Acta Universitatis Danubius
ŒCONOMICA

The Stability of Money Demand in South Africa

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Abstract: The stability of money demand is central to South Africa's monetary policy. Furthermore, it has implications on the work of the SARB which is the monetary authority of South Africa. Since year 2000, the SARB has been hawkish in its behaviour, which raises questions about stability of money demand. This is because for an inflation targeting economy that provides information to the public to stabilize the market, its money demand should be stable, thereby, making the behaviour of the central bank more stable. However, the behaviour of the SARB does not seem to portray that the demand for money in South Africa is stable. Hence, this study assesses the demand for money in order to comprehend its behaviour. The study uses CUSUM test to test for the stability of money demand. And it is found that before year 2015, money demand was stable. Hence, the money demand in South Africa is becoming unstable overtime. The sample data used in the study is from 2003 to 2023.

Keywords: monetary policy; stability money demand; inflation rate; economic growth; interest rate

JEL Classification: E52

1. Introduction

A stable relationship between money demand and its determinants is a required condition for monitoring monetary aggregates. When the central bank has control of the money balance, it can have an effective monetary policy. If money demand is

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stable, the long run equilibrium relationship between macroeconomic variables is determinable. Hence, the bases of arguing that inflation is a monetary phenomenon as assumed by the equation of exchange, lies on the demand for money being stable. However, the literature shows that constantly changing MP may lead to unstable money demand.

The South African Reserve Bank (SARB) often changes its monetary policy. Although, the central bank is inflation targeting, as such, the SARB provides information to the public in order to stabilize market expectations Msomi and Ngalawa, (2024a); Mtonga, (2011). It follows that demand for money should follow stable market expectations because the SARB has credibility (see Kabundi & Mlachila, 2020). However, Niyambanira (2013) shows that over time money demand becomes less stable. Conversely, Omar & Hussein (2020) showed money demand is stable. The contesting finding in the literature gives an interest into investigating the behaviour of money demand. The inconclusiveness in the literature make it difficult to assess the SARB policy decisions. In this case, any policy decision of the SARB can be regarded as yielding unintended outcome.

However, when money demand grows, it serves as a signal for an improving macroeconomic environment. In this situation, it is reasonably assumed that, the rise in demand for money is associated with an increase in consumption (see Heinrich et al.; (2020). Therefore, money demand can be perceived as an instrument of gauging the influence of the money demand function. Hence, the relationship between money demand and monetary variables can be used to realise a change in consumption therefore output. Therefore, changing money demand fundamental can help the SARB to influence macroeconomic situation in the economy.

In the past 24 years, South Africa (SA), through its inflation targeting managed to reduce inflation for the most part to wonder within the targeted range. These gains can be associated with improvement in the central bank's credibility. Consequently, they allow the SARB to influence markets expectations. This can be linked with SA's strong financial system even though it is an emerging market. However, ensuring that the SARB remain on its promise to maintain the targeted range requires changing monetary policy tools in many instances. The variations in monetary policy tools thereby impact the stability of money demand.

Since 2000, the SA domestic economy experienced various structural changes which should necessitate that the relationship between money demand and its fundamentals is constantly changing. Therefore, one can suspect these structural breaks have an impact on the long-run stability of money demand function. These structural breaks are the 2002, sharp depreciation of the South African Rand against the United States of American Dollar, 2007 financial crisis, massive capital inflow as a result of 2010 FIFA world cup preparations and the COVID-19 pandemic. These structural breaks add to reasons for investigating the relationship between money demand and its

explanatory variables. The analysis of money demand stability can provide insight about long -run money growth behaviour. Further, this allows us to evaluate if the structural breaks significantly impacted the relationship of money demand and its fundamentals.

The sequence of the paper is organised in the following order; money demand fundamentals, methodology, and conclusion.

2. Money Demand Fundamentals

A stable money demand is a fundamental concern for monetary policy (Asongu et al.; 2020; Bahmani-Oskooee & Gelan, 2009; Kapingura, 2014; Nell, 1999, 2003; Omar & Hussein, 2020). The stability of the money demand function is vital for central banks in executing their functions (Shafiq & Malik, 2018). Despite the number of questions raised and explanations provided about the stability of money demand since the 1980s, "the research in this area remains inconclusive" (Shafiq & Malik, 2018, p. 67). As in South Africa, various research studies were conducted. Nell (1999) tested empirically whether there exists a stable long-run demand for money function over the period 1965-1997. The empirical results suggest that a stable long-run demand for money function for M3 exists in South Africa, while the demand for M1 and M2 display parameter instability following financial reforms since 1980. In 2003, they also presented empirical evidence of a constant and structurally stable M3 money demand function for South Africa over the period 1968–97. However, Omar and Hussein (2020) indicated the unstable money demand function among its determinants, including real income, interest rate, stock price, and real exchange rate.

The empirical results presented by Kjosevski (2013) suggest that most variations of money demand, in the long run, can be explained by the exchange rate and interest rate payable on very short-term time deposits, while in the short run, variations can be explained by the repo rate. South Africa uses short-term interest rates as a monetary policy tool to control money demand (du Rand et al.; 2021; Seoela, 2020). Should the central bank be of the view that the demand for money exceeds the amount of production, the repurchase rate will be increased, and vice versa? In a nutshell, if the repurchase rate is increased, the demand for money is expected to fall, and vice versa. The instability of money demand is an indication that the demand for money is irresponsive to the monetary policy tool (Woodford, 2022). This was widely experienced when South Africa implemented the hard lockdown as response to the novel coronavirus pandemic (Şen et al.; 2020; Wei & Han, 2021; Woodford, 2022).

Besides the issues relating to the unresponsiveness of money demand due to the coronavirus response, the South African Reserve Bank (SARB) has been hawkish in

its behaviour (du Rand et al.; 2021; Kamin, 2023; Loate et al.; 2021; Malik, 2021). There are two main contesting doctrines of central banks behaviours, dovish and hawkish. The former referred to when central banks choose to be intentional about keeping the interest rate low in order to stimulate economic growth. Whereas the latter is when central banks are mainly concerned about raising interest rates in order to keep the inflation rate controlled. Hawkish behaviours place little to no emphasis on economic growth. In most cases, even if there are signs of declining inflation, central banks would still be reluctant to relatively reduce interest rates. If people believe that the central bank is hawkish, they would likely not respond to interest rate declines as they would be expecting that this is only temporary. This was evidence during the early stages of COVID 19 in South Africa (Fotso et al.; 2022; Gumata, 2022; MATLASEDI; Tezcan, 2021). A decline in repurchase rate in South Africa appeared not to improve the demand for money and did not present any evidence of economic growth stimulation. Although, hawkish central bank behaviours are easily predictable, but often criticised to lacking accurate understanding of the economy (Blinder, 2001; Blinder et al.; 2008; Dietsch et al.; 2018; Lehtimäki & Palmu, 2019; Stiglitz, 1998). With the inflation control objective, central banks place much emphasis on a demand punishment whenever there is inflation, even if that inflation may be cost push or imported. From March 2021 to May 2023, South Africa experience a sustained general increase in inflation rate. This was mainly due to imported factors such as the Russia-Ukraine conflict that is still ongoing, and the European food crisis experienced in 2022 (Câmpeanu, 2022; Di Ciommo et al.; 2022; Okhrimenko, 2022; Rabbi et al.; 2023; Sohag et al.; 2023). During this period, South Africa would have benefitted from the Dovish central bank behaviour which would have been attractive to investors. Nevertheless, the SARB behaved as if the inflation was caused by the sudden increase in money demand in South Africa by raising repo rate from 3.5% in 2021 to 8.25 at the end of 2023. As such South Africa's economics growth remained weak.

3. Methodology

3.1. Theocratical Framework

Following Romer (2006), assume time is discrete. Further, the only input in to the production process is labour such that;

$$Y = F(L) \qquad F'^{(\cdot)} > 0, F''(\cdot) \leq 0 \tag{1}$$

here, output is Y, it is a function of labour L. Moreover, we assume there's no government and international trade for this model. To make consumption and aggregate output equal, we further we exclude capital in this model. Further, assume households derive utility from consumption and holding real money balances. Moreover, Households obtain disutility from working. Thus, there's a fixed number

of households who are infinitely lived. To make this model work, we normalize population growth to 1, but we ignore it. And then, the household represented in the model has the objective function defined by

$$U = \sum_{t=0}^{\infty} \beta^t \left[U(C_t) + ב\left(\frac{M_t}{P_t}\right) - K(L_t)\right], \qquad 0 < \beta < 1 \tag{2}$$

where U denote utility, C_t is consumption, M_t denote nominal money and P_t represents price. Holding money and consumption are subject to diminishing marginal utility. And workers derive disutility from working. If $U'(\cdot)$ and $ב(\cdot)$ have a constant relative risk aversion, therefore,

$$U(C_t) = \frac{C_t^{1-\theta}}{1-\theta}, \qquad \theta > 0 \tag{3}$$

$$ב\left(\frac{M_t}{P_t}\right) = \frac{(M_t/P_t)^{1-z}}{1-z}, \qquad z > 0 \tag{4}$$

In this model, money holding is not done because it provides utility directly. However, money holding allows household to purchase goods and services easily. Consequently, $\frac{M_t}{P_t}$ inclusion in the representative household's objective function indicates a rise in the household's convenience instead of contributing directly to utility.

In our model, the representative household faces a choice between two assets: firstly, bonds b_t, where the household earns interest rate by holding. Secondly, money, which the household derives an interest rates of zero by holding. Suppose household's wealth is denoted by φ_t in the current period. And then, labour will earn an income of $\omega_t L_t$(here ω_t denote money wages earned by the representative household). The representative household consumption is $\rho_t C_t$. Then, the total amount of bonds a representative household hold from current period to next is such that;

$$b_t = \varphi_t + \omega_t L_t - \rho_t C_t - M_t \tag{5}$$

Thus, wealth evolves from the current period to the next according to,

$$\varphi_{t+1} = b_t(1 + i_t) \tag{6}$$

Assuming there's no Ponzi scheme game, then, the household has a choice on the magnitude of M and C. However, the representative household takes the magnitudes of i, ρ and ω as given to maximize utility over its lifetime. In addition, the representative choice of supplying labour is exogenously determined. The value of M is determined by monetary authorities. However, the household perceives the level of the i as being given while choosing the level of M. Although, the value of M in equilibrium is exogenous while i is determined endogenously.

3.2. Estimation

In this study, we use the CUSUM test which is based on the cumulative sums of residuals that are obtained from recursive regressions. This test is used to determine the stability of the coefficients in a regression model as shown below

$$\gamma_t = \beta_0 + \beta_{1t} l_{1t} + \beta_{2t} l_{2t} + \cdots + \beta_{nt} l_{nt} + \mu_t, \qquad t = 1, \dots, T \tag{7}$$

we can rewrite (7) as

$$\gamma_t = \beta_1 l_t + \mu_t, \qquad t = 1, \dots, T \tag{8}$$

In this equation γ_t denote the dependent variable and $l_t = (1,\ l_{1t}, \dots, l_{nt})$ is the explanatory, n is the predictor and β_0 is the intercept term $\beta_t = \beta_0, \beta_{1t}, \dots, \beta_{nt}$ is an $(n+1)$- dimensional vector regression coefficients. While μ_t is white noise innovation with a mean zero and variance σ^2. In (8) l_t and γ_t are specified by a matrix of, respectively, $T \times n + 1$ and $T \times 1$ vector where T denote the total number of observations.

Let's show the process that evolves in the production of a CUSUM test, from (8) we compute the recursive residuals such that

$$\tau_r = \frac{\gamma_r - l_r \dot{\beta_{r-1}}}{\sqrt{1 + l\prime_t \left(l'_{r-1} l_{r-1}\right)^{-1} l_r}}, \qquad r = k+1, \dots, T, \tag{9}$$

here k denote the number of regressors. As stated above we use the residuals to construct the CUSUM test statistic such that,

$$H_r = \sum_{t=k+1}^{r} \frac{\tau_r}{\dot{\sigma}}, \qquad r = k+1, \dots, T, \tag{10}$$

here

$$\dot{\sigma} = \sqrt{\frac{\sum_{t=1}^{T} \left(\gamma_t - \dot{\beta_{r-1}}\right)^2}{T-k}} \tag{11}$$

The null hypothesis in CUSUM test is (8) is stable in for all sequential samples. On the contrary, the alternative hypothesis is that coefficients of a regression vary during the sample period.

After running the CUSUM test statistic we found result that seemed interesting, so we further used the Bayesian vector autoregressive (BVAR) to provide a detailed explanation. The idea behind using BVAR is to determine the impulse response functions in order to explain the response of money demand following a shock.

A vector autoregressive (VAR) model is based is a finite order j, which is commonly referred to in the literature as VAR model.; that can be defined such that:

$$\gamma_t = \beta_0 + \beta_1 \gamma_{t-1} + \cdots + \beta_n \gamma_{t-n} + \mu_t, with\ \in_t \sim N(0, \sum) \tag{12}$$

The pure VAR model often lead to inaccuracies with regards forecast and structural inferences and out-of-sample. This usually occurs in high dimensional models. Hence, in this study, we opt to use the BVAR. The BVAR model is able to overcome VAR challenges through imposing additional structure in the model. For advantages of BVAR (see Msomi and Ngalawa, 2024b). In addition, we select Minnesota prior. The BVAR use priors to impose particular beliefs about the estimators.

3.3. Data

The data used in this study is collected from Bloomberg and South African Reserve Bank (SARB). The sample period of the data is from year 2000 quarter 1 to 2023 quarter 3. The sample period being used in this study corresponds to the period the SARB started implementing inflation targeting. Hence, we aim to analyse the stability of money demand during this period. The variables used are money demand which is proxied by monetary base (m3), inflation rate (in), interest rate (ir) and real gross domestic product (rgdp). However, we convert all variable into growth variables.

3.4. Estimated Results

The following diagram shows the behaviour of the growth of demand for money over the period under analysis.

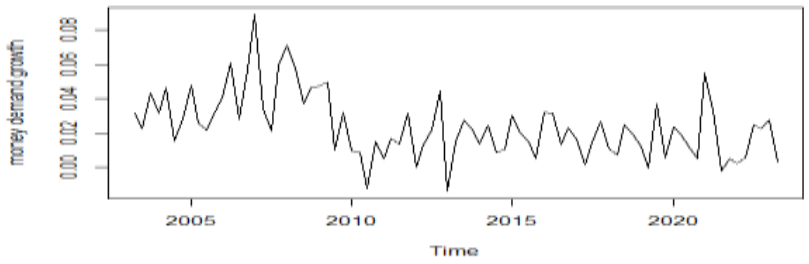

Figure 1. Money demand (2003q1 - 2023q3)
Source: Authors' computation

The money demand growth is volatile during the sample (see Figure 1). There are notable spikes in movement of money demand. In the period between 2005 and 2010, the growth of money demand increases sharply to reach the highest growth rate in the period under analysis (Figure 1). Accordingly, from the beginning of 2009, the money demand declines to its lowest level since year 2000 (Figure 1). Thereafter, the money demand grows slightly and fluctuate at levels above the ones it reached at the end of 2010, but in 2013 it falls to the level of 2010 (see Figure 2). In the

following years, money demand fluctuates at a higher level, but which are lower than that of pre-2010 levels (Figure 2). Furthermore, the following diagram depict the behaviour of real gross domestic product (rgdp).

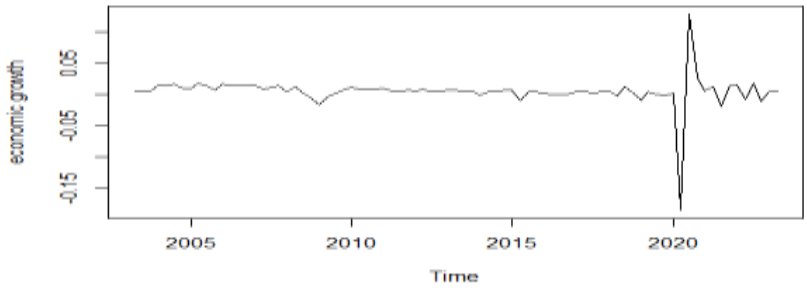

Figure 2. Real Gross domestic Product (2003q1 - 2023q3)
Source: Authors' computation

The economic growth was stable since 2000 until the end of 2007 (Figure 2). Thereafter, it plummeted, but rebounded towards the end of 2009 (see Figure 2). The evolution of economic growth is not abnormal as it is period connected to the 2007 global financial meltdown. And then, the economic growth remained flat throughout. However, in 2020 there is a spike of the growth rate of the economy, it can be seen declining sharply (Figure 2). This period corresponds to the COVID-19 lockdown period. In this period, the South African economy was lockdown as well as all other economies around the world. Hence, this is expected. Although, just before 2021, the economy rebounds, and the spike indicate a period of rapid economic growth (see Figure 2). Next, we discuss the movement of a variable measuring the interest rates.

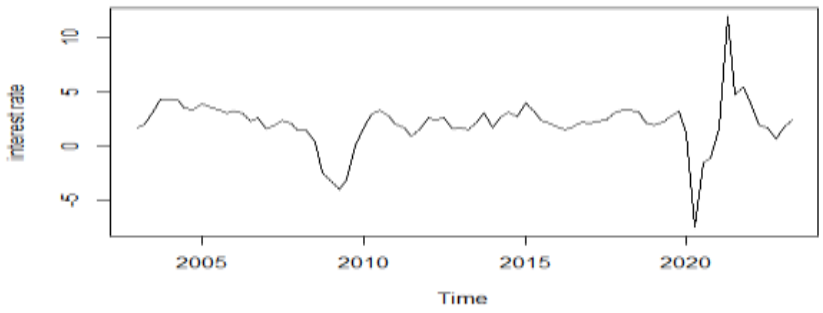

Figure 3. Interest rates (2003q1 - 2023q3)
Source: Authors' computation

The interest rate rose slightly after adoption of inflation targeting (see Figure 3). Initially, the SARB acted hawkish in order to show the markets its commitment to bringing inflation rate within the specified target. Following the increase, the interest rate began falling steadily until 2007 (Figure 3). Subsequently, the interest rate experienced a rapid decline until the beginning of 2008 (Figure 3). As indicated above, the world economy entered into a financial meltdown in 2007. At the end of 2009, the interest rate began increasing rapidly (Figure 3). Subsequently, the interest rates fluctuation become stable until the first quarter of year 2020 (Figure 3). The decline can be associated with the COVID-19 pandemic lockdown, however, at the end of 2020 the interest rate increases rapidly until the 2022 (see Figure 3). Then the interest rate declined until mid-2023 (Figure 4).

The following diagram completes the discussion about the visualisation of the variables used in assessing the stability of money demand. Therefore, the following figure shows the visual behaviour of the inflation rate in South Africa during the sampled period.

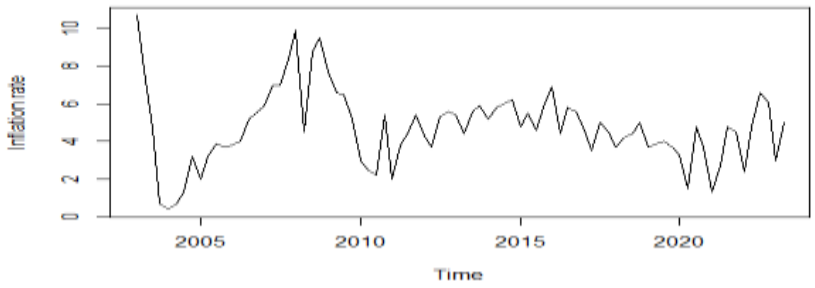

Figure 4. Consumer price index (2003 – 2023)
Source: Authors' Computation

At the beginning of inflation targeting in South Africa, the inflation rate declined rapidly (Figure 3). Following the sharp decline of the inflation rate, at the end of 2002, the price level began increasing rapidly (see Figure 3). Thereafter, the inflation rate increased until 2007, and then, fell just before the end of 2008 (Figure 3). Following previous year decline, the inflation rate increased until mid-2009 (Figure 3). Subsequently, the price level fell rapidly until 2011 (Figure 3). Afterwards, the inflation rate fluctuated within the targeted band of 3% to 6%, however, in 2016, it went above the 6%, soon it went back to the targeted range until the end of the sample period (Figure 3).

Following the description of the variables above, we tested the maximum number of lags that could be used in the estimation of the model. The following table shows the selected number of lags. The selection of optimal number of lags is based on the information criterion. The results are presented below as follows;

Table 1. Lag Selection Criteria

number of lags	1	2	3	4
AIC(n)	-1.434403e+01	-1.418035e+01	-1.427966e+01	-1.509445e+01
HQ(n)	-1.410212e+01	-1.374492e+01	-1.365071e+01	-1.427197e+01
SC(n)	-1.373974e+01	-1.309264e+01	-1.270852e+01	-1.303988e+01
FPE(n)	5.898937e-07	6.971817e-07	6.366114e-07	2.863569e-07

1, 2, 3 & 4 means the number of lags while AIC, HQ, SC & FPE are information criteria

Source: Authors' computation

The estimated information indicates the maximum number of lags to be used by producing the lowest number. Firstly, the AIC show that the lowest number is -1,5095 at 4 lags (Table 1). Secondly, while the HQ statistic with the lowest number of lags is -1,4272 at a maximum number of 4 lags (Table 1). Thirdly, the SC statistic lowest statistic is -1.37397 at 1 lag (Table 1). Lastly, the FPE statistic lowest value is 2,8636 at 4 lags (Table 1). Therefore, we choose to use 4 lags for this study (Table 1).

After establishing the maximum number of lags to be use in the estimation of this model, we test for unit root in the series. The following table presents results obtained from estimating an ADF test. All the variables are tested at level.

Table 2. ADF Test

variables	coefficients
money demand	-2,5007
Inflation rate	-3,3874*
interest rate	-0,1929*
Real gdp growth	-4,8636**

***, **, &*, respectively mean 1%, 5% & 10%

Source: Authors' computation

The variables are all stationery at level except for money demand (Table 2). Following the ADF test, we find that series for inflation rate and interest rate are both stationary at 1% level of significance (Table 2). Whereas, the variable measuring the interest real gdp growth is stationary at 5% level of significance (Table 2). While the variable measuring demand for money is insignificant (Table 2).

The money demand is statistically insignificant at all of conversional levels when tested at level. In this case, we proceeded to first difference the variable measuring money demand variable. The result of money demand at first difference are shown below;

Table 3. ADF test

Variable	Coefficient
money demand (2nd diff)	0,4076*
***, **, &*, respectively mean 1%, 5% & 10%	

Source: Author's computation

The first difference money demand is significant at 5% level of significance (Table 3). In this case, the variable measuring money demand is converted in to a growth variable. Thereby, all other variables are converted into growth variables. Therefore, all subsequent results presentation to follow will be representing growth variables. The conversion is done in order to avoid estimating the money demand relationship using variables that are significant at different levels.

Therefore, following the conversion of variables into growth, we proceeded to estimating the stability of the demand function for inflation, interest rates, and real gross domestic product. The estimation is conducted employing the CUSUM test of stability. The figure presented below shows the results of the demand function stability test.

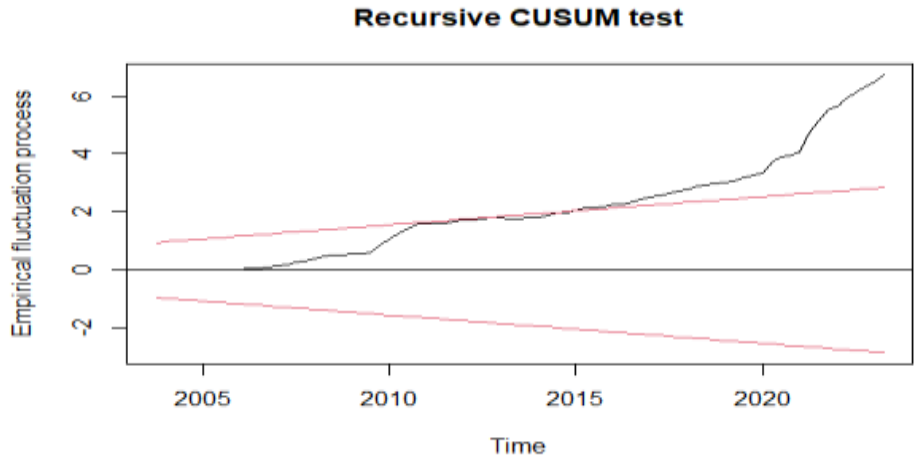

Figure 5. CUSUM test

Source: Authors' computation

The red line is the boundary demarcating the condition in which the system meets the requirements for a function to be stable (Figure 5). From year 2000 to about the last quarter of 2014, the money demand was stable but increasingly its stability worsened (Figure 5). The period beginning after the last quarter of 2014, the money demand became unstable increasingly. The results are similar to what is argued by Niyambanira (2013), who found that overtime demand for money becomes unstable.

These results show that since the beginning of 2011, the money demand function was edging toward instability.

At this point, the result of the CUSUM test shows an interesting insight. This led our investigation to extend the analysis into examining the impact of each variable on the evolution of money demand overtime. The extension of the analysis intends to determine which variables are driving money demand to increasingly become less stable overtime. We conducted the investigation by using BVAR model.

From here on, the objective was to evaluate the impulse response functions. The intention was to establish what response does money demand exhibit following a shock on its fundamentals. The insight we obtained from impulse response functions explained what led money demand system to become less stable overtime.

Following the results, we examine the trace and density plots to determine if there is convergence of hyperparameters of the model. The aim is to determine if their posterior distribution is estimated appropriately.

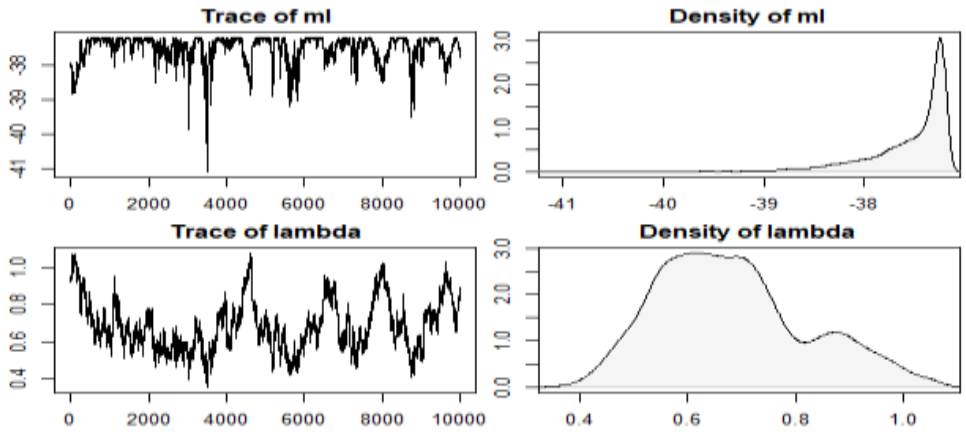

Figure 6. Trace and Density plot Hierarchal Bayesian VARs

Source: Authors' computation

The model estimated the posterior distribution well (Figure 5). Although, there are few outliers that are recognisable (Figure 6). However, the trace and density plots indicate a convergence, which shows a good estimation of the posterior distribution. Therefore, the finding that money demand stability becomes less overtime is not a consequence of the abnormalities of the data.

Since there's convergence, we are going to show the fitted residual values. This is important because we've shown how the posterior distribution of the BVAR model is estimated. Therefore, in the following diagram we use the mean of the posterior distribution to show the fitted residual.

Figure 7. Fitted Residuals

Source: Authors' Computation

The residuals of the growth of money demand appear random throughout the sample period. Further, the fitted values of inflation rate at first follow each other briefly but towards the end they tend to behave randomly. While the growth of interest rates is fitted more accurately in the data. Although, towards the end of the sample period variability increases slightly. And then, real gdp residuals are fitting the data better than all other variables. Thus, we move on to analyse the impulse response functions where growth of money demand responds to shock of growth of inflation, growth of interest rates and economic growth. The results are shown in the following diagram.

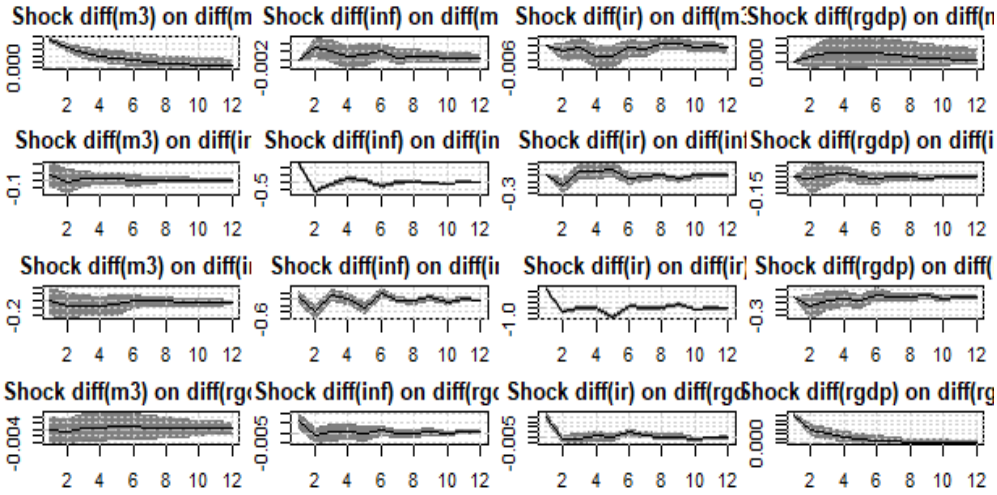

Figure 8. Impulse Response Functions

Source: Authors' computation

The focus of this analysis is on the first row which shows growth of money responding to all other variables (Figure 7). The shocks being analysed in this irf refer to a marginal increase of the specified variable. In the first diagram, the of

growth of money demand on itself lead to a decline in subsequent years (see Figure 7). This particular response of the growth of money demand is expected because a rise in money demanded lead to a demand for money being higher than money supply. Therefore, the rate of interest rises, which is a disincentive to increasing investment. At this point, the households choose to use money to purchase bonds because money is only required for convenience of exchanging goods and services. Therefore, households choose to hold less money because holding bonds earns them interest. Hence, the decline in growth of money demand.

The shock of inflation rate growth initially lead the growth of money demand to respond by increasing, and then, in the second quarter, the growth of money demand declines (Figure 7). Subsequently, it increases at a steady rate until it picks in the 6th quarter. Immediately, declines slightly and then remain stable for the entire remaining period (Figure 7).

The shock of inflation rate causes the demand for money to respond with a fall, immediately, increased in the second quarter (Figure 7). This increase is followed by a decline which rebounds between quarter 4 and quarter 6 (see Figure 7). The growth of money demand increased slightly from quarter 6 but deeps in from quarter 8 until the end of the period (Figure 7), but remain stable.

When we shock economic growth, the demand for money increases (see Figure 8). This is expected because when the economy grows, the households demand for money increases. Hence, they hold more money for the convenience it offers for exchange of goods and services. For instance, as the economy grows, spending in the economy follows the trajectory of the real gdp growth. Further, money demand flattens out from quarter 5 to quarter 8 (Figure 8). Subsequently, the growth of money demand starts declining until the end of the sampled period (Figure 8).

4. Conclusion

The debate in the literature about the demand for money in South Africa is well documented. This study shows that overtime demand for money becomes less stable. However, this is concerning because monetary variables are supposed to be stable if the SARB has credibility. Since the SARB provides information, the money demand function should be stable because the central bank's news stabilizes the market expectations. A change in monetary variable should be anticipated. Therefore, the anticipation of any change should dampen the effect on all monetary variables.

The impulse response functions determined that the shock of inflation and interest rates increases the variability of the demand for money. These variables are contributors to the money demand becoming less stable overtime. The SARB needs to work harder in stabilizing inflation and interest rate in order to maintain a stable demand for money overtime.

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