

The Role of the Exchange Rate and Dollarization in Monetary Transmission Mechanism: The Case of Tanzania

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Abstract

The main objective of this study is to investigate the extent of Tanzania's dollarization and trace whether it has impacted the country's monetary transmission mechanism. Specifically, it aims to examine the exchange rate channel of the monetary transmission mechanism; and examines the exchange rate pass-through to prices. The study applies the Bayesian Vector Autoregression and also incorporates the Markov switching processes to account for the structural breaks in the data. The results indicate that positive shocks on interest rates contract money supply, which leads to lower output growth and inflation, while exchange rates appreciate. Also, the degree of dollarization has a negative impact on the monetary supply of the local currency, as the central bank seeks to maintain a relatively constant rate of total money supply. This has the effect of lowering inflation and interest rates; and is also associated with further depreciation of the exchange rate. The positive shock on the exchange rate is associated with an increase in dollarization. The exchange rate pass-through to prices is not significant. The findings suggest the possibility of other factors that affect the exchange rate, which may be beyond the direct control of the central bank, such as the amount of foreign currency in circulation.

1. Introduction

There is a growing informal dollarization in the Tanzanian economy. This is evidenced by the increasing use of the US dollar in day-to-day domestic transactions. If assets or credits on loans are denominated in foreign currency, nominal exchange rate developments may change their value in terms of domestic currency, which also influences borrowing capacity (Égert & MacDonald, 2006). This paper evaluates exchange rate channels for the transmission of monetary policy to output, and inflation in a partially de-facto dollarized economy. It also examines the effectiveness of the exchange rate pass-through.

Traditionally, monetary policy has been one of the most effective instruments through which a central bank is able to influence macroeconomic and financial controls. A well-designed monetary policy system might contribute towards sound economic and financial outcomes, while a poor monetary policy framework might have counterproductive effects. To run a prosperous economy, therefore, it is crucial to understand how monetary policy works, through what mechanisms its policy actions are transmitted, what factors affect its transmission mechanisms, which channels are most effective and why they are effective. The transmission of

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monetary policy indicates how changes in monetary sectors are transmitted to real sectors. This process starts with a change in an interest rate that affects investment spending and consumption, which influences aggregate demand. The change in aggregate demand would then lead to a change in prices, as a part of the interest rate channel in the monetary policy transmission system.

Since 1993 the monetary policy in Tanzania has focused on money supply targets, which implies that this policy framework allows interest rates to fluctuate freely (although they are obviously influenced by monetary supply). This contributes to the volatility of interest rates in the country. The choice to target money supply was due to relatively underdeveloped financial markets, unavailability of high frequency data and structural rigidities in the economy. This currency framework is in a transitional phase towards that of inflation targeting, which requires an expansion of institutions and good general institutional conditions (Brito & Bystedt, 2010). The growth of institutions, such as the much-needed development of the financial sector, helps to reduce the probability of missing inflation targets (Hove, 2010). Despite the fact that the current focus is to move towards inflation targeting, the money supply target has proven to be reasonably successful in controlling inflation over the past decade of the 2000s (IMF, 2014).

The objective of this study is to evaluate exchange rate channels for the transmission of monetary policy to output and inflation in a partially de-facto dollarized economy. Also, it examines the effectiveness of the exchange rate pass-through. The main findings are: interest rate shocks lead to lower money supply; aggregate demand shocks fuel inflation; cost-push shocks decrease interest rates; exchange rate shocks lower interest rates; and dollarization shocks reduce the supply of the local currency. The findings also indicate that there is a possibility that other factors—such as the amount of foreign currency in circulation, which may be beyond the direct control of the central bank—affect exchange rates.

Following this introductory section, section two looks at the evidence of dollarization in the country. Section three is on the conceptual framework of the study, the interpretation of the study results in section four. Section five concludes the study and its policy implications.

2. Evidence of Dollarization in Tanzania

Dollarization refers to the frequent use of foreign currencies by domestic residents to store wealth or utilize as means of payment. It can be official dollarization, which is a total substitution of the domestic currency; official semi-dollarization, which is the use of both domestic and foreign currencies interchangeably as legal tender; and unofficial dollarization, which is the use of foreign currency when local currency is the only legal tender (Meyer, 2000). The latter, which is practised in Tanzania and many other African countries, is also known as de-facto dollarization. The Tanzanian (TZS) shilling is the only legal tender in Tanzania. However, the US dollar is widely used as a medium of exchange and store of value in metropolitan areas.

This increasing use of foreign currency in Tanzania can be traced back a few decades to the influx of international offices in the country, for example the United Nation offices, and the arrival of international schools. Additionally, it could also have resulted from a loss of confidence in the TZS or unbridled growth of the underground economic sector (Honig, 2009; Feige, 2003). Excessive dollarization leads to a loss of control over monetary policy. Baliño et al. (1999) categorize two types of de-facto dollarized economies: highly dollarized economies, where foreign currency deposits are above 30 percent; and moderately dollarized economies, where foreign currency deposits are less than 30 percent of the broad money supply (M2). Tanzania is presumed to be in the highly dollarized economy category, as, since 2000 the ratio of foreign currency deposits to broad money is above 30 percent.

Dollarization in Tanzania has two main features. Firstly, the degree of dollarization moves opposite to the inflation rate but parallel to the exchange rate. Secondly, there is a parallel movement in the degree of dollarization and the exchange rate. The former suggests the possibility of dollarization hysteresis, i.e., the increasing use of a foreign currency after a period of high inflation even after inflation is reduced (Tellería, 2006). A high use of foreign currencies lowers the demand for domestic currency; and this leads to exchange rate depreciation, which in turn reduces the purchasing power of the domestic currency, and therefore encourages further dollarization.

Dollarization is also viewed as an outcome of competition among currencies such as the local legal tender where foreign currencies compete in the absence of restrictions (Schaub, 2009). In an inflationary environment, foreign currency is often used as a protection mechanism against loss of purchasing power when transacting. This increases the availability of loans from commercial banks because foreign currency deposits are recognized, though there is a possibility of creating a currency mismatch if the exchange rate risk is not properly accounted for by commercial banks and foreign account owners in their balance sheets (De Nicoló et al., 2005). A bank's balance sheet describes its financial position, which include fixed assets, loans to customers, securities for sale, and loans to other banks on the assets side. It also includes customer deposits, and other trade liabilities on the liabilities side. As noted by various scholars (Meyer, 2000; Arteta, 2002; De Nicoló et al., 2005), dollarization creates a currency mismatch in a bank's balance sheets if it is receiving dollar deposits but not issuing dollar loans. This currency mismatch is due to the immediate impact of exchange rate depreciation on foreign-currency denominated liabilities (Alvarez-Plata & García-Herrero, 2008). For example, a sudden real devaluation when bank liabilities are sometimes in US\$ and at other times in TZS encourages depositors to immediately transform their TZS deposits into dollars, which leads to a currency mismatch between assets and liabilities. To hedge this risk, a bank is left with only the option of selling assets and buying foreign reserves of a central bank, thus undermining the currency board (Roubini, 2001). Real devaluation shocks and sudden shift of depositors' currency preferences in dollarized economies creates financial distress in the banking system (Roubini, 2001).

Currency mismatch has happened in several economies, including Argentina (2002), Brazil (1999), Turkey (2000) and Uruguay (2002) (Cowan et al., 2005; Levy-Yeyati, 2006). In Tanzania, customers can have foreign currencies account for their deposits but cannot get loans in foreign currencies. If deposits and loans are not expressed in a particular currency they may perhaps not balance if there is a real exchange shock. This can happen even when banks are formally foreign-currency-hedged, i.e., when they have equal foreign currency assets and foreign currency liabilities, as it happened in Argentina (Roubini, 2001). An imbalance of assets and liabilities can cause financial instability, which may give rise to a banking crisis (García-Herrero, 1997), which refers to a situation where banks have lent out most of their cash deposits, and therefore customers cannot retrieve their deposits.

In Tanzania, commercial banks were authorised to open foreign currency deposit accounts for both residents and non-residents in 1992. Foreign currency deposits as a percentage of total deposits have increased over time; and reached a peak in 2006 (Fig. 1). Bureau de change markets were introduced in 1993 to liberalize the foreign exchange regime. However, the TZS remained the country's only legal tender. Nevertheless, individuals and companies were allowed to quote their prices in dollars and receive payments in either TZS or US\$, based on customer preferences. These have been costly to customers, owing to exchange rates set by sellers, which are normally above market rates. The consequence of this has been an increase in foreign currency accounts among individuals. It is common for parents with children in private schools to pay fees directly into their schools' account US\$ (Kessy, 2011). Other industries accepting dollars in Tanzania include the real estate and tourism sectors.

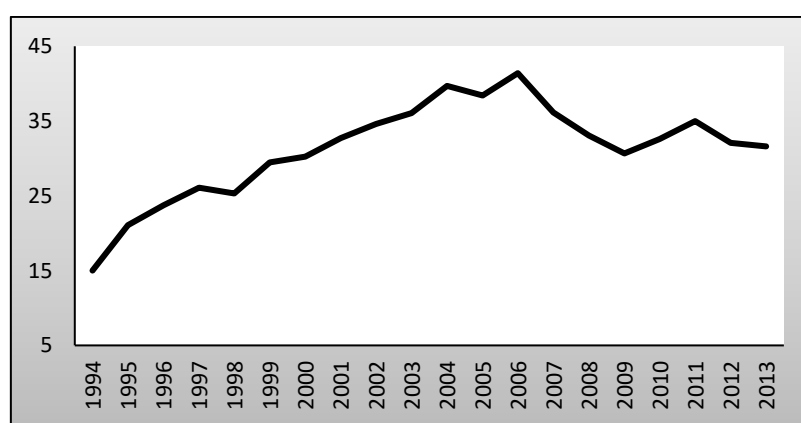


Figure 1: Foreign Deposit (% Total Deposits)

Source: BOT statistics

Because of the unavailability of data on foreign currency in circulation, analysts have used foreign currency deposits as an indicator of the extent of dollarization in the country. According to the BoT, foreign currency deposits are the difference of

extended broad money supply (M3) and broad money supply (M2). Foreign currency deposits in Tanzania are supposed to facilitate transactions and are not meant to act as a store of value (Kessy, 2011). From 2000 to 2009 around 60 percent of foreign currency deposits were demand deposits (ibid.).

The standard measure of dollarization is the ratio of foreign currency deposits to broad money supply (Fig. 2). Although this is the most widely accepted measure, it may underestimate the problem in this case since Tanzania is a cash-based economy. The ratio of foreign currency deposits to broad money supply was above 30 percent during the 2000s. The highest recorded ratio, which was above 49 percent, occurred in 2006. This happened after inflation had fallen to its lowest rate of 4.4 percent in 2005.

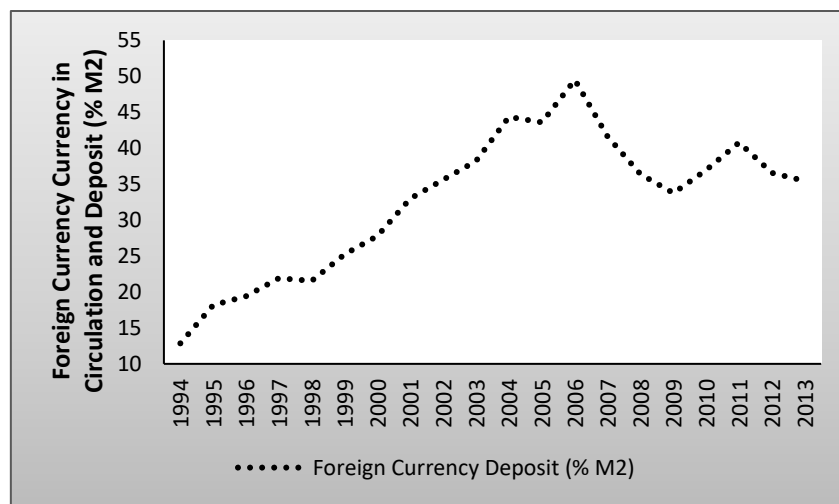


Figure 2: Dollarization (%M2)

Source: BOT statistics

A study in a number of developing countries on the effectiveness of monetary policy (control of inflation), given dollarization, found that efforts to lower inflation are not hindered by the use of foreign currency. Alternatively, the use of foreign currency is not driven by high inflation (Reinhart et al., 2003). Researchers have concluded that using foreign currency does not harm domestic monetary policy and its efforts to combat inflation (Havrylyshyn & Beddies, 2003; Mongardini & Mueller, 2000; Savastano, 1996; Mueller, 1994). Similarly, the Tanzanian government does not seem to see the level of dollarization as a threat to the economy. A former Minister of Finance, Adam Malima (2014), stated that "...the use of foreign currency in the economy enables banks to provide loans to foreign investors, hence improves the growth of the economy." In a similar vein, the former Governor of the BoT, Professor Benno Ndulu (2014), explains that "...the reason for using the foreign currency is to simplify business transactions with foreigners."

3. Conceptual Framework

The main objectives of monetary policy in Tanzania are to maintain and ensure price stability conducive to a balanced and sustainable growth of the national economy, and to ensure a stable exchange rate (BOT Act 1995). The BoT handles monetary policy by managing base money (M0) as the operational target, with a view to attaining a level of broad money (M2) that is consistent with its macroeconomic objectives of increasing output growth and the level of international reserves; and reducing the level of inflation. The experience of Tanzania indicates that monetary policy implementation prior to the mid-1990s was subordinated to fiscal imperatives, initially to the financing of large and ultimately unsustainable fiscal deficits. This resulted in higher levels of inflation that eroded real income, hampered productive investment and reduced export competitiveness. Since the second half of the 1990s the monetary policy was conducted in support of decisive fiscal consolidations (Buffie et al., 2004). The monetary policy was conducted with the intention of reducing the government's domestic financing needs. All these efforts aimed at reducing the growth rate of money supply and the level of inflation, which in turn could boost export competitiveness. Monetary policy shocks that give rise to an expansionary (non-sustainable) monetary policy increase domestic price levels, appreciate the real exchange rate and reduce export competitiveness. Fig. 3 illustrates the exchange rate channel of monetary policy transmission for Tanzania.

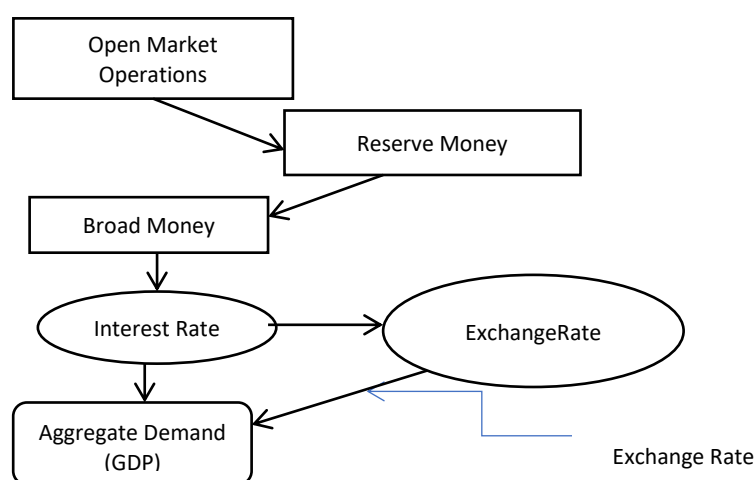


Figure 3: Exchange Rate Channel of Monetary Transmission Mechanism

The exchange rate channel (ERC) of a monetary policy transmission refers to how shocks on monetary variables (reserve and broad money) impact aggregate prices, output and demand through the effects of the domestic interest rate on the exchange rate. Expansionary monetary policy has a tendency to decrease interest rates, and vice versa; a change in domestic interest rates affects the exchange rate,

which is then transmitted to other variables, such as prices and trade. This paper answers the following questions in relation to the monetary policy transmission mechanism in Tanzania as a partially de-facto dollarized economy.

- How much of the variation in the exchange rate is derived from the variation in monetary variables, that is, money supply/interest rate?
- How much of this accounts for fluctuations in nominal macroeconomic aggregated variables, that is, prices?

4. Monetary Policy Implementation

Monetary policy transmission mechanisms refer to the different ways through which monetary policy operating targets are transmitted to influence economic objectives such as low inflation rate and high economic growth. Although transmission mechanisms differ among countries, there are mainly six channels. These are: interest rate, exchange rate, bank lending, balance sheet, asset prices, and formation of expectation. Monetary policy transmission channels are not entirely independent, but rather supplement each other (Dabla-Norris & Floerkemeier, 2006). For example, the exchange rate channel is an interest channel in an open economy. Also, the income effect of the interest rate channel on net wealth goes through the cost of servicing short-term and floating-rate debt, thus affecting the balance sheet channel.

The BoT has moved to indirect instruments of monetary policy since 1995. These include open market operations, repurchase agreements, discount windows, foreign exchange market operations, statutory minimum reserve requirements, and moral suasion. Open market operation (OMO) is the leading instrument, through the sale and purchase of government securities. Under a floating exchange rate regime, the exchange rate channel can be categorized in two stages. The first stage of the transmission mechanism shows how short-term interest rates impact exchange rates; while the second stage is the pass-through from exchange rates to import and domestic prices, followed by an adjustment in real variables, such as imports, exports, investment and others. A contractionary monetary policy is characterized by a decrease in money supply (broad money), which raises the domestic interest rate and appreciates the exchange rate due to the inflow of capital. The end result is a fall in aggregate demand. Monetary policy that increases domestic interest rates relative to foreign interest rates enhances the strength of the domestic currency, and vice versa. The exchange rate often portrays the international side of a country's monetary policy (Taylor, 1995). A tight monetary policy raises the domestic real interest rate; and increases the value of domestic currency relative to foreign currency, which is exchange rate appreciation. The focus of this study is on the exchange rate channel because of its numerous influences on both aggregate demand and aggregate supply (Juks, 2004).

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income, hampered productive investment, and reduced export competitiveness. Since the second half of the 1990s monetary policy was conducted in support of decisive fiscal consolidations (Buffie et al., 2004). Monetary policy was conducted with the intention of reducing the government's domestic financing needs. All these efforts aimed at reducing the growth rate of money supply and the level of inflation, which in turn can boost export competitiveness. Monetary policy shocks that give rise to an expansionary (non-sustainable) monetary policy increase the domestic price level, appreciate the real exchange rate, and reduce export competitiveness.

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4.1 Monetary Transmission Mechanism Model

The variables that have been included in this model include measures of output, consumer prices, interest rates, monetary supply, exchange rates and dollarization. This dataset includes a relatively low number of observations, which gives rise to few degrees of freedom. This would necessitate the use of Bayesian techniques, which have been applied to estimate the respective parameter values, while Markov switching processes have been incorporated in the model structure to account for the structural breaks in the data.

The parameters in the model are estimated with the Bayesian techniques for which we make use of a normal-inverse-Wishart prior, as we are primarily interested in the dynamics of the economic variables and how they affect one another. In contrast, the popular use of the Minnesota prior would restrict the cross-equation dynamics, so that the effect of the lags of the own variable dominate the description of any subsequent behaviour of that variable.

In this case, we assume that the prior takes the distribution that is described by the two moments $p(\beta, \Sigma)$. As it is assumed that the variables exhibit stationary behaviour, the first moment of the prior takes the value $\beta = 0$.¹ The matrix for

¹This is later confirmed by the impulse response functions, which suggest the effects of shocks are temporary.

Σ takes an appropriate inverse-Wishart distribution to allow for the derivation of the posterior from:

$$p(\beta, \Sigma | l, y) \propto p(y | l, \beta, \Sigma) p(\beta, \Sigma)$$

In this case, $p(\beta, \Sigma | l, y)$ represents the posterior probability for the parameter values that may be associated with the given data and the likelihood function, and $p(y | l, \beta, \Sigma)$ represents the data density for the likelihood function.

To allow for structural breaks in the data we incorporate the Markov-switching process in the model. This practice has been popularised in several important macroeconomic investigations, including those of Sims and Zha (2006) and Sims et al. (2008). Evidence of prominent structural breaks was noted, and these features of the data are discussed in more details below.

The manner in which the Markov-switching process has been incorporated in the model to account for structural breaks largely follows Koop and Korobilis (2010), who allow for a single switch between regimes. However, in contrast to their procedure, we allow for multiple breaks across two regimes. The transition probabilities, which range between zero and one, are then treated in the same way as an endogenous dummy variable, so that the effects of the structural breaks are contained.²

4.2 Identification of the Model

As the initial model will take the form of a reduced-form expression that employs Choleski decomposition, the ordering of the variables will be of importance (Christiano et al., 1998). To develop some form of intuition for the ordering we start with a simple parsimonious model and develop it further, to ensure that we derive results that are reasonably consistent.

The first representation of the model takes the form of a closed-economy model that relies on recursive structural relationship between measures of output, inflation and interest rate and the corresponding shocks. The structural moving average form of the model could be written as:

$$\begin{bmatrix} y_t \\ \pi_t \\ i_t \end{bmatrix} = \begin{bmatrix} \theta_{1,1} & 0 & 0 \\ \theta_{2,1} & \theta_{2,2} & 0 \\ \theta_{3,1} & \theta_{3,2} & \theta_{3,3} \end{bmatrix} \begin{bmatrix} \varepsilon_{y,t} \\ \varepsilon_{\pi,t} \\ \varepsilon_{i,t} \end{bmatrix} + \theta_1 \varepsilon_{t-1} + \dots$$

where y_t represents GDP growth, π_t represents inflation, and i_t represents nominal interest rates.

²Both of the notable structural breaks in 2001/2002 and 2010/2011 were contained in the periods of 'unusual' behaviour, as described by the resulting transition probabilities that had a value of one (and for which equivalent dummy variable values would have been assigned).

When the variables are ordered in this recursive manner, we are able to recover the structural shocks from the covariance of the reduced form residuals using the Choleski decomposition that contains identification restrictions. These restrictions imply that the variable ordered on top will only react to its own shock, while the variable ordered on the bottom will react to all shocks. Alternatively, it takes a single period before the monetary policy shock will affect output and inflation. However, the nominal interest rate will include the effect of this shock immediately.

A similar structure has been followed in Bjørnland and Thorsrud (2014), where contemporaneous changes in output can only result from shocks to output, while shocks to output and inflation can shift inflation contemporaneously. Lastly, all of the shocks can affect interest rate contemporaneously. This type of reaction function would be largely consistent with the macroeconomic theory for a closed-economy model, as described in Clarida et al. (2002).

Since the central bank has made use of an explicit role for monetary supply, m_t , we include it in the model as follows,

$$\begin{bmatrix} y_t \\ \pi_t \\ m_t \\ i_t \end{bmatrix} = \begin{bmatrix} \theta_{1,1} & 0 & 0 & 0 \\ \theta_{2,1} & \theta_{2,2} & 0 & 0 \\ \theta_{3,1} & \theta_{3,2} & \theta_{3,3} & 0 \\ \theta_{4,1} & \theta_{4,2} & \theta_{4,3} & \theta_{4,4} \end{bmatrix} \begin{bmatrix} \varepsilon_{y,t} \\ \varepsilon_{\pi,t} \\ \varepsilon_{m,t} \\ \varepsilon_{i,t} \end{bmatrix} + \theta_1 \varepsilon_{t-1} + \dots$$

where shocks to the monetary supply will affect the interest rate contemporaneously, while the central bank will respond to inflation and output shocks contemporaneously by making a change to monetary supply.

As an exchange rate reacts to a number of external factors, most researchers treat it as a relatively exogenous process. In this case we place an exchange rate as the first variable, where the only effect of contemporaneous shocks are due to factors that have an impact on the exchange rate, x_t . The structural moving average representation would then take the form:

$$\begin{bmatrix} x_t \\ y_t \\ \pi_t \\ m_t \\ i_t \end{bmatrix} = \begin{bmatrix} \theta_{1,1} & 0 & 0 & 0 & 0 \\ \theta_{2,1} & \theta_{2,2} & 0 & 0 & 0 \\ \theta_{3,1} & \theta_{3,2} & \theta_{3,3} & 0 & 0 \\ \theta_{4,1} & \theta_{4,2} & \theta_{4,3} & \theta_{4,4} & 0 \\ \theta_{5,1} & \theta_{5,2} & \theta_{5,3} & \theta_{5,4} & \theta_{5,5} \end{bmatrix} \begin{bmatrix} \varepsilon_{x,t} \\ \varepsilon_{y,t} \\ \varepsilon_{\pi,t} \\ \varepsilon_{m,t} \\ \varepsilon_{i,t} \end{bmatrix} + \theta_1 \varepsilon_{t-1} + \dots$$

The degree of dollarization would be affected by the exchange rate and those factors that impact on the external value of the domestic currency, we place the measure

of Dollarization (D_t) under the exchange rate. Hence the ordering for the six variables look as follows:

$$\begin{bmatrix} x_t \\ D_t \\ y_t \\ \pi_t \\ m_t \\ i_t \end{bmatrix} = \begin{bmatrix} \theta_{1,1} & 0 & 0 & 0 & 0 & 0 \\ \theta_{2,1} & \theta_{2,2} & 0 & 0 & 0 & 0 \\ \theta_{3,1} & \theta_{3,2} & \theta_{3,3} & 0 & 0 & 0 \\ \theta_{4,1} & \theta_{4,2} & \theta_{4,3} & \theta_{4,4} & 0 & 0 \\ \theta_{5,1} & \theta_{5,2} & \theta_{5,3} & \theta_{5,4} & \theta_{5,5} & 0 \\ \theta_{6,1} & \theta_{6,2} & \theta_{6,3} & \theta_{6,4} & \theta_{6,5} & \theta_{6,6} \end{bmatrix} \begin{bmatrix} \varepsilon_{x,t} \\ \varepsilon_{D,t} \\ \varepsilon_{y,t} \\ \varepsilon_{\pi,t} \\ \varepsilon_{m,t} \\ \varepsilon_{i,t} \end{bmatrix} + \theta_1 \varepsilon_{t-1} + \dots$$

All of the data used in this analysis was obtained from the International Monetary Fund (IMF) database for International Financial Statistics (IFS). The data is available at a quarterly frequency for the period 2001q1 to 2013q3. Prior to this period, measures of gross domestic output were not collected at this frequency. All variables are not stationary, but stationary at first differences. The measure of output (y_t) is seasonally adjusted with the aid of the X13 seasonal filter. Thereafter, the stochastic trend in the natural logarithm of the series was identified with the aid of the Hodrick-Prescott filter, where the smoothing coefficient for quarterly data was set at 1,600. After removing the stochastic trend, we obtained the cyclical component of economic output. This measure was then compared to the growth rate in economic output, along with a number of other approaches that included those that made use of a Beveridge-Nelson, Band-Pass, Christiano-Fitzgerald and linear filter (see, Nelson, 1981; Fitzgerald, 2003; King, 1999; Prescott, 1997; and King & Rebelo, 1993).

As the periods of positive and negative economic growth (as measured by the logarithmic change in seasonally adjusted real gross domestic product) appeared to coincide with the periods where the Hodrick-Prescott filter appeared, this suggests that there were notable contractions and expansions in the business cycle, and this measure was used in the subsequent analysis. Indeed, the correlation between this measure of the business cycle and output growth was 0.6. However, the difference between these measures was not found to be all that significant. The measure of consumer prices was also clearly subject to notable seasonal variation. Therefore, to ensure that this measure is consistent with that of output, we also applied the X13 seasonal filter to this measure. The measure of inflation (π_t) is then derived from the quarter-on-quarter logarithmic change in the seasonally adjusted consumer price index.

Domestic monetary supply (m_t) was measured as M2, which is also known as broad money that includes currency in circulation, quasi-money and other deposits in domestic currency. The reason for not using extended broad money supply is that we are primarily interested in the role of the central bank and its ability to influence interest rates through the control of the domestic currency. The foreign currency deposits in the economy that are included in the M3 definition are treated

as a separate feature, which is the focus of the measure of dollarization. In addition, if we had included foreign balances in our measure of money supply and dollarization, then we would have double-counted this feature. The quarter-on-quarter logarithmic change in the level of this variable has been used for further modelling purposes.

The interest rate is measured as the central bank discount rate, which has been annualised. This is the rate which the central bank charges commercial banks. It is worth noting that the discount rate has become relatively constant as of 2010. The measure of the exchange rate (x_t) is the nominal exchange rate between the US\$ and the TZS. To ensure that it is consistent with the other variables, we make use of the quarter-on-quarter logarithmic change for this series.

There are a number of possible measures of dollarization (D_t) that could be used. The amount of foreign currency in the economy at a point in time could largely be measured by the difference in M3 and M2 monetary supply. This could be expressed as a fraction of M2 to convey information about the ratio of foreign monetary supply to domestic money supply. Alternatively, we could express the foreign holdings as a percentage of total money supply, which would also be a useful indicator. However, one of the problems that would be associated with using these measures to characterise the degree of dollarization in Tanzania is that domestic money supply (M2) is much more volatile than foreign money holdings. It is thus more often the case that changes in M2 would give rise to a change in these measures of dollarization (rather than a change in foreign holdings). As such we make use of the quarter-on-quarter change in the natural logarithm of foreign monetary holdings to describe the degree of dollarization in the economy, while the effects of a change in domestic money supply are captured separately in the model. This measure of dollarization includes two notable structural breaks in 2001/2002 and 2010/2011, which are accounted for in the model.

It is also worth noting that the measure of the difference between M3 and M2 would capture the total amount of foreign currency holdings in the economy. The information content of this measure could therefore be contradictory at times. For example, where there is little confidence in the economy, individuals may wish to make additional use of foreign currency for transactional purposes (leading to an increase in the demand for foreign currency), while foreign investment would decline (leading to a decrease in foreign currency reserves that are held by the central bank).

Fig. A1 presents these variables after transformation. The results of the model are summarised with the following impulse response functions. The first of these shows the effects of a monetary policy shock, which follows a positive innovation of one standard deviation in the interest rate in Fig. A2. The positive spike in interest rates is associated with a sharp reduction in money supply. It takes about ten quarters for money supply to return to its steady-state value, whereupon it takes a bit of time to stabilize (which is partly because all the variables are endogenous

in this framework). The positive innovation in the interest rate gives rise to sharp reduction in output, while the rate of inflation starts to decline after four quarters. In this case the extent of the decline in output is greater than the decline in inflation, which is consistent with the findings of most macroeconomic models. The higher interest rate also results in a reduction in the depreciation of the external value of the currency, as it strengthens during the impact period. The appreciation in the exchange rate that would have resulted from the increase in foreign capital would give rise to an increase in foreign reserves. These results in an increase in the measure of foreign capital in the economy, as Fig. A2 shows.

The aggregate demand shock would result in an innovation in the cyclical component of output. This fuels inflation, and in this case, it has increased monetary supply due to the persistent demand for real monetary balance. In addition, the nominal exchange rate depreciates as the amount of foreign currency holdings declines. These results are shown in Fig. A3.

The effect of an unexpected increase in inflation is captured by the cost-push shock that follows an innovation to the rate of inflation. The effect of such a shock on other endogenous variables is characterised in Fig. A4. The relatively high environment would appear to be associated with low interest rates, although one would expect that the central bank would react to the increase in inflation by raising the nominal interest rate.

The positive innovation to monetary supply is associated with a significant reduction in the interest rate. This gives rise to an initial increase in output and a significant increase in inflationary pressure. The exchange rate also experiences a significant deterioration, with the result that the foreign holdings of the central bank, and other factors that contribute to dollarization, decline. The effects of such a monetary supply shock are depicted in Fig. A5.

A positive exchange rate shock would result in a depreciation of the external value of the domestic currency, as shown in Fig. A6. This is associated with inflationary pressure, which leads to an initial reduction in monetary supply and a rise in nominal interest rates (which is somewhat short-lived). The depreciation in foreign currency is also associated with an increase in dollarization as it would be more desirable to hold foreign currency when the economy is affected by an exchange rate shock that depreciates the value of the domestic currency. An innovation of one positive standard deviation to the level of dollarization in the Tanzanian economy would result in a reduction in the monetary supply of local currency (M2), as the central bank seeks to maintain a relatively constant rate of total money supply (including foreign currency holdings). This reduction in domestic monetary supply eases inflationary pressure, which allows the central bank to lower interest rates. The lower interest rate would then fuel depreciation in the currency. These results are shown in Fig. A7.

5. Concluding Remarks

The results from this study suggest that an exchange rate pass-through is not significant. In addition, foreign currency deposits are positively related to exchange rate depreciation; and interest rate increases are associated with a reduction in money supply. This in turn leads to a decline in real GDP. A shock from aggregate demand would appear to increase inflation rate, while the de-facto dollarization in an economy lowers the inflation rate through a reduction in money supply. This is also explained by the negative relationship between foreign currency deposits and the inflation rate, which influences the exchange rate. When a firm opts to conduct transactions in foreign currencies, there would appear to be a depreciation of the TZS, which is a form of hedging. Honohan (2007) has explained this as the direct effect of partial dollarization in an economy.

It should be noted that this study is limited by the fact that the data on foreign currency in circulation is not available, requiring instead that foreign currency deposits are used as the principal data. The results show that the use of foreign currency in Tanzania does not harm the monetary transmission mechanism. The findings also indicate that there is a possibility that other factors, such as the amount of foreign currency in circulation, which may be beyond the direct control of central banks, affect the exchange rate. This implies that the ability of policy-makers to influence the movement of the exchange rate is limited. In the long-run, however, appropriate structural changes and a competitive policy can be designed and implemented to minimize external shocks.

This study recommends the pursuance of a sound monetary policy as an instrument for achieving exchange rate stability. The increasing credibility of the BoT's inflation targeting framework and the relatively low and stable rate of inflation in the current regime have established a solid policy basis for a more stable exchange rate in the future. There is a need for coordinating exchange rate and monetary policies. Policies that seek to maintain a competitive exchange rate should be accompanied by an appropriate monetary policy to control inflation. Implementing a policy-mix that achieves stability in both the internal and external value of the currency should be the objectives of the BoT.

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Appendix

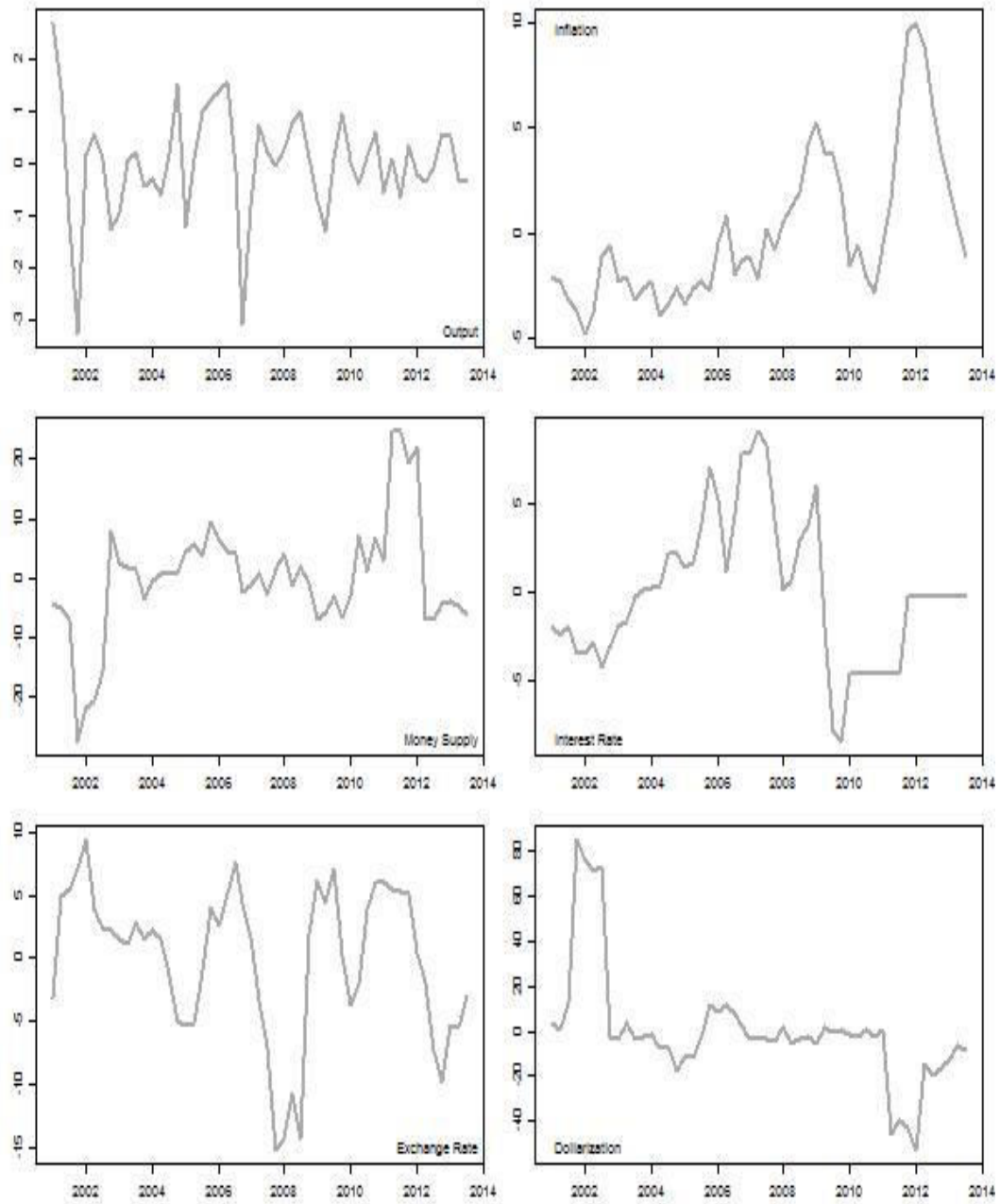


Figure A1: Variables after Transformation

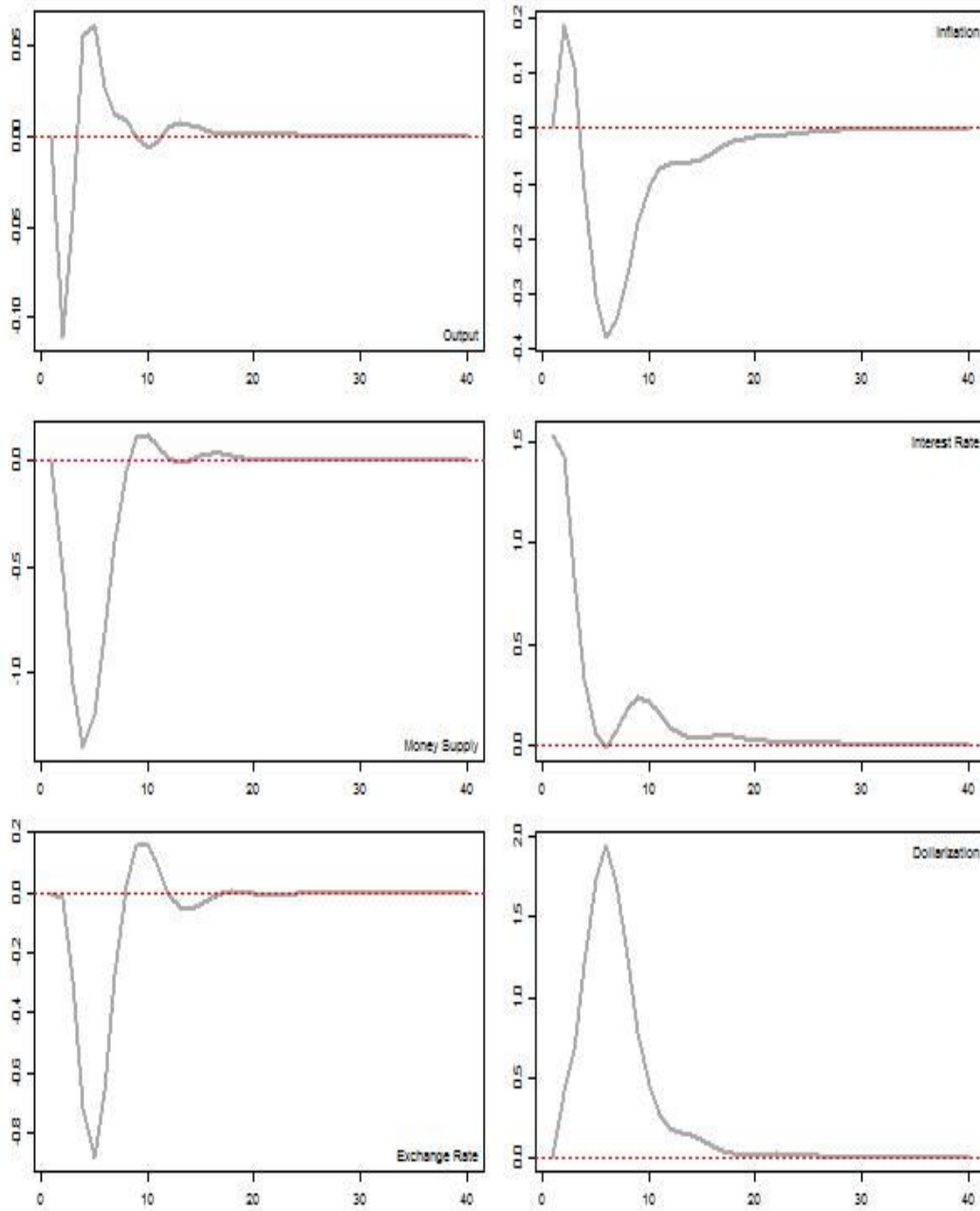


Figure A2: Bayesian VAR - Monetary Policy Shock

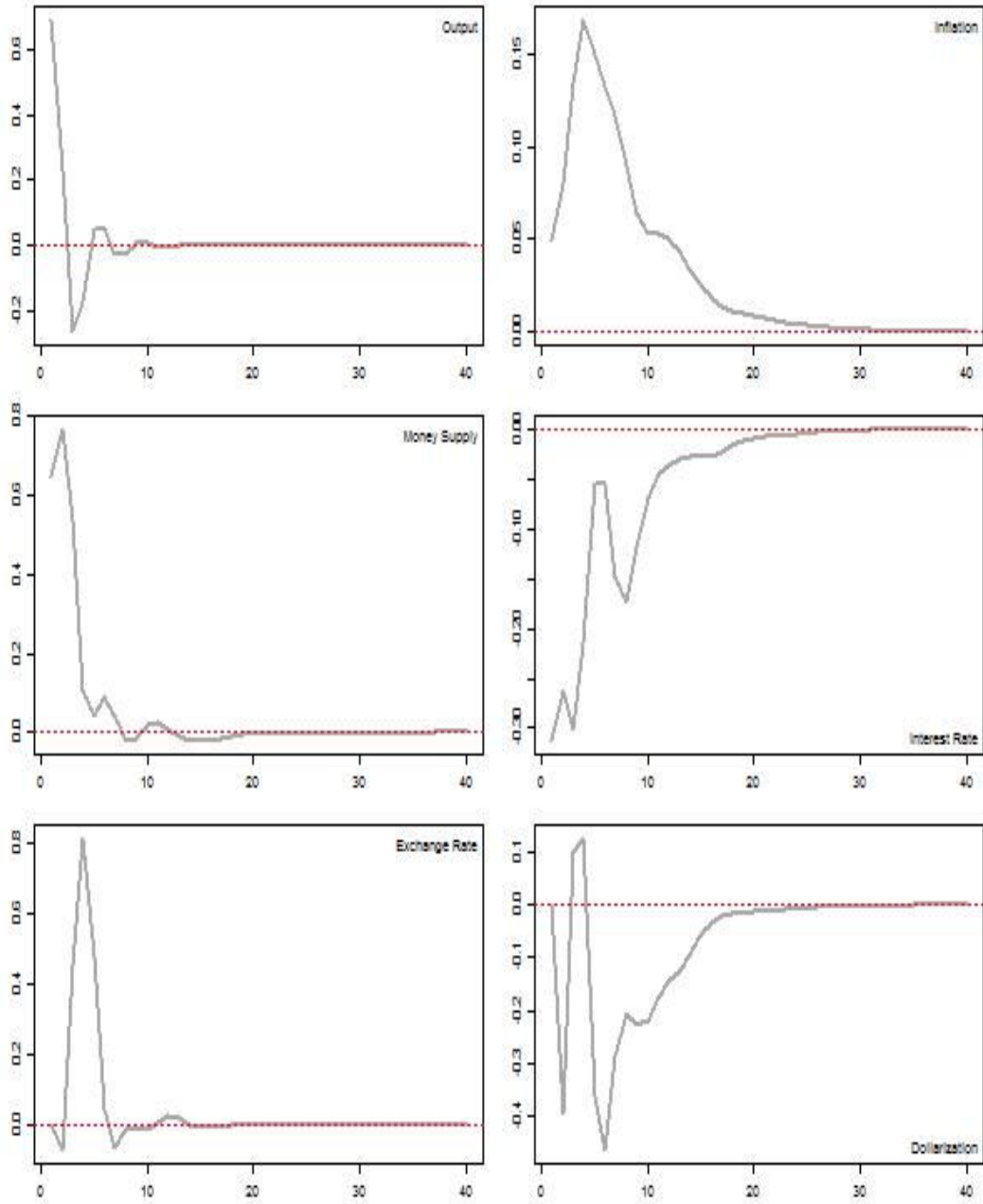


Figure A3: Bayesian VAR -Aggregate Demand Shock

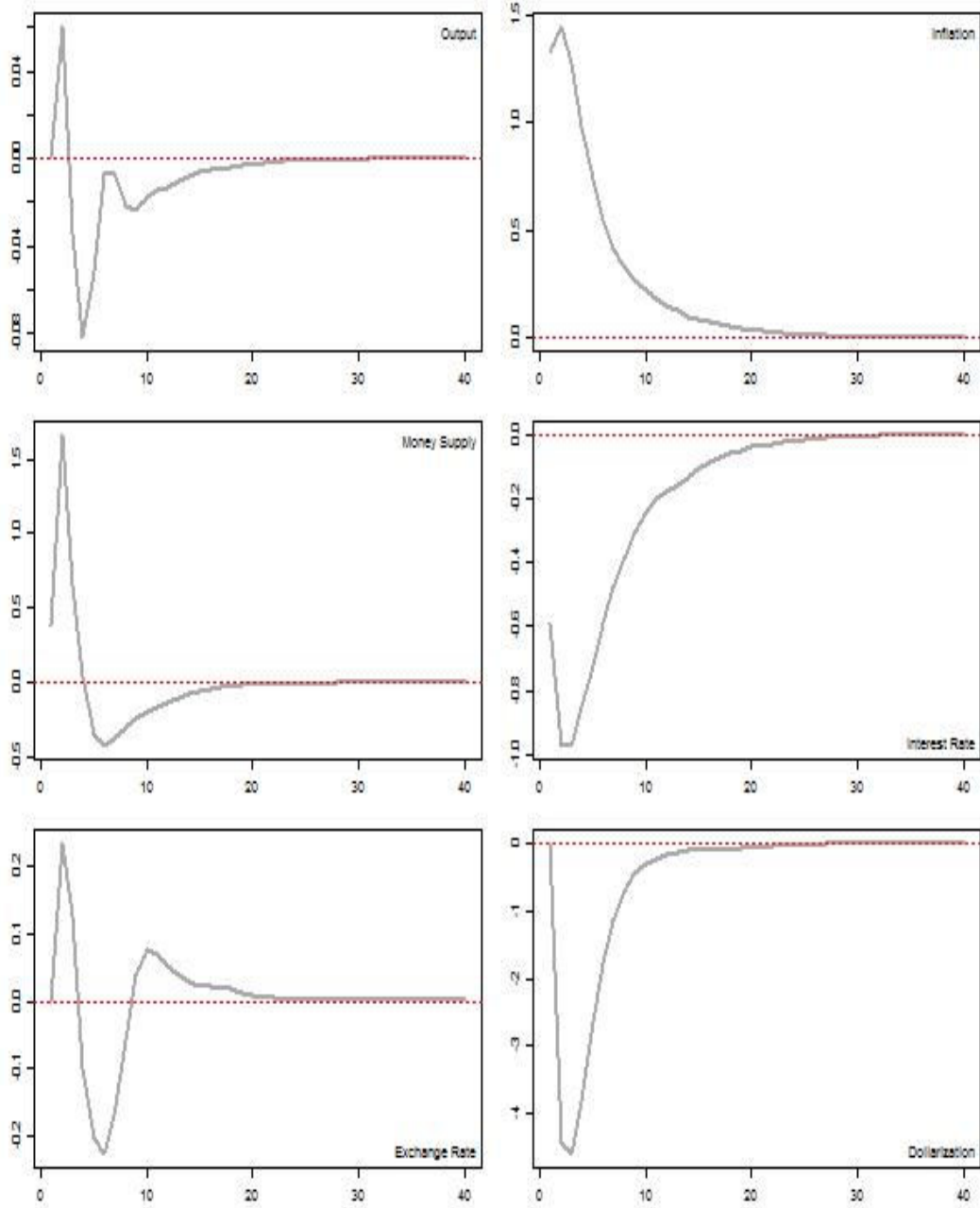


Figure A4: Bayesian VAR - Cost Push Shock

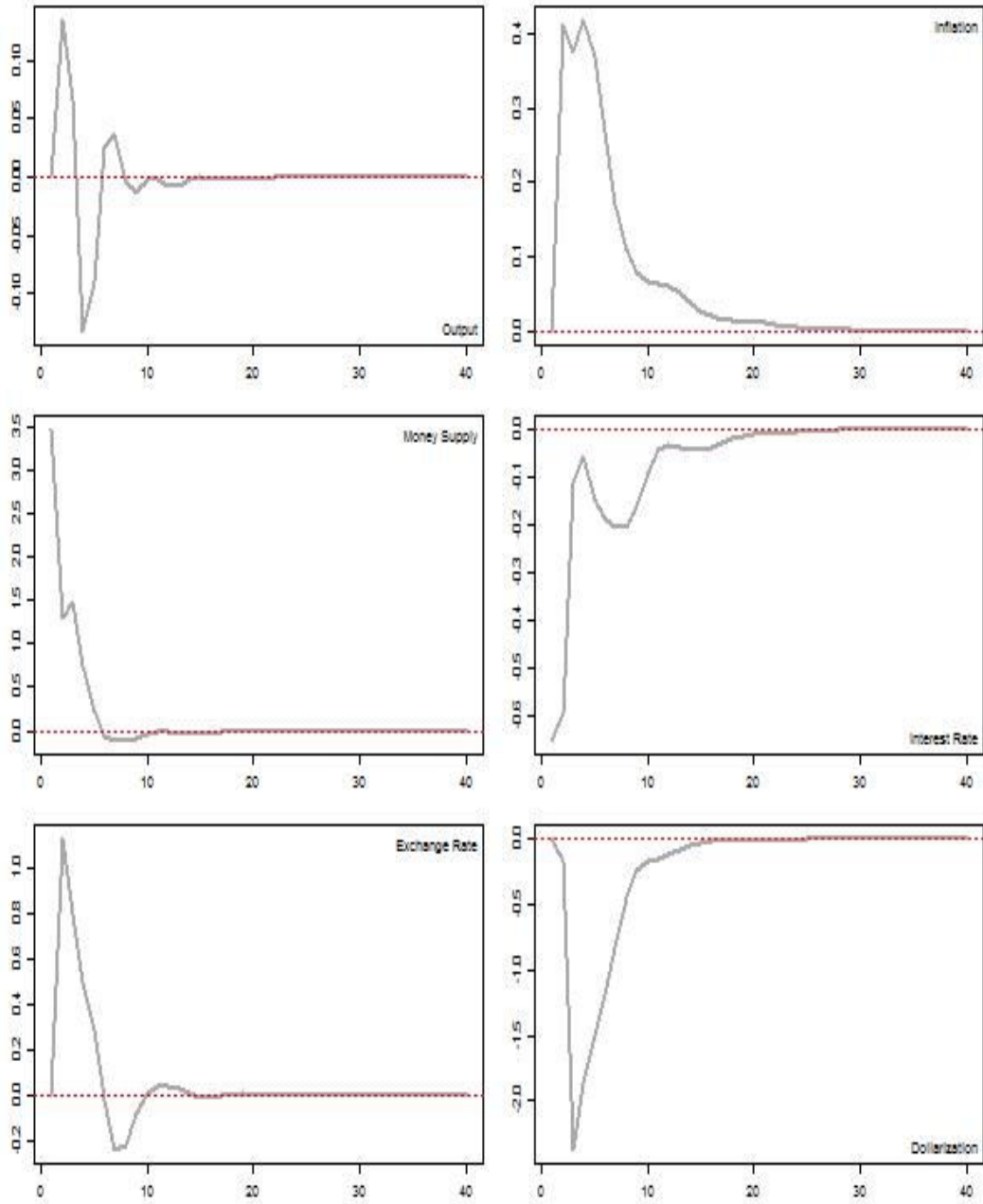


Figure A5: Bayesian VAR - Monetary Supply Shock

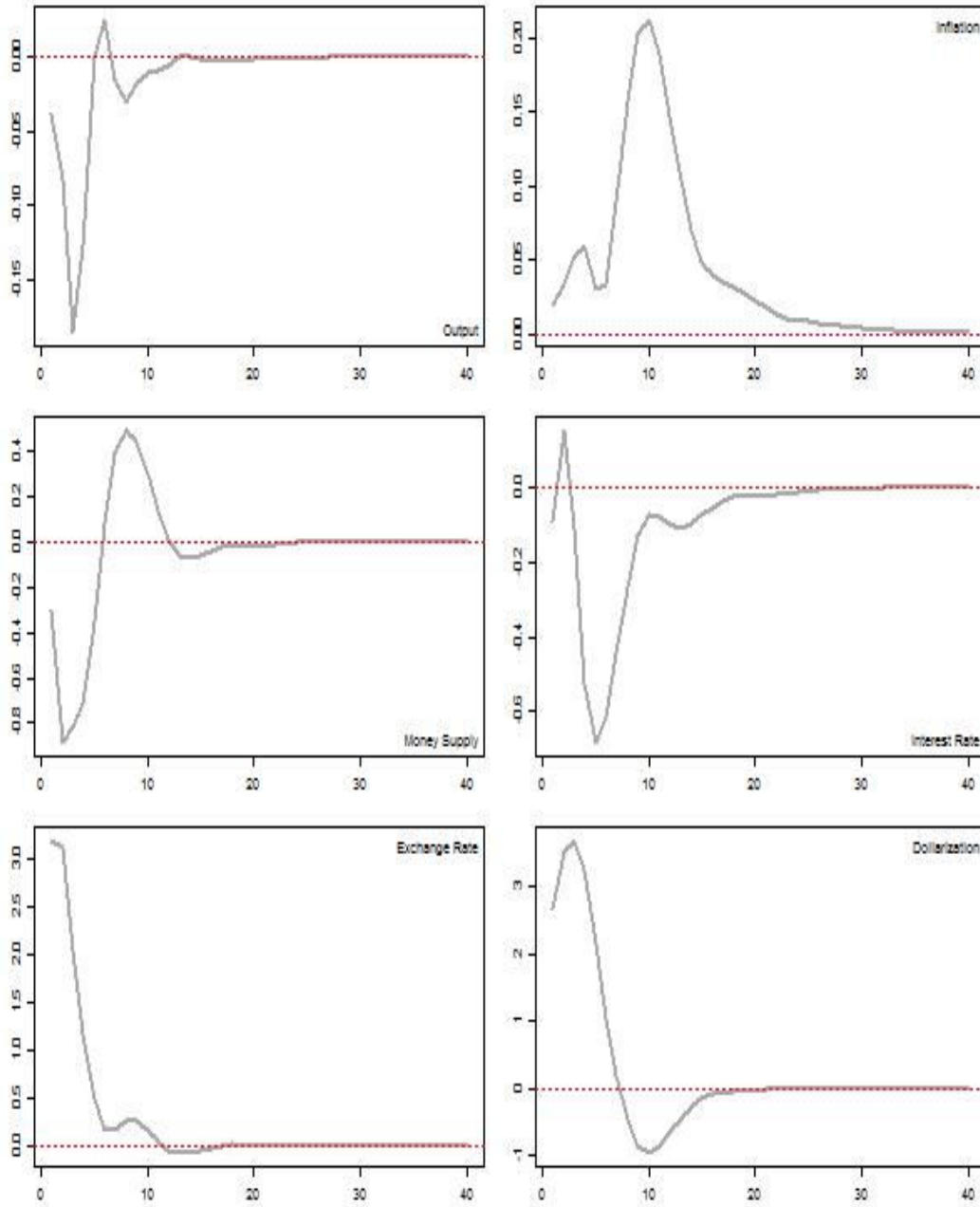


Figure A6: Bayesian VAR - Exchange Rate Shock

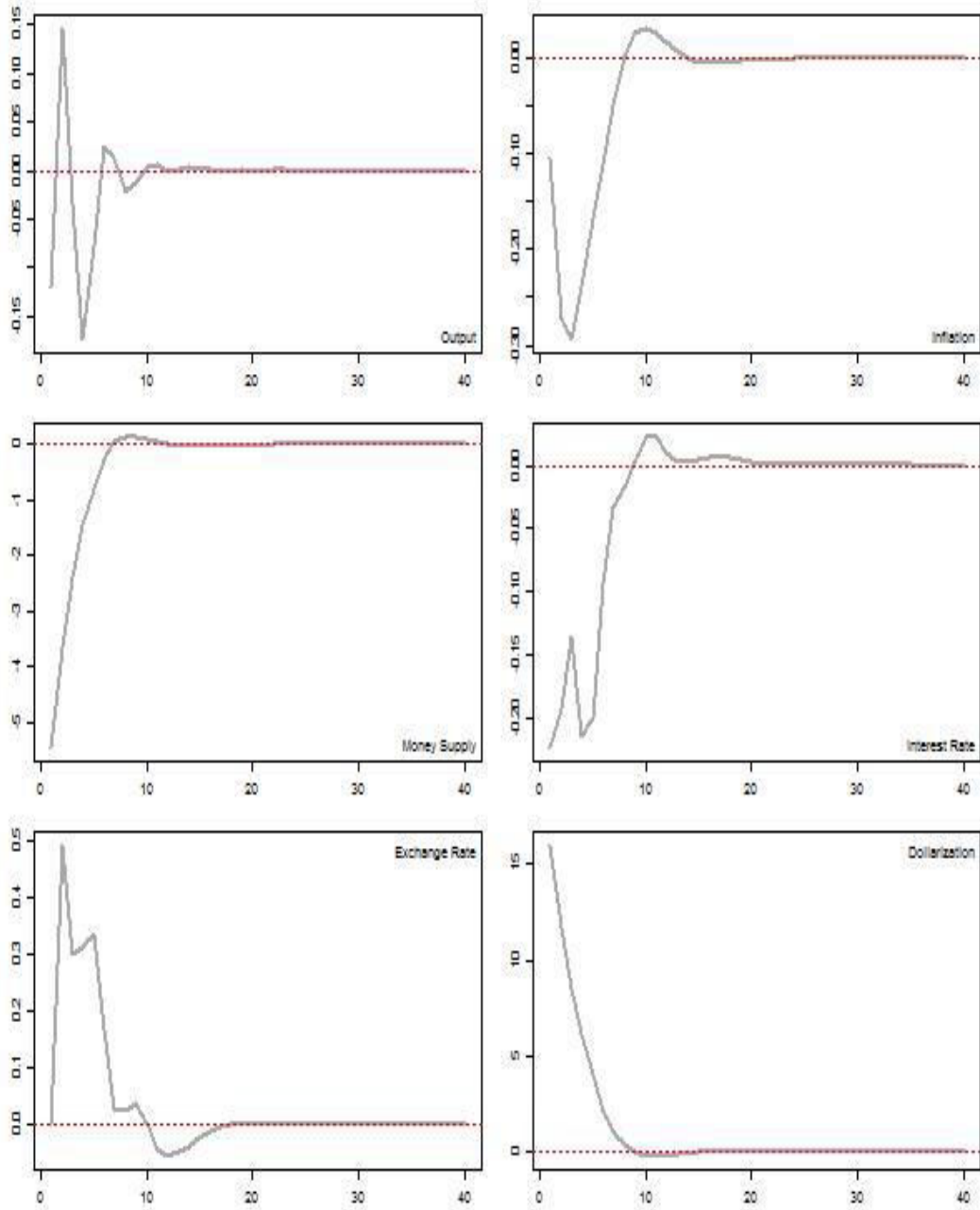


Figure A7: Bayesian VAR - Dollarization Shock