (*reer*).

Table 6: Roots of characteristic polynomial

Root	Modulus
0.884549 - 0.243293i	0.917398
0.884549 + 0.243293i	0.917398
0.871107	0.871107
0.701677 - 0.478547i	0.849328
0.701677 + 0.478547i	0.849328
0.518986 - 0.370654i	0.637754
0.518986 + 0.370654i	0.637754
-0.426156	0.426156
0.028779 - 0.392354i	0.393408
0.028779 + 0.392354i	0.393408
-0.192318 - 0.092913i	0.213586
-0.192318 + 0.092913i	0.213586
0.120394 - 0.160188i	0.200387
0.120394 + 0.160188i	0.200387

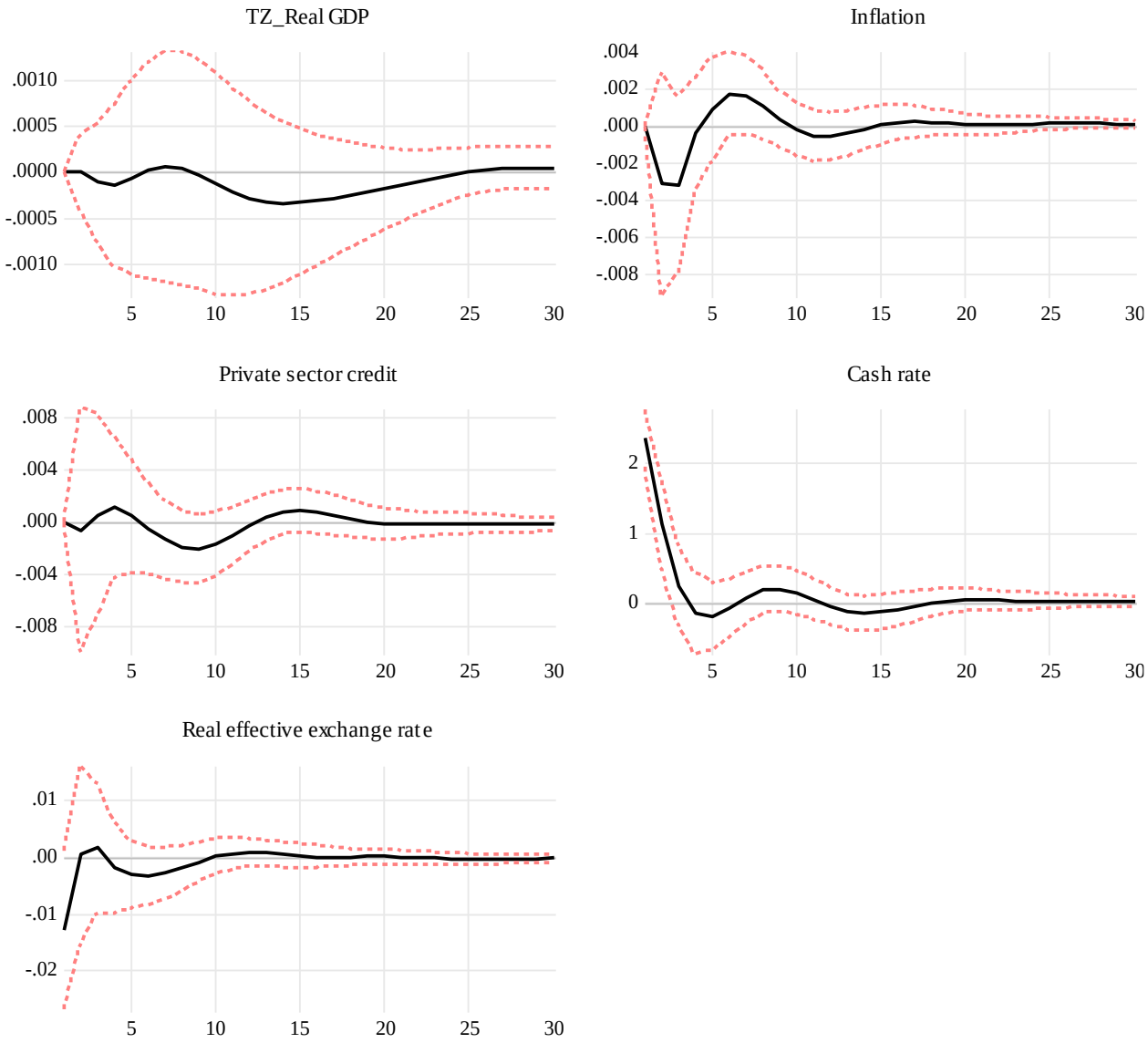
Note:
a. Endogenous variables: uscpi, usgdp, tzgdp, π, rcred,reer. Exogenous variables: D2 (dummy for 2008/9 GFC)
b. Lag specification: 1 2. No root lies outside the unit circle, VAR satisfies the stability condition.

5.2 Impulse responses and variance decomposition

Figure 3 displays the impulse responses to a positive shock in the cash rate (*i*) that is unexpected tightening in monetary policy, on the trajectories of growth in other variables in the quarters ahead following the shock. The dashed lines are 95 per cent confidence intervals/bands derived based on the asymptotic standard errors — used to interpret the economic significance of variable responses. The figures shows the deviation of each variable from its baseline. Given that all variables (except for cash rate), in the model are in log form, multiplication by 100 yields the approximate percentage deviation from baseline.

Consistent with economic predictions, the shock to the cash rate depresses growth in real private sector credit, instant fall in inflation and appreciation of the real effective exchange rate. The fall in credit growth, in turn leads to a fall in GDP, and a rise in inflation from around the 3rd quarter following the shock. Growth of credit to private sector responds slowly to the cash rate shock, but relatively faster than does the GDP. In particular, the real effect of monetary policy on credit growth is quantitatively small — a 2.5% rise in cash rate leads to a small decline in real growth of credit to the private sector (around 0.1%), reaching a turning point during the 2nd quarter. In response to the immediate fall in inflation (0.3%), the credit growth picks-up back to equilibrium during the 3rd quarter, and overshoot the equilibrium a year after the shock, and registered a maximum decline of around 2.0% during the 9th to 10th quarter, and steadily falls back to reach the equilibrium just over two years after the shock. GDP starts pick-up a year after the shock, whereas inflation stabilize almost more than two years after the initial shock in cash rate. The relatively slow response of inflation to a monetary policy shock is partly explained by the weight of the supply components in the headline CPI basket. Following the initial appreciation, the exchange rate depreciates, consistent with uncovered interest rate parity to its equilibrium around the 2nd quarter, before it appreciate again to during the 5th to 6th quarter, after which starts to depreciate steadily to the base line in the 10th quarter. In response to the paths of the other variables, notably the declines in inflation and output, the monetary policy is roughly back to its initial equilibrium 18 quarters after the shock.

Figure 3: Impulse responses to cash rate

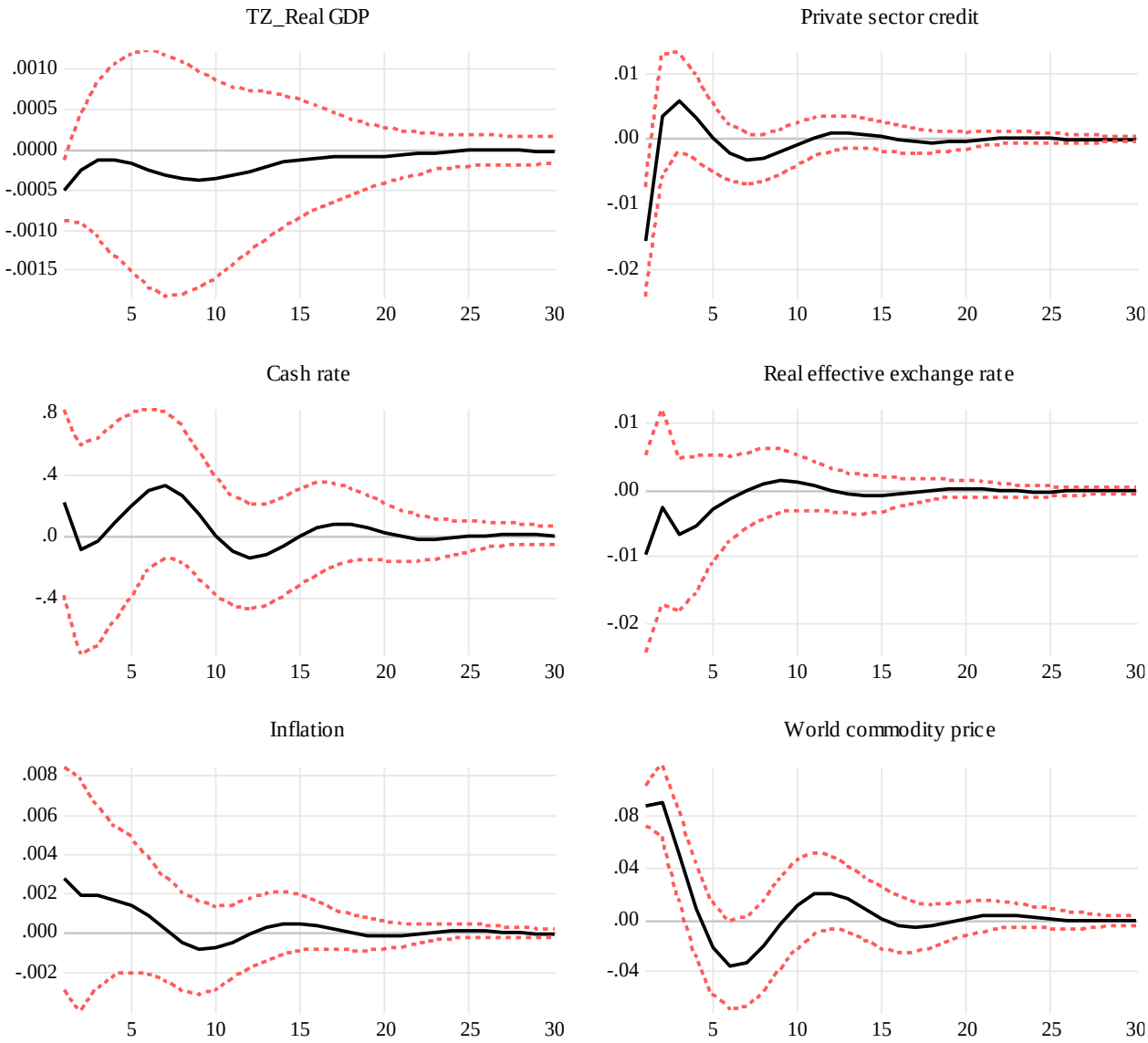


Note:

a. Response to Cholesky One S.D. (d.f. adjusted) Innovations ,± 2 analytic asymptotic S.E.s

Figure 4 shows responses of domestic variables to a shock in external environment. A positive shock in the world commodity prices has contemporaneous effects on the real growth of private sector credit. Increase in world commodity prices results in to immediate increase in domestic inflation by just over 2% and appreciation of real effective exchange rate by 1%, fall in growth of private sector credit by 1.5%, and decrease in domestic GDP by 0.05%. In response to increased inflation, monetary policy tightens, that leads to an increased cash rate from the 2nd quarter after the shock, and inflation gradually falls back to its equilibrium just around two years after the shock. The growth of private sector credit picks-up gradually from the 2nd quarter, and overshoots the equilibrium in the 3rd quarter, before it stabilizes on equilibrium just over two years after the shock. On the other hands, the real growth of output remains below its equilibrium for two years, before it starts to pick up to equilibrium from around the 10th quarter after the shock.

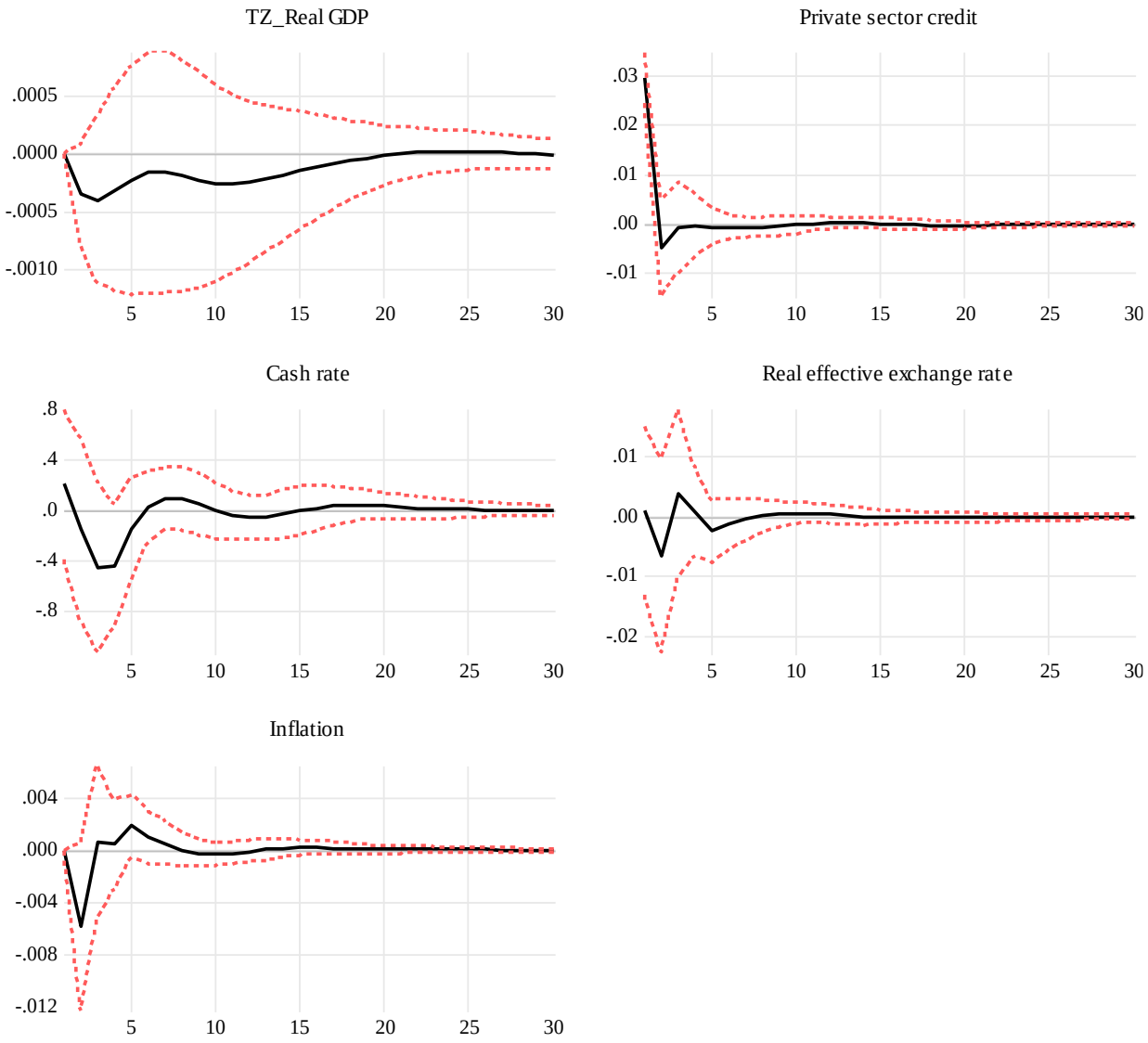
Figure 4: Impulse responses to world commodity price



Note:
Response to Cholesky One S.D. (d.f. adjusted) Innovations, ± 2 analytic asymptotic S.E.s

Figure 5 presents the response of other variables to a 2.8% shock in real growth of private sector credit. In response, monetary policy tightens immediately (i.e., cash rate rise by 2%), but it become loose so fast, and undershoot the equilibrium in the 3rd and 4th quarter. As such, inflation declines, and the growth of credit initially falls and undershoots the equilibrium around the 2nd quarter, but immediately picks-up and stabilizes on equilibrium during the 3rd and 4th quarter. Meanwhile, the exchange rate appreciates following the policy tightening, real growth of output falls slowly, but starts to pick up from the 3rd, however remains below the equilibrium up to the 20th quarter after the shock. Response of the private sector credit to shocks other variables in the model is as shown in Figure 1A in the appendix.

Figure 5: Impulse responses to private sector credit



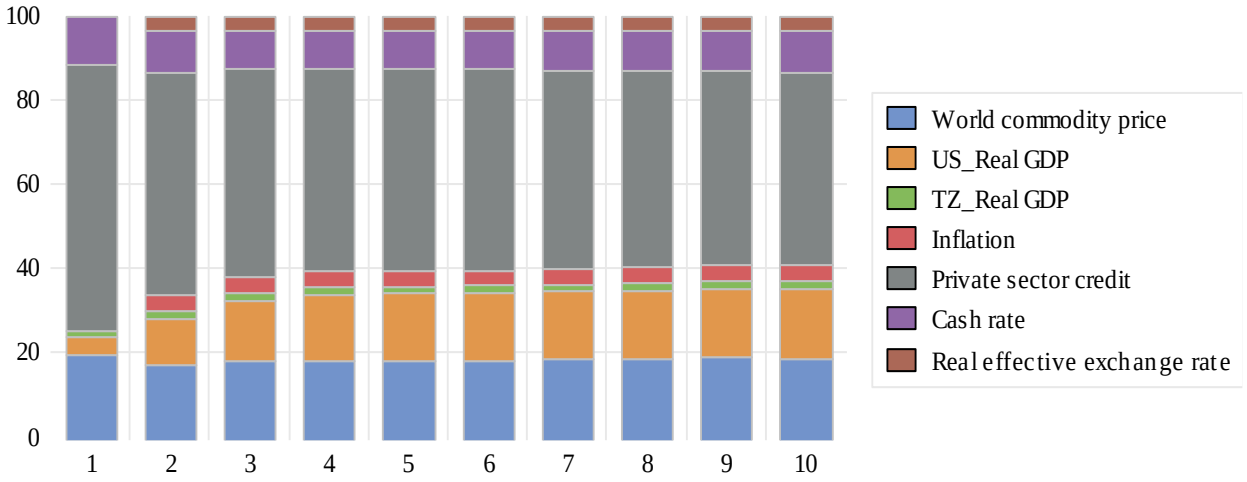
Note:

a. Response to Cholesky One S.D. (d.f. adjusted) Innovations ,± 2 analytic asymptotic S.E.s

An alternative method of interpreting the properties of the model is with variance decomposition. This reports the proportions of the error of forecasts, generated by the SVAR, that are attributable to shocks to each of the variables in the model. The variance decompositions for domestic variables are reported in Figure 6 (a – e), largely indicating that innovations to the international variables become more important as time passes across the spectrum of domestic variables. This reflects the role that these exogenous factors play in determining the long-run values of the domestic variables in this type of model. For a different domestic variable, the proportion of the forecast error that is explained by structural shocks to each of the seven explanatory variables. Over the short and longer horizons, the forecast errors for credit are largely explained by the past shocks to credit, global

economic activities, world commodity prices and monetary policy. However, at the longer horizons shocks to external variables – world commodity prices and global economic activities – plays a greater role (Figure 6a). Shocks to GDP, domestic prices and private sector credit are important for GDP forecast errors (Figure 6b). But as the horizon lengthens, the exogenous global variable, global economic activities play a greater role. This is consistent with studies by Brischetto & Voss (1999), Dungey & Pagan (2000) and Kim & Roubini (2000). For domestic prices, its own shocks and domestic GDP are responsible for almost all of the short-term and longer-term forecast errors (Figure 6c). However, over longer horizons, shocks to monetary policy, bank's private sector credit and external environment are increasingly important

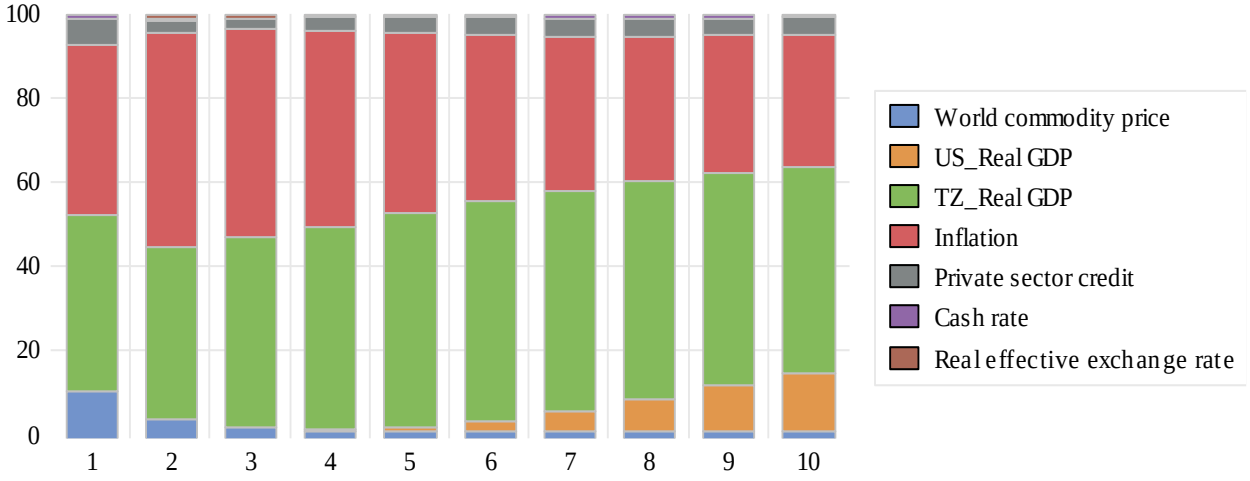
Figure 6a.Variance decomposition of private sector credit



Note:

a. Using structural VAR factors

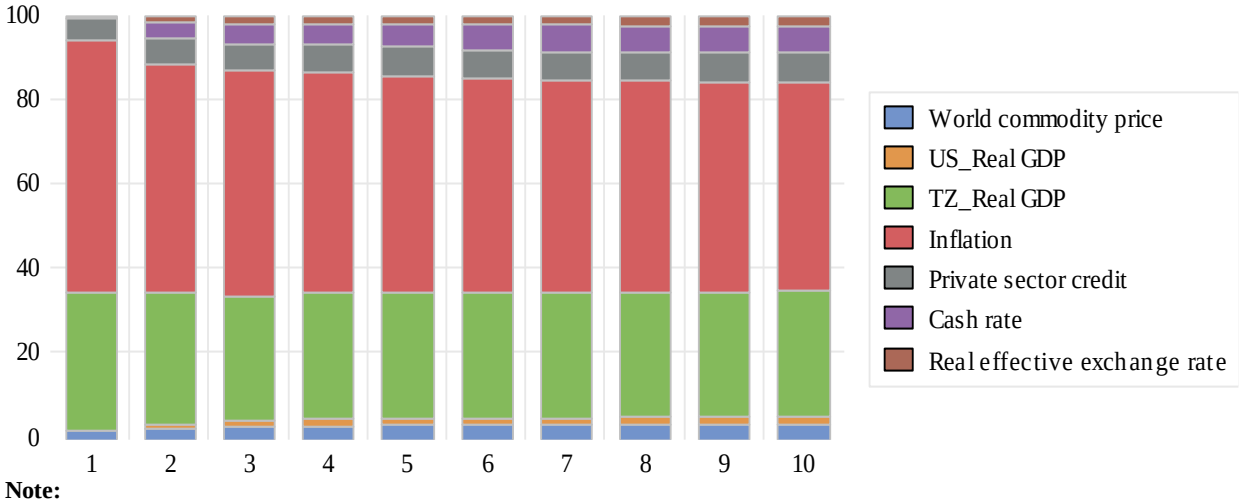
Figure6b. Variance decomposition of real GDP



Note:

a. Using structural VAR factors

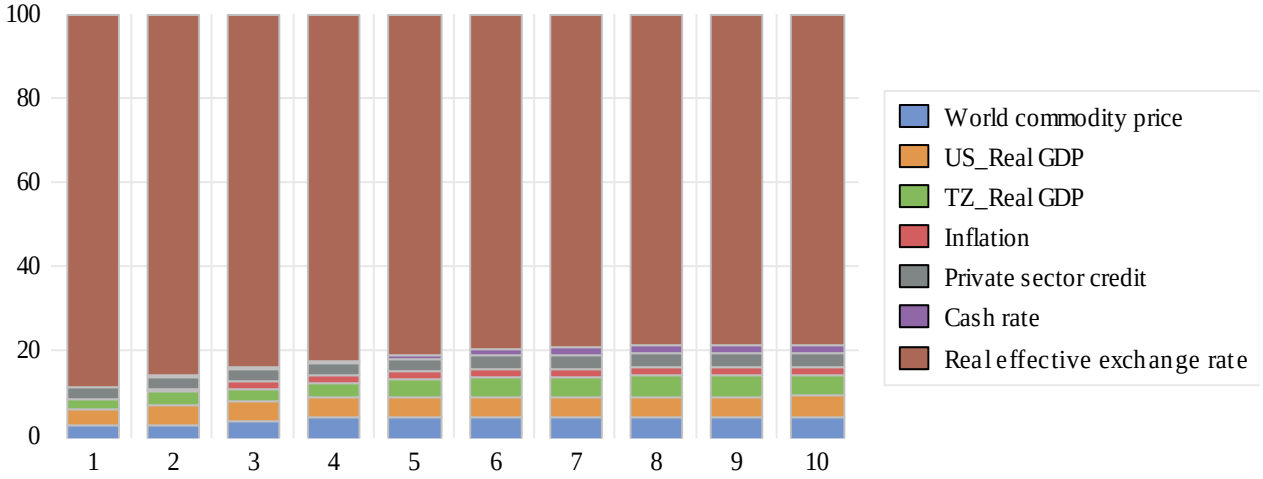
Figure 6c. Variance decomposition of inflation



Note:

a. Using structural VAR factors

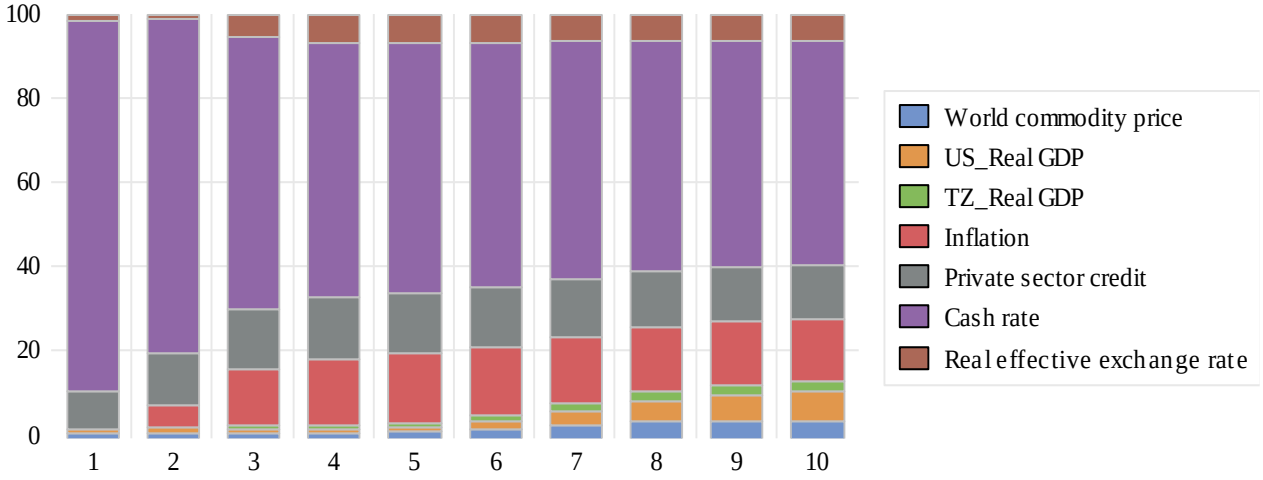
Figure 6d. Variance decomposition of real exchange rate



Note:

a. Using structural VAR factors

Figure6e. Variance decomposition of cash rate



Note:

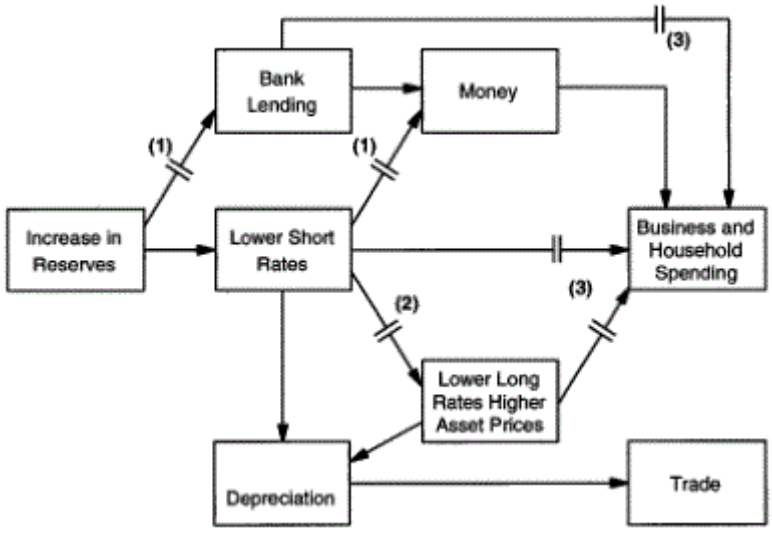
b. Using structural VAR factors

6. Conclusion

The purpose of this study was to investigate effects of monetary policy on macroeconomic variables in Tanzania, with a particular attention being paid on the relationship between credit to the private sector and monetary policy. The SVAR was estimated, and the econometric results revealed that, the real effect of monetary policy on credit growth is quantitatively small — a 2.5% rise in cash rate leads to a decline in real growth of credit to the private sector by 0.1%. Though, in responding to the macroeconomic consequences of the shock to the growth of private sector credit, monetary policy appears to stabilise the economy effectively. Variance decompositions indicates that, at short horizons, shocks to cash rate, external environment, and past shocks to credit growth are important in explaining movements in the growth of private sector credit. Over longer horizons, shocks to cash rate, domestic and external prices, and past shocks to credit growth plays a greater role in explaining the changes in private sector credit.

These findings asserts that, the "credit channel" of monetary policy in Tanzania is vulnerable to both domestic and external shocks, hence low bank's capacity to credit extension in response to easy monetary policy stance. Although the monetary policy stance during the period (i.e. 2016 - 2019) was somewhat different from past cycles, policy stance alone cannot completely explain the observed extraordinarily slow growth real credit to private sector. Indeed the dynamics of credit growth during the period (i.e., from 2016) suggest that during the transmission of policy changes through financial markets and banks was weaker than in past episodes. Some of the channels through which policy should affect the economy, but which may have been blocked because of financial system fragility, are shown in Figure 7a. Blockage (*1*) suggests that the reductions in short-term market interest rates was not transmitted to bank lending rates or growth of credit—perhaps related to high non-performing loans (NPLs). Evidence of this seems quite overwhelming: bank's credit growth was low and bank lending rates remained relatively high. Blockage (*2*) suggests that the channels to long-term bonds and other assets were blocked by inflation fears or by a high level of investor uncertainty—perhaps related to credit problems or due to the shift in government policies during the fifth phase government (from October 2015). Certainly, long-term rates fell substantially less than short-term rates from January 2016, making the term structure quite steep, but the term structure is usually steep when the economy is weak and monetary policy is loose (Figure 7b)

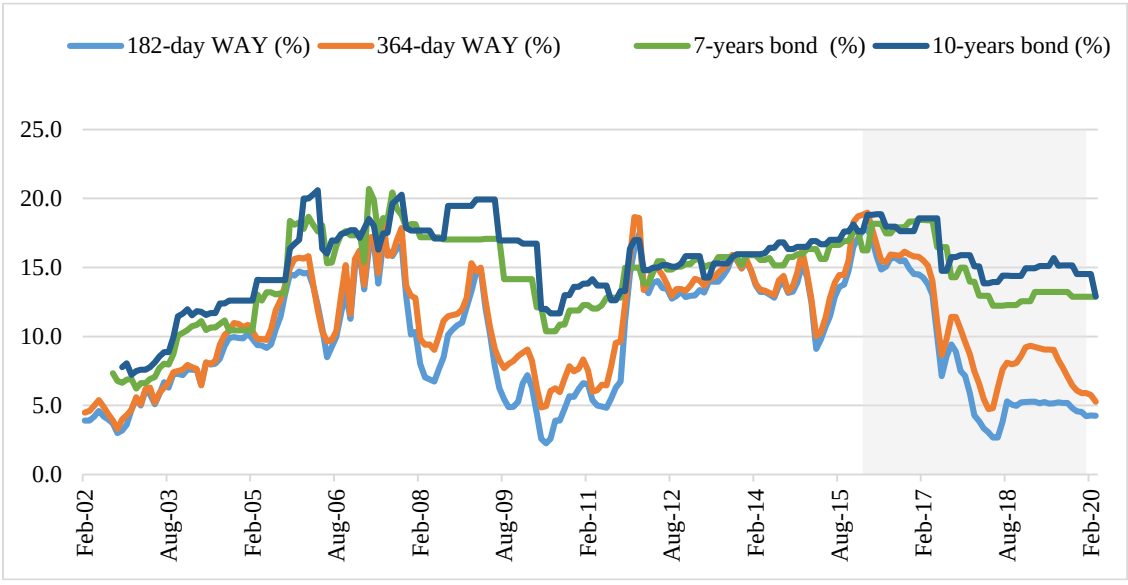
Figure 7a: Blockages in monetary policy transmission



Notes:
Possible "Blockages"
(1) Large write-offs, Non-performing loans (NPLs), poor asset quality (balance sheet problems).
(2) Uncertainty, inflation concerns, long-term budget deficit.
(3) Deleveraging and balance sheet problems of firms and households.

Blockage (*3*) suggests that deleveraging and debt restructuring by households and firms depressed spending and credit demand, making them less responsive to easing monetary policy. For example, lower interest rates due to easy monetary policy may have induced firms and consumers to deleverage more quickly, while keeping spending growth modest. Either way, the results suggest that it may be unfeasible for the monetary policy to fully caution the banking system from shocks, however rapid and appropriate policy response may help banks to quickly recover from shocks. It is worth noting that, continued prudent supervision of the banking system may further help to tackle the blockages of policy transmission and minimize the severity of shocks to the stability of the banking sector, and thus lower the size of the policy response requirement.

Figure 7b: Treasury bills and bond rates



Note: Shaded area represent the period of decreased growth in bank's credit to private sector.

References

Abuka, C. K. & A. Egesa. 2007. An Assessment of Private Sector Credit Evolution in the EAC: The Candidates for a region wide reform strategy for the financial sector. *The Bank of Uganda Staff Papers Journal*.

Aikaeli, J., Mugizi, F. M., & Ndanshau, M. O. (2011). The determinants of interest rate spreads in developing countries: Evidence on Tanzania, 1991-2009. University of Dar es Salaam Department of Economics Working Paper, (02/11).

Amisano, G., & Giannini, C. (1997). From VAR models to Structural VAR models. In *Topics in structural VAR econometrics* (pp. 1-28). Springer, Berlin, Heidelberg.

Amisano, G., & Giannini, C. (2012). *Topics in structural VAR econometrics*. Springer Science & Business Media.

Al-Mashat, R., & Billmeier, A. (2008). The monetary transmission mechanism in Egypt. *Review of Middle East Economics and Finance*, *4*(3), 32-82.

Amidu, M. (2006). The link between monetary policy and banks' lending behavior: The Ghanaian Case. *Banks and Banks System*, 1(4), 38–48.

Afolabi, M. A., Adeyemi, K. K., Salawudeen, O. S., & Fagbemi, T. O. (2018). Monetary policy & bank credit in Nigeria: A Toda-yamamoto approach. *Economica*, 14(5), 717–735.

Agbonkese, A. I., & Asekome, M. O. (2013). Impact of monetary policy on bank creation in Nigeria. *International Journal of Business & Social Sciences*, 4(15), 160–165.

Amacher, R. C., & Ulbrich, H. H. (2016). Principles of macroeconomics. Cincinnati, Ohio: South Western Publishing Co.

Azira, A. A., L.E. Sheng & A. B. Julnaida. 2018. Bank Lending Determinants: Evidence from Malaysia Commercial Banks. *Journal of Banking and Financial Management*, 13: 2018

Barro, Robert J. Determinants of Economic Growth: A Cross-Country Empirical Study. Cambridge, Mass.: *MIT Press*, 1997.

Bank of Tanzania (BOT). 2007. The Second Generation Financial Sector Reforms. Dar es Salaam: Bank of Tanzania.

Bank of Tanzania. (BOT) 2015. Tanzania Mainland's 50 Years of Independence: A Review of the Role of the Bank of Tanzania. (1961–2011). Dar es Salaam: Bank of Tanzania.

Bank of Tanzania (BOT) (2018). Financial Stability Report, March 2018. Dar es Salaam: Bank of Tanzania.

Bank of Tanzania (BOT). 2019. *Quarterly Economic Bulletin* (various issues). Available: https://www.bot.go.tz/Publications/Filter/3

Berg, M. A., Charry, M. L., Portillo, M. R. A., & Vlcek, M. J. (2013). The monetary transmission mechanism in the tropics: A narrative approach. *International Monetary Fund*.

Bullock, M., Morris, D., & Stevens, G. (1968). The Relationship between Financial Indicators and Economic Activity: 1968–1987| Conference–1989.

Blundell-Wignall, A., & Gizycki, M. (1992). Business Credit and Investment| RDP 9208: Credit Supply and Demand and the Australian Economy. *Reserve Bank of Australia Research Discussion Papers*, (July).

Bernanke, Ben S., and Alan Blinder. Credit, Money, and Aggregate Demand. *American Economic Review* (1988) 78, 435-39

Bernanke, Ben S., and Mark Gertler. Inside the Black Box: The Credit Channel of Monetary Transmission. *Journal of Economic Perspectives 9* (Fall 1995), 27-48.

Bernanke BS and AS Blinder (1992), 'The federal funds rate and the channels of monetary transmission', *American Economic Review,* 82(4), pp 901–921.

Berkelmans, L. (2005). Estimation and Results| RDP 2005-06: Credit and Monetary Policy: An Australian SVAR. *Reserve Bank of Australia Research Discussion Papers*, (December).

Brischetto A and G Voss (1999), 'A structural vector autoregression model of monetary policy in Australia', *Reserve Bank of Australia Discussion Paper* No 1999-11.

Bernanke BS and M Gertler (1995), Inside the black box: the credit channel of monetary policy transmission, *Journal of Economic Perspectives*, 9(4), pp 27–48.

Bernanke BS, M Gertler and M Watson (1997)**,** Systematic monetary policy and the effects of oil price shocks, *Brookings Papers on Economic Activity*, 1, pp 91–157.

Blundell-Wignall A and M Gizycki (1992), Credit supply and demand and the Australian economy, *Reserve Bank of Australia Research Discussion Paper* No 9208.

Claudia Dziobek and Ceyla Pazarbasioglu, (1997), Lessons from Systemic Bank Restructuring: A Survey of 24 Countries, No 1997/161, *IMF Working Papers*, International Monetary Fund

Chowdhury, I., Hoffman, M., & Schabert, A. (2013). Inflation dynamics and the cost channel of monetary transmission. *European Economic Review*, 50, 995–1016

Christiano LJ, M Eichenbaum and CL Evans (1998), 'Monetary policy shocks: what have we learned and to what end? *NBER Working Paper* No 6400.

Chandra, N., & Tallman, E. W. (1996). The information content of financial aggregates in Australia. *Federal Reserve Bank of Atlanta*. (No. 96-14).

Dhungana, N. T. (2016). Effects of monetary policy on bank lending in Nepal. *International Journal of Business and Management Review*, 4(7), 60–81.

Dungey M and A Pagan (2000), A structural VAR model of the Australian economy, *Economic Record*, 76(235), pp 321–342.

Dungey, M., & Fry, R. (2009). The identification of fiscal and monetary policy in a structural VAR. *Economic Modelling*, *26*(6), 1147-1160.

Ezirim, F. (2015). Impact of bank lending on liquidity of banks in Nigeria. *IJJS Publication*, 2, 44–56.

Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of monetary economics*, *32*(3), 485-512.

Friedman, M., & Schwartz, A. (2006). Money and business cycles. *Review of Economics and Statistics*, 32–64.

Fontana, G., & Palacio-Vera, A. (2007). Are long-run price stability and short-run output stabilization all that monetary policy can aim for? *Metroeconomica*, *58*(2), 269-298.

Garretsen H and J Swank (1998), The transmission of interest rate changes and the role of bank balance sheets: a VAR-analysis for the Netherlands', *Journal of Macroeconomics*, 20(2), pp 325–339.

Gertler M and S Gilchrist (1993), The role of credit market imperfections in the monetary transmission mechanism: arguments and evidence, *Scandinavian Journal of Economics*, 95(1), pp 43–64.

Gumata, N, E. Ndou, 2017. Bank Credit Extension and Real Economic Activity in South Africa, DOI: 10.1007/978-3-319-43551-0_19

Harron, S. & W. N. Azim. 2006. Deposit Determinants of Commercial Banks in Malaysia. *International Journal of Islamic Financial Services*, 1(5).

Hurley, M., & Adebayo, J. (2016). Credit scoring in the era of big data. *Yale JL & Tech.*, *18*, 148.

Haug AA, O Karagedikli and S Ranchhod (2003), Monetary policy transmission mechanisms and currency unions: a vector error correction approach to a trans-Tasman currency union, *Reserve Bank of New Zealand Discussion Paper* No DP 2003/04.

IMF, 2013.The interaction of monetary and macroprudential policies. *IMF*.

Issing, O., Gaspar, V., Angeloni, I., & Tristani, O. (2001). *Monetary policy in the euro area: strategy and decision-making at the European Central Bank*. Cambridge University Press.

Ibrahim, M. H. 2006. Stock Prices and Bank Loan Dynamics in a Developing Country: The Case of Malaysia. *Journal of Applied Economics*, 10(1).

Kilindo, A.A.L. 2020. Macroeconomic Determinants of Private Sector Credit in Tanzania: 1991 2018. *Tanzanian Economic Review*, Vol. 10 No. 2, December, 2020: 84–96.

Loayza, N., & Schmidt-hebbel, K. (2012). Monetary policy functions and transmission mechanisms: An overview**.**

Loupias, C., Savigna, F., & Sevestre, P. (2011). Monetary policy and bank lending in France: Are there Asymmetries? European central bank working paper series.

Levine, R., & Renelt, D. (1992). A sensitivity analysis of cross-country growth regressions. *The American economic review*, 942-963.

Mankiw, N. G. (2010). Intermediate macroeconomics.

McCandless, G. T., & Weber, W. E. (1995). Some monetary facts. *Federal Reserve Bank of Minneapolis Quarterly Review*, *19*(3), 2-11.

McAdam, P., & Morgan, J. (2001). Effects of Euro area interest rate changes: Evidence from macroeconomic models. *Sage Journals*, 93–103.

Mishra, Prachi, Peter J. Montiel, and Antonio Spilimbergo 2010, Monetary Transmission in Low-Income Countries: Effectiveness and Policy Implications, *IMF Economic Review.*

Montiel, Peter, Christopher Adam Wilfred Mbowe Stephen O'Connell, 2012, Financial Architecture and the Monetary Transmission Mechanism in Tanzania, *International Growth Centre*, mimeo.

Montiel, P., Adam, C., Mbowe, W., & O'Connell, S. (2012). Financial architecture and the monetary transmission mechanism in Tanzania. *Centre for the Study of African Economies*.

Mbowe, W. E. N. (2017). The Bank Lending Channel of Monetary Policy Transmission: A Dynamic Bank-Level Panel Data Analysis on Tanzania. *Applied Economics and Finance*, 4, 169-190. https://doi.org/10.11114/aef.v4i1.2097

Mbowe, W. E. Mrema, A., & Shayo, S. (2020). Determinants of Bank Lending Interest Rates in Tanzania. *American Journal of Industrial and Business Management*, 10, 1206-1236. https://doi.org/10.4236/ajibm.2020.107081

Moussa, M.A. & H. Chedia.2016. Determinants of Bank Lending. Case of Tunisia. *International Journal of Finance and Accounting*, 5(1): 27–36.

Moussa, A., & Chedia, S. (2014). Bank loans and monetary policy tools: An empirical analysis. International Journal of Sustainable Development, 2(12), 2201–2222.

Ndikumana, L., & Heintz, J. (2010). Is There a Case for Formal Inflation Targeting in Sub-Saharan Africa?.*University of Massachusetts, Political Economy Research Institute Working Paper*, (218).

Ndanshau, M. O. & A.A. L. Kilindo. 2016. Interest Rates and Financial Savings in Tanzania:An Empirical Investigation. *Journal of Social and Economic Policy*, 13(1): 25–46.

Ngalawa, H., & Viegi, N. (2011). Dynamic effects of monetary policy shocks in Malawi. *South African Journal of Economics*, *79*(3), 224-250.

Onyeiwu, C. (2012). Monetary policy and economic growth of Nigeria. *Journal of Economics and Sustainable Development*, 3(7), 62–88.

Onoh, J. O., & Nwachukwu, T. (2017). Monetary policy and credit delivery in commercial banks –Evidence from Nigeria. *International Journal of Social Sciences and Management Research*, 3(7), 2545–5303.

Onyemaechi, J. O. (2015). Monetary theory and policy. Victoria Island, Lagos

Papademos, L. (2003). The contribution of monetary policy to economic growth. *Die Förderung des Wirtschaftswachstums in Europa Fostering Economic Growth*, *23*.

Ramlogan, C. (2007). "Anism of Monetary Policy in Small Developing Countries: an Application to Trinidad and Tobago", *The Journal of Developing Areas*, Volume 41, Number 1, Fall 2007, pp. 79-91.

Ramlogan, C. (2004). The transmission mechanism of monetary policy: Evidence from the Caribbean. *Journal of Economic Studies*.

Romer CD and DH Romer (1990), New evidence on the monetary transmission mechanism, *Brookings Papers on Economic Activity*, 1, pp 149–213.

Stevens, G., & Thorp, S. (1989). The Relationship between Financial Indicators and Economic Activity: Some Further Evidence| Conference–1989.

Suzuki T (2004), Is the lending channel of monetary policy dominant in Australia, *Economic Record*, 80(249), pp 145–156.

Safaei J and NE Cameron (2003), Credit channel and credit shocks in Canadian macrodynamics – a structural VAR approach, *Applied Financial Economics*, 13(4), pp 267–277

Sims CA (1992), Interpreting the macroeconomic time series facts: the effects of monetary policy, *European Economic Review*, 36(5), pp 975–1000.

Sharifi-Renani, H. O. S. E. I. N. (2010, August). A structural VAR approach of monetary policy in Iran. In *International Conference On Applied Economics–ICOAE* (p. 631).

Tallman, E. W., & Chandra, N. (1997). Financial aggregates as conditioning information for Australian output and inflation *Working Paper*. (No. 97-8).

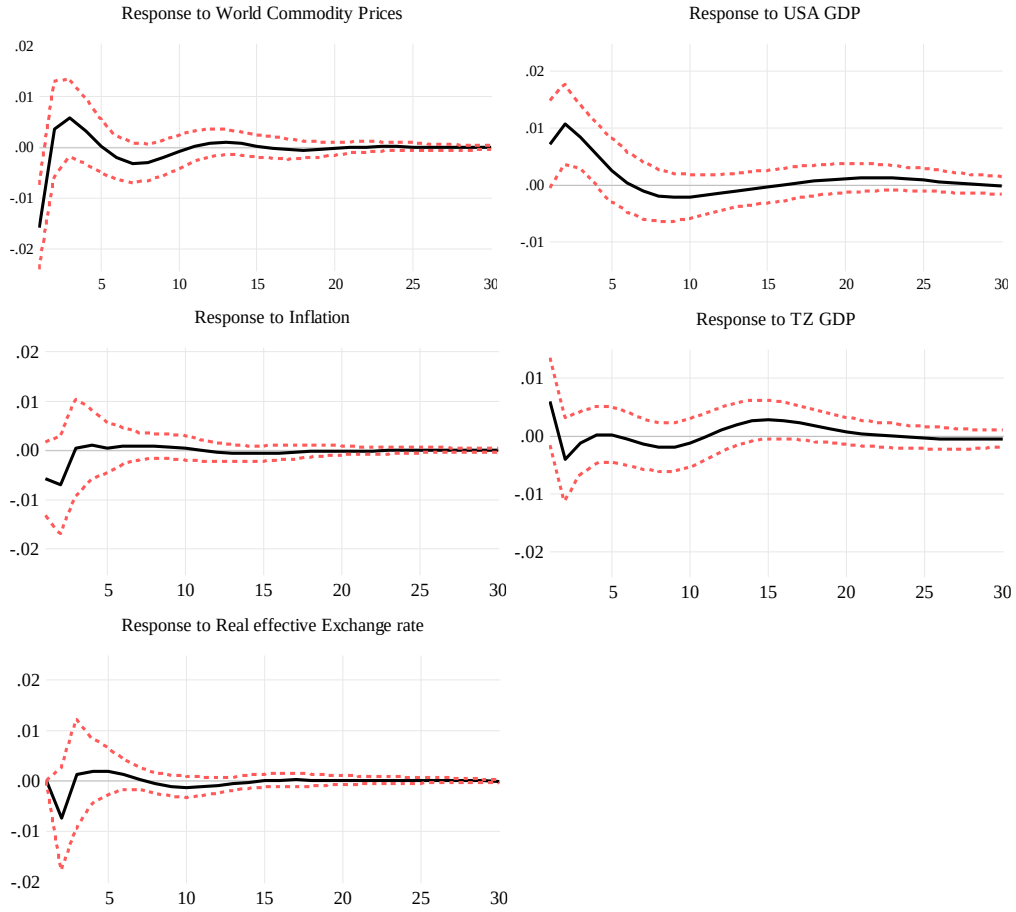
Tallman, E. W., & Bharucha, N. (2000). Credit crunch or what? Australian banks during the 1986-93 credit cycle. *Economic Review-Federal Reserve Bank of Atlanta*, *85*(3), 13.

Tomak, S. 2013. Determinants of Commercial Banks Lending Behaviour: Evidence from Turkey. *Asian Journal of Economic Research*, 3(8): 933–943.

Wrightman, P. (2012). Monetary policy and bank performance in Nigeria: A two-step cointegration approach. *African Journal of Scientific Research*, 9(1), 463–468.

Appendix 1

Figure 1A: Response of private sector credit to a positive shocks in other variables



Note:

a. Response to Cholesky One S.D. (d.f. adjusted) Innovations ,± 2 analytic asymptotic S.E.s

[1] Data source: datacatalog.worldbank.org: https://datacommons.org/tools/timeline#place=country%2FTZA&statsVar=GrowthRate_Amount_EconomicActivity_GrossDomesticProduction

[2] Other attributes includes: risk-averse behavior of commercial banks as a result of an adverse selection problem; new credit standards set by bankers (Clair and Tucker 1993); the impact of regulatory capital constraints on banks' balance sheets; and a "flight to quality," whereby banks shift their loan portfolios toward more creditworthy borrowers (Borensztein and Lee 2000; Bernanke, Gertler, and Gilchrist 1996).

[3] Rise in interest rates occurs when there is decreased reserve provision through a tightened central bank policy, triggers reduced spending and particularly, investment spending as it propels an increase in the cost of borrowing (Ezirim, 2015, Afolabi et al.,2018). Interest rate increase also causes a reduced spending as interest sensitive sectors of the economy prefer to speculate thereby, earning more interest on their money rather than spending on durable goods (Ekpenyong et al., 2013).

[4] Banks account for about three-quarters of the financial sector's assets, and a large part of production is by small businesses some of which are bank-dependent.

[5] Other measures that had effect on interest rates are in respect to widening of the central bank's oversight functions to cover community banks in 2003, and deposit-taking microfinance and microcredit institutions and credit reference bureaus in 2006 (BoT, 2016).

[6] In the same period, Uganda registered an average lending rate of 22.14 percent, Rwanda (17.05 percent) and Burundi (16.13 percent).

[7] Bernanke and Gertler (1995) and Mishkin (1996) provide a more extensive discussion of the credit channel. Monetary policy will operate through a lending channel if (1) changes in policy affect the supply of bank loans and (2) some borrowers depend on banks for credit (Bernanke and Blinder 1988.

[8] Suggesting that countercyclical monetary policy can be counterproductive.

[9] The link between macroeconomic variables and bank credit has received attention in many studies with GDP being a major macro-variable being the investigated (see, e.g., Ibrahim (2006), Amidu (2014), and more recently Thaker et al. (2013) and Azira et.al. (2018). An increase in GDP will raise both supply and demand for loans. As GDP increases banks will have more funds to make loans due to an increase in the amount of deposits. This is in support of the generally agreed theory that financial development and economic development are correlated (Amidu, 2014; Olumuyiwa et. al. (2012); Olokoyo, 2011).

[10] Global Price Index of All Commodities prices in US dollars deflated by the US CPI, Seasonally unadjusted.

[11] Real Gross Domestic Product, Billions of Chained 2012 Dollars, (Q-o-Q, annualised), seasonally unadjusted.

[12] Growth of real credit (Nominal credit deflated by the CPI, then Q-o-Q, annualised).

[13] Overnight interbank cash market rate.

[14] See Romer (2001) for a discussion of the Lucas-Phelps model.

[15] Brischetto and Voss and Bernanke and Blinder use the price level rather than inflation.