THE EFFECTIVENESS OF MONETARY POLICY IN RWANDA

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INTRODUCTION

Monetary policy can be simply defined as the process by which the monetary authority, namely the Central Bank of a country controls the supply of money to attain a given set of objectives.

While implementing monetary policy, Central Banks can act directly using their regulatory powers, or indirectly using their influence on the money market conditions, hence influencing the supply and demand of money in the economy so as to achieve the monetary policy main objectives of low and stable inflation, economic growth and low unemployment. The most common direct instruments are interest rates controls, credit ceilings and directed lending resulting from the lending at the behest of the authorities rather than commercial and profit driven motives.

The National Bank of Rwanda (BNR) conducted monetary policy using direct instruments for a period of 26 years before adopting market based mechanisms since 1995, coupled with larger financial sector liberalizations and economic reforms.

The National Bank of Rwanda (BNR) implements a monetary targeting regime using the broad monetary aggregate (M3) as an intermediate target to achieve the objective of price stability. In this framework, the transmission mechanism of monetary policy sets out from the quantity of monetary base (B) as an operational target and moves towards inflation through the money supply (M3). In formulating its monetary policy, BNR sets M3 growth targets in line with targets on inflation and economic growth and an estimated money demand in the economy.
I. RWANDA’S MONETARY POLICY FRAMEWORK

I.1 Introduction

The period 1990–2012 was first marked by the four year’s war (1990–1994) that culminated into genocide, both of which led to the collapse of the Rwandan economy. It was also a period characterized by important economic reforms that enabled the country to make a progressive transition from a regulated to a market economy. Those reforms were carried out within a framework of successive economic stabilization programs; the Structural Adjustment Program-SAP (1990) and the ESAF-PRGF (1998) and the Policy Support Instrumentthat the country has been implementing since 2010 with the support of the international community, notably the IMF and World Bank.

The Government of Rwanda opted to liberalize the Rwandan economy and this was materialized through various measures. Price controls were abolished in 1991 and the privatization process of state-owned companies started in 1996. In connection with the monetary and exchange rate policy, measures of direct control were progressively replaced by mechanisms that relied more on market forces to regulate the economy.

Regarding the monetary area, the direct control of credit was removed in 1992 and the interest rates were fully liberalized in 1996. The BNR adopted indirect control instruments to conduct monetary policy such as, the required reserve ratio, the discount rate and the open market operations and the BNR’s policy rate was introduced in August 2005.

The reform of the exchange rate system began with the launch of the SAP in 1990. Residents were authorized to hold accounts in foreign currencies in commercial banks since 1990, while in 1995, the flexible exchange rate system
was introduced and new exchange control regulations were put in place. The main features of these new regulations are: full liberalization of current and capital account operations, determination of the exchange rate by the market, introduction of foreign exchange bureaus, authorization of foreign direct investment in Rwanda and the transfer abroad of the return on this investment.

Other measures were taken later to supplement these exchange control regulations: right granted to exporters to own and use their foreign currency export proceeds and authorization given to residents to withdraw money from their foreign currency accounts without providing any justification. For some operations, however, prior approval from the BNR was maintained; this concerned invisible operations (medical care, tourist trips, etc.) for which the purchase of foreign currency was subject to ceilings and capital transfers abroad that were not related to current operations.

I.2. Monetary policy framework

The National Bank of Rwanda is operating its monetary policy under a monetary targeting regime. In this framework, broad money (M3) is the intermediate target for regulating the money supply and reserve money is the operating target. In implementing this framework, the NBR continuously monitors on a daily basis the Reserve Money of the NBR (which must be kept below a specified ceiling) and the net foreign assets (which must be maintained above a designated floor). The authorities signal the policy stance by announcing the policy rate (key repo rate) during the quarterly meetings of the MPC. The existing framework also assumes a stable demand for money and money multiplier.

In this monetary aggregates target framework, the monetary transmission mechanism is set out from the quantity of reserve money and moves towards inflation. The broad money (M3) is determined in line with targets on inflation
and economic growth assuming a stable money velocity. Reserve money target is defined compatible with the estimated M3 assuming stability of money multiplier.

Broad money M3 is defined as the aggregation of currency out of the banking system and monetary deposits. Three levels of monetary aggregates exist in Rwanda. In addition to M3 which is the sum of M2 and foreign currency deposits, M1 includes currency out of the banking system and demand deposits, while M2 includes M1 and time & saving deposits.

As for the reserve money, it is defined as the aggregation of currency outside the central bank, banks reserves held at the central bank and nonbank deposits.

The objective of the monetary programing referred to in the introduction is to determine the level of broad money compatible with the desired economic growth for stable prices. This desired broad money level is derived by the relationship between money supply and nominal GDP as follows:

\[ Y = V \times M3 \Rightarrow M3 = \frac{Y}{V} \]

Whereby Y stands for nominal GDP, M3 stands for broad money supply and V stands for velocity.

From this level is derived the reserve money that will be targeted during the implementation of the monetary policy, based on the relationship between broad money and reserve money illustrated as follows:

\[ M3 = m \times MB \]

Whereby M3 stands for broad money supply; MB stands for monetary base or reserve money, and m for money multiplier.

All the components of the reserve money come from the Central Bank balance sheet. Based on expected external budget and project support disbursements,
as well as projected expenditures on the Government’s accounts, weekly reserve money projections and estimates of the nature and stance of its intervention on the money market are made.

I.3 Monetary policy formulation

In its monetary program, the National Bank of Rwanda in collaboration with IMF determine the reserve money target compatible with an estimated level of broad money M3, given a stable money multiplier. A monetary program is prepared to project the appropriate level of monetary expansion to meet the demand for money generated by economic activities.

Hence, in the monetary program, the monetary base, which is defined as currency in circulation outside the central bank and the deposits of commercial banks with the NBR, is used as an operating target for conducting monetary policy. The National Bank of Rwanda continuously monitors developments in reserve money on a daily basis and takes appropriate measures to maintain it within the targeted levels.

The required monetary policy measures to maintain the projected targets are discussed at the Monetary Policy Implementation Committee (MPIC) meetings. The monetary management is based on indirect policy instruments, particularly through open market operations to inject or absorb liquidity to or from the market. The BNR uses its policy interest rate as instrument to influence these operations in order to maintain the expected target in the reserve money.

The primary objective of monetary policy is price stability as stipulated in the NBR Act 2007. The NBR also has other objectives such as (1) achieving and maintaining exchange stability, and (2) having a sound and vibrant financial system to encourage and promote sustainable economic development. However,
the overarching objective of the National Bank of Rwanda remains to preserve price stability.

I.4 Liquidity forecasting

The authorities use a short-term liquidity forecasting framework to guide their decision on the extent of liquidity to be injected/ mopped to attain their operating target. In the weekly exercise, the National Bank of Rwanda considers the main factors that will increase or decrease liquidity of the banking sector during the forecasting period usually one month and 3 to 6 months. These factors include the government’s cash flows for outlays and expenditures, issuance or maturing of the treasury bills, and/or purchases/sales of foreign exchange. These factors are combined with the deviation of actual from the targeted reserve money to derive a measure of liquidity overhang/ underhang. The authorities then take decision on the amount and the maturity composition of treasury bills to be issued or retired to close the liquidity gap.

In the current monetary policy framework, open market operations conducted using Repo operations and the treasury bills are the main policy instrument in Rwanda. The National Bank of Rwanda also has other instruments to influence the liquidity conditions in the market. They include reserve requirements, rediscount window, and purchases/sales of foreign exchange. The reserve requirement is currently 5 percent as of end-2009. It is uniformly applied for all types of deposits, including those denominated in domestic and foreign currencies. The reserves are unremunerated and must be held in RWF (against both the domestic and foreign-currency denominated deposit liabilities). The reserves are calculated on a lagged averaging system, with a one-week lag and a one-week maintenance period. The reserve requirement is relatively low in comparison with several countries in the world and especially in EAC region.
Direction of monetary policy is contemplated and agreed upon during the quarterly MPC meeting. The MPC also decides on the level of discount rate during the meeting and announces it by a press release the same day. The press release also provides the rationale for the MPC’s decision. The discount rate is currently tied to the central bank rate plus a margin (4 percent) as of mid-2008. Many banks would adjust their lending rates according to the prevailing discount rate. The National Bank of Rwanda also has another monetary instrument in the form of purchases/sales of foreign exchange. But, lately it does not use it for the sole purposes of influencing exchange rate or liquidity conditions in the market.

I.6. Monetary policy transmission mechanism

The process through which monetary policy decisions affect the economy in general and the price level in particular, is known as the transmission mechanism of monetary policy. Further, the individual links through which monetary policy impulses proceed are known as transmission channels. In Rwanda, the main channels of the monetary policy transmission are set out in a simplified form:
The process linking monetary policy decisions with the price level starts with a change in the official interest rates set by the NBR on its own operations. In these operations, the NBR bank provides funds to banks. The banking system demands money issued by the central bank (monetary base) to meet the public demand for currency, to clear interbank balances and to meet the requirements for minimum reserves that have to be deposited with the central bank.

Given its monopoly over the creation of the monetary base, the NBR can fully determine the interest rates on its operations. Since the NBR thereby affects the funding cost of liquidity for banks, commercial banks need to pass on these costs when lending to their customers.

Through this process, the NBR can exert a dominant influence on money market conditions and thereby steer money market interest rates. Changes in money market rates, in turn, affect other interest rates.
Changes in the exchange rate will normally affect inflation in some ways:

(1) Exchange rate movements may directly affect the domestic price of imported goods. If the exchange rate appreciates, the price of imported goods tends to fall, thus helping to reduce inflation directly, insofar as these products are directly used in consumption;

(2) If these imports are used as inputs into the production process, lower prices for inputs might, over time, feed through into lower prices for final goods;

(3) Exchange rate developments may also have an effect via their impact on the competitiveness of domestically produced goods on international markets. If an appreciation in the exchange rate makes domestically produced goods less competitive in terms of their price on world markets, this tends to constrain external demand and thus reduce overall demand pressure in the economy. All other things being equal, an appreciation of the exchange rate would thus tend to reduce inflationary pressures. The strength of exchange rate effects depends on how open the economy is to international trade. Exchange rate effects are in general less important for a large, relatively closed currency area like the euro area than for a small open economy. Clearly, financial asset prices depend on many other factors in addition to monetary policy, and changes in the exchange rate are also often dominated by these factors.

I.7. MONETARY POLICY IMPLEMENTATION

In the first quarter of each year, the institutions involved in the economic management of the country namely the Ministry of Finance and Economic Planning and Central Bank jointly design an economic and financial program which ensures consistency in the evolution of the key indicators in the four macroeconomic accounts (National accounts, Fiscal, External and Monetary) to
ensure the achievement of the ultimate target for the year of projection. This exercise is supported by the International Monetary Fund.

Within the whole set of the comprehension economic and financial program, BNR is in charge of two sectors, namely the balance of payments and the monetary sector through monetary programing. The monetary program sets quantitative targets on net foreign assets and reserve money that the implementation through monetary policy seeks to achieve in order to maintain economic stability.

A set of policy instruments are at the disposal of the Central Bank to achieve these targets; those include the reserve requirements, money market operations, and foreign exchange sales or key repo rate.

1.7.1 Monetary policy instruments

1.7.1.1 Reserve requirement

Reserve requirements are reserves that deposit taking institutions must hold at the Central bank without any remuneration. They have been introduced in the National Bank of Rwanda in 1990 with two objectives, namely (1) to serve as a security buffer for depositors and (2) to enhance the ability of the monetary authority to control money supply while fulfilling their responsibility to maintain stable monetary conditions.

As monetary policy instrument, reserve requirement ratio may be changed to inject or withdraw liquidity in the banking system, therefore discouraging banks from lending or encouraging them to do so.

The reserve requirement can be adjusted by changing the reserve base, the maintenance period or the required reserve ratio. On top of these three channels of managing liquidity through the reserve requirement adjustments,
the central bank can also regulate banks’ liquidity by determining financial institutions that are subject to reserve requirement.

I.7.1.2 Refinancing rate

The financing instrument is a facility offered by central banks to allow banks get the needed funds to finance their operations. This instrument existed also under the direct control of monetary expansion era, but was used to control the amount of credit to the economy and favoring certain sectors of activities, in order to achieve the set economic monetary and economic objectives. In so doing, different quota and interest rates were set.

Contrary to the direct control era, with the implementation of financial liberalization in 1995, only one refinancing rate was set by BNR, and commercial banks got reserves at predetermined rate and after providing collaterals. Thus, the refinancing window operates as a collateralized loan, and commercial banks chose the maturity of refinancing which must be shorter than the residual maturity of the collateral and must be equal or less than seven days.

The refinancing instrument differs from the discount window whereby the ownership of the collateral is transferred to the central bank for its whole residual maturity and the refinancing is granted for a period of time corresponding to the maturity of the collateral involved in the transaction.

The refinancing funds are offered as the last resort facility and institutions seeking to use the refinancing window must first fully exhaust all alternative market sources. It is in this context that the refinance rate is the highest of the money market rates.
I.7.1.3 Money market operations

Whenever it is deemed necessary and in order to keep the reserve money constantly close to the desired level, the central bank intervenes on the money market to mop up or inject liquidity from or in the banking system.

During the period between August 1997 and August 2005, instruments that were used to intervene on the market were three fold, namely weekly tender for liquidity injection or liquidity mop up; refinance window and Treasury bills issuance.

Weekly tenders

Based on liquidity situation, the BNR launched weekly tenders, specifying required conditions but not disclosing the amount to inject or mop up. Commercial banks responding to tenders were the ones to decide the amount for bids and interest rates. The BNR, after estimating banks’ liquidity and taking into account the objectives set regarding the money supply growth, determined the total amount of liquidity to mop up or inject and made market allocation based on offered interest rates.

Refinancing window

The refinancing rate has often been used during this period to supply liquidity to the banking system and as this rate was considered costly, banks used this facility as the last resort.

Treasury bills issuance

In line with provisions of the instruction no 05/98 signed on September 24th, 1998, BNR intervenes on the money market by issuing Treasury bills ranging from 4 to 52 weeks. In conjunction with the Ministry of Finance and Economic Planning, monetary authorities determine the public debt to issue and, before the beginning of every quarter, the Bank publishes for the Treasury a schedule
indicating planned issues, the approximate amounts, dates, categories of bills and their maturities. Some issues are made to finance temporary Treasury deficits occurring when government expenditures exceed revenues. This way of financing government spending was a result of financial reforms that aimed at limiting the inflationist lending from the central bank by providing overdrafts, and incited the Treasury to use private savings, a resource allocation that should sensibly be done in order to avoid the crowding out effect.

Others are made for monetary policy purposes, to sterilize excess liquidity when treasury bills and other liquidity mop up instruments fail to bring the reserve money to the targeted level. The later should, in normal circumstances, be called Bank’s bills. However, because the total cost incurred by issuing bills is born by the government, they are all called treasury bills. The issue of monetary policy for monetary policy purposes aims at sterilizing the banking system excess liquidity for longer periods than the duration of other monetary policy instruments.

**Foreign currency sales**

Foreign currencies’ sales are conducted as a tool to regulate liquidity in the banking system liquidity. In this regard, the BNR sells foreign currency, mostly U.S. dollars, and consequently reduces the volume of the local currency in circulation.

**Overnight operations**

Since the last quarter of the year 2004, the Rwandan banking system was characterized by abundant liquidity although its levels exhibited a downward trend in the year 2008. Consequently, some of the monetary policy instruments were not in use until early 2009, namely refinance instrument and liquidity injection tenders. However, liquidity mop up instruments were developed to counteract prevailing liquidity conditions.
It is in this regard that on top of the 7-day liquidity mop-up instrument, a standing facility called “Over-night operations” was introduced in August 2008, simultaneously with the interest rates corridor that regulated money market rates.

The corridor was set as follows: [5%-9%-12.5%], where the floor of the corridor was the rate offered for overnight deposits and the 7-day mop-up bids.

The second wing of the interest rates corridor was the range of rates that the NBR could offer while injecting liquidity in the banking system, whereas the ceiling of this corridor was the minimum refinance rate that NBR could offer while providing the last resort funds.

**Repos operations**

In a world of increasing financial innovations, improved technology, increasing regional and international integration, the development of financial instruments both for money markets and capital markets instruments, to suit market needs and reduce or hedge against risk, is the core element for markets development. In this context, the NBR introduced the repo operations in August 2008 to smoothly manage liquidity, while ensuring the collateralization of traded instruments in order to minimize risk initially associated with the former operations. Another advantage of repos operations is their features that can be tailored according to prevailing liquidity conditions, namely various maturities, various interest rates and amount offered by different banks.

**Key repo rate**

Accompanying repos operations was the ‘Key repo rate’, a bank rate that is set together with the interest rates corridor to guide interest rates which are offered on the money market. As an illustration, on August 8th 2008, the Key Repo Rate was set at 8% per annum and the interbank interest rates corridor was set as a range of 250 basis points above and below the Key repo rate. This means that banks borrowing and lending money to each other on the money
market offered rates that ranges between [6.75%-10.25%], and the floor of the corridor was the maximum interest rate that the NBR offered while borrowing on the money market, whereas the 10.25% was the minimum rate that commercial banks were supposed to offer when borrowing from the central bank.

**T-bonds**

To boost the development of the financial system in Rwanda, a capital market was launched in January 2008. In order to initiate operations on this market, two 2-year Treasury bonds which matured in 2010 were issued in January and a 3-year treasury bond was issued in late February 2008.

To date, only one corporate bond (Banquecommerciale du Rwanda 10-year corporate bond) has been issued on the Over-The-Counter market, what one could associate with the level of awareness that is still low.

In order to enhance the capital marked development, the CMAC has initiated IPOs and shares trading in order to diversify products and attract more market players.

The capital market was launched also to enable already sold instruments to be more liquid, allowing holders to sell them on the secondary market. Such move encourages the issue of long-term debt and will enable investors to provide share capital, as long as they will bear in mind that the instruments they invest in can be sold on the secondary market, thus they can get the liquidity any time it is needed.
I.7.2 Institutional arrangements

I.7.2.1 The Monetary Policy Committee (MPC)

The National Bank of Rwanda seeks to meet low and stable inflation by setting an interest rate. The level of interest rates is decided by the Monetary Policy Committee (MPC). The MPC meets quarterly and when necessary. Decisions are made after analyzing the international and national economic developments. The MPC sets an interest rate it judges will enable the inflation objective to be met.

I.7.2.2 The Monetary Policy Implementation Committee (MPIC)

The National Bank of Rwanda has established the Monetary Policy Implementation Committee (MPIC) composed of 17 members and the Governor is the Chairperson. The meetings of the Committee take place every Friday. The meetings are chaired by the Governor or the Vice Governor in the absence of the Governor. The Agenda is decided by the Chairperson and the working documents are distributed by the Committee’s Secretary to members at least one day before the meeting. The decisions of the Committee are taken by consensus and implemented immediately.

I.7.2.3 The Monetary Policy Technical Committee

The National Bank of Rwanda has established the Monetary Policy Technical Committee (MPTC) composed of 14 members and the Chief Economist is the Chairperson. Each member of the Committee is responsible for timely delivery, reliable statistical data and other information relating to his or her field. Each member must ensure that the information submitted to the Committee for consideration is updated regularly. On monthly basis, the Chairperson of the Committee is required to submit to the Management and to the Bank and the
Monetary Policy Implementation Committee (MPIC) a report on the Committee’s activities. The decisions are taken by consensus, unless one or more members require the decision to be subjected to a vote.

II. EMPIRICAL ANALYSIS

This part focuses on the analysis of the money demand function, the monetary policy transmission mechanism and the stability of the money multiplier.

II.1 Estimation of the money demand function

Demand for money investigates what motivates people to hold money balances. Deducing from the estimations of money demand equations, the monetary authority can decide which monetary policies are better to implement under the current economic conditions. A stable demand function for money has long been perceived as a prerequisite for the use of monetary aggregates in the conduct of monetary policy (Goldfeld and Sichel, 1990).

The effectiveness and success of a monetary policy crucially depends on a stable money demand function. The stable money demand function ensures that the money supply would have predictable impacts on other economic variables such as inflation, interest rates, national income, and private investments.

II.1.1 Data used

The empirical work used quarterly data for real money, real income, deposit rate, real exchange rate and inflation rate over the period 1999:Q1 to 2013:Q3.
We first examine the time series properties of these variables with the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) stationarity tests. The results of the ADF and PP unit root test are presented in table no.1

**Table 1. Results of Augmented Dickey Fuller test of stationarity**

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF Test Statistics (Absolute Value)</th>
<th>Critical Values</th>
<th>Order of integration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1% 5% 10%</td>
<td></td>
</tr>
<tr>
<td>RM3</td>
<td>2.32</td>
<td>4.12 3.48 3.17</td>
<td>I(1)</td>
</tr>
<tr>
<td>RGDP</td>
<td>1.39</td>
<td>4.13 3.49 3.17</td>
<td>I(1)</td>
</tr>
<tr>
<td>DEPRATE</td>
<td>2.17</td>
<td>4.12 3.48 3.17</td>
<td>I(1)</td>
</tr>
<tr>
<td>CPI</td>
<td>2.63</td>
<td>4.12 3.49 3.17</td>
<td>I(1)</td>
</tr>
<tr>
<td>RER</td>
<td>1.98</td>
<td>4.12 3.49 3.17</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

*Source: Own calculations*

**Table 2. Specification of the model**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Expected Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM3</td>
<td>Real Money defined as the difference between log M3 and log CPI.</td>
<td></td>
</tr>
<tr>
<td>LRGDP</td>
<td>Log of the Real Gross Domestic Product</td>
<td>Income affects positively the demand for money;</td>
</tr>
<tr>
<td>DEPRATE</td>
<td>Deposit rate (in percentage, p.a)</td>
<td>The increase in deposit rate is supposed to increase the return of money and negatively affect the volume of credit and hence money supply in general;</td>
</tr>
<tr>
<td>LRER</td>
<td>Log of Real Exchange Rate</td>
<td></td>
</tr>
</tbody>
</table>
II.1.2 Methodology

The estimated cointegrating relationship model is the following:

\[
(m_t - p_t) = C_0 + C_1(m_{t-1} - p_{t-1}) + C_2X_{t-1} + \varepsilon_t
\]

Where \(m_t\) = the log \(M_{3t}\) is broad money; \(p_t\) = log \(P_t\) is the consumer price index; \(X_t\) is a vector of explanatory variables relevant for explaining movements in money demand (such as scale variable, usually real income, and interest and exchange rates). The disturbances, denoted by \(\varepsilon_t\), are assumed to be serially uncorrelated and distributed normally.

In addition to the income (or scale) variable, we included in the money demand model the nominal exchange rate and several opportunity costs variables. The opportunity cost variables comprise the domestic deposit interest rate, which measures the return to bank deposits.

II.1.3 Cointegration Test

Stock and Watson (2007, p.658)suggest three ways to decide whether two (or more) variables can plausibly be modeled as cointegrated: (i) use expert knowledge and economic theory; (ii) graph the series and see whether they appear to move together in such a way that a linear combination of them is stationary; and (iii) perform statistical tests for cointegration.
This figure plots real money, \textit{rm3}, and the log of real income, \textit{LRGDP}. The log of the real money stock grew rapidly, but experienced a decline for the period 2008-2010. The log of income, on the other hand, grew steadily over the entire sample period. However the graph shows that the real income and the real money are moving together showing a long run relationship.

\textbf{II.1.3.1 Lag selection}

The results that will guide us in selecting the lag order are reported in the table below.
Table 3. Lag selection

VAR Lag Order Selection Criteria
Endogenous variables: RM3 LRGDP TBRATE LNER
Exogenous variables: C
Date: 08/09/14   Time: 20:04
Sample: 1999Q1 2013Q3
Included observations: 54

<table>
<thead>
<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14.93222</td>
<td>NA</td>
<td>7.84e-06</td>
<td>-0.404897</td>
<td>-0.257565</td>
<td>-0.348077</td>
</tr>
<tr>
<td>1</td>
<td>288.6527</td>
<td>496.7519</td>
<td>5.62e-10</td>
<td>-9.950099</td>
<td>-9.213438*</td>
<td>-9.665998</td>
</tr>
<tr>
<td>2</td>
<td>307.2706</td>
<td>31.02991</td>
<td>5.15e-10</td>
<td>-10.04706</td>
<td>-8.721070</td>
<td>-9.535678</td>
</tr>
<tr>
<td>3</td>
<td>336.9449</td>
<td>45.06103*</td>
<td>3.19e-10*</td>
<td>-10.55352*</td>
<td>-8.638199</td>
<td>-9.814854*</td>
</tr>
</tbody>
</table>

* 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

Four test out of five gives the optimal lag length of 3

Next we test the existence of a long-run relationship between real money and the other variables.

II.1.3.2 Results of the VAR (3) estimation

Table 4. The estimated long-run money demand

<table>
<thead>
<tr>
<th></th>
<th>Parameter</th>
<th>Standard error</th>
<th>T-Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM3</td>
<td>0.48</td>
<td>0.16</td>
<td>-3.06</td>
</tr>
<tr>
<td>LRGDP</td>
<td></td>
<td>0.17</td>
<td>-4.91</td>
</tr>
<tr>
<td>DEPRATE</td>
<td></td>
<td>1.32</td>
<td>5.22</td>
</tr>
<tr>
<td>Constant</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Own calculations
The results of the estimation show a significant positive relation between RGDP, DEPRATE and RER to the real money demanded.

The income elasticity less than one per cent is a sign of modernization moving from liquid money to electronic money.

In order to examine short-term dynamics of the model, we estimate an error-correction model associated with the above long-run money demand function. These results are reported in table below.

### II.1.3.3 Interpretation of VEC estimation RESULTS

**Table 5. VEC estimation RESULTS**

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ECT</strong></td>
<td>-0.17</td>
<td>[-2.84]</td>
</tr>
<tr>
<td>DRM3_{t-1}</td>
<td>-0.10</td>
<td>[-0.78]</td>
</tr>
<tr>
<td>DRM3_{t-2}</td>
<td>0.30</td>
<td>[1.97 ]</td>
</tr>
<tr>
<td>DRM3_{t-3}</td>
<td>-0.04</td>
<td>[-0.31]</td>
</tr>
<tr>
<td>DLRGDP_{T-1}</td>
<td>-0.27</td>
<td>[-0.83]</td>
</tr>
<tr>
<td>DLRGDP_{T-2}</td>
<td>-0.33</td>
<td>[-1.40]</td>
</tr>
<tr>
<td>DLRGDP_{T-3}</td>
<td>-0.60</td>
<td>[-1.69]</td>
</tr>
<tr>
<td>DDEPRATE_{t-1}</td>
<td>-0.01</td>
<td>[-1.00]</td>
</tr>
<tr>
<td>DDEPRATE_{t-2}</td>
<td>-0.01</td>
<td>[-1.07]</td>
</tr>
<tr>
<td>DDEPRATE_{t-3}</td>
<td>-0.03</td>
<td>[-2.76]</td>
</tr>
<tr>
<td>DLRER_{t-1}</td>
<td>-0.23</td>
<td>[-0.79]</td>
</tr>
<tr>
<td>DLRER_{t-2}</td>
<td>-0.17</td>
<td>[-0.52]</td>
</tr>
<tr>
<td>DLRER_{t-3}</td>
<td>-0.14</td>
<td>(-0.48)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>0.04</td>
<td>[2.64]</td>
</tr>
</tbody>
</table>

*Source: Own calculations*
The estimated coefficient of the error correction term is -0.17, which suggests that any disequilibrium would be substantially reduced within one-year and a half time frame. The short-run income elasticity is not significant.

Regarding the exchange rate, the results show that in short-run its effect is not significant. The deposit rate (3 quarters lagged) is significant meaning that over the short period the demand for money in Rwanda is driven by the level of the deposit rate.

Finally, we need to examine the stability of the long-run coefficients.

**II.1.4 Stability of money demand**

Most of the roots lie inside the unit circle but in the recent period some roots lie at the border of the unit circle which implies increasing volatility in the money demand function.
II.2 Money multiplier stability in Rwanda

Before we test the existence of cointegrating relationship between Broad money (m) and reserve money (b) it is necessary to check if the two series are stationary or not. As indicated in the table 5 below, m and b are I (1).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Levels</th>
<th>First differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>-2.98 (0.14)</td>
<td>-14.3(0.00)</td>
</tr>
<tr>
<td>B</td>
<td>0.52(0.98)</td>
<td>-14.7(0.00)</td>
</tr>
</tbody>
</table>

We then test for cointegration using Engle - Granger test. Results reported in table 7 indicate that the test fails to reject the null hypothesis of absence of cointegration between m and b indicating that there exists a long-run and time invariant relation between the two variables.

However, considering recent development in financial sector and changes in monetary policy implementation, this assumption of time invariant developments have happened in the Rwandan banking sector. In 2010, one microfinance institution has been upgraded to a cooperative bank and three other microfinance institutions upgraded as microfinance banks. This led to significant increase of broad money. In addition, two regional banks entered the sector in 2010 and 2011. In addition, existing banks have significantly extended their networks out of Kigali to increase their market.

This situation has led to an increase in the banking sector competition as indicated by the Herfindah Index (HI) constructed based on total deposits, total loans and total assets from 2002 to 2013. Development in HHI indicates that the competition in the Rwandan banking sector has been improving over
time, from high concentration (between 2002 and 2009) to moderate concentration as new banks entered the sector and existing banks extending their networks.

**Graph 2: Development Herfindah Index (HI) of the banking sector in Rwanda**

On the monetary policy side, the National Bank of Rwanda introduced the use of the Key Repo rate in August 2008 to help banks in their liquidity management. However, since 2010, the key repo rate has become a tool to signal its monetary policy stance and it is reviewed regularly by the monetary policy committee. In addition, the bank has significantly developed its communication strategy with the banking sector and the public in such a way that since 2010 the interest rate pass through has been progressively improving.

These developments may have caused a shift in the cointegrating vector. The following graph shows a possible structure break in 2010 to be confirmed using more elaborated statistic tests: the Chow test and the Gregory – Hansen test.
The results presented in table 3 show that the chow break point test (break period 2010:10) rejects the null hypothesis that the cointegrating vector is stable overtime because the test statistics are greater than critical value as indicated by the probability of F and Chi square tests which are less than 5%.

This result is confirmed by the Gregory – Hansen test (table 7) which rejects the null of no cointegration against the alternative of cointegration with structural break at 5% level of significance. This test has the advantage compared to Chow test of structural stability as it allows for an endogenous regime change, where structure break time is not known a priori. We consider three cases: the model with regime shift, model with level shift with trend and model with regime shift.

The interpretation of these results is that there exist a stable, but time varying long- run relationship between broad money (m) and reserve money b) in Rwanda.
### Table 7: Engle Granger cointegration test

<table>
<thead>
<tr>
<th>Cointegration test-Engle Granger</th>
<th>Value</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engle-Granger tau statistic</td>
<td>-3.92</td>
<td>0.011</td>
</tr>
<tr>
<td>Engle-Granger Z-statistic</td>
<td>-31.8</td>
<td>0.003</td>
</tr>
</tbody>
</table>

**Chow Break point test (2010:10)**

| F(2,163) | 11.3 | 0.00 |
| χ²(2)    | 22.6 | 0.00 |

### Table 8: Gregory - Hansen cointegration test

**Gregory – Hansen cointegration test**

<table>
<thead>
<tr>
<th>Model with Level Shift</th>
<th>ADF procedure</th>
<th>Z-stat</th>
<th>Phillips procedure</th>
<th>Z-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010:11</td>
<td>-5.9*</td>
<td></td>
<td>-8.6*</td>
<td></td>
</tr>
<tr>
<td>2010:10</td>
<td>-5.6*</td>
<td></td>
<td>-81*</td>
<td></td>
</tr>
<tr>
<td>2010:10</td>
<td>-6.01*</td>
<td></td>
<td>-8.6*</td>
<td></td>
</tr>
</tbody>
</table>

* Critical value for the test at 5% of significance are -4.61 as reported in Gregory and Hansen (1996)
II.3. Monetary transmission mechanism in Rwanda

3.1 Specification, data and choice of variables

We use a VAR analysis to examine the relationships between monetary policy variables and both output and prices in Rwanda. We first present results of Granger causality tests before estimating a reduce form VAR and identify monetary policy shocks through assumptions about variable ordering. VAR analysis has been used extensively to examine the effect of monetary policy on output and prices. The VAR methodology, a dynamic system of equations in which the current level of each variable depends on lagged values of that variable and of all other variables involved in the system, places minimal restrictions on description of how monetary shocks affect the economy. In this analysis it is useful to discriminate the transmission from instrument directly under the central bank’s control to financial conditions and the impact of financial conditions on firms’ and household’s spending decisions (Christiano at al, 1999).

The used unrestricted VAR is represented by:

\[ Y_t = A(L)Y_{t-1} + B(L)Z_t + \epsilon_t \]

Where \( Y_t \) is a vector of endogenous variables and \( Z_t \) a vector of exogenous variables. \( Y_t \) consists of real GDP (RGDP), the Consumer Price Index CPI, nominal exchange rate (NER), monetary aggregate (M3) and interest rate on bank loans (LENDING RATE). The vector \( Z_t \) consists of oil price and international price.

Given that the Rwandan economy doesn’t have an impact on the global economy, these variables are treated as exogenous. \( A(L) \) corresponds to matrices of coefficients to be estimated, with lag lengths determined on basis of Schwartz and AIC criteria. Those criteria suggest that the number of lag is \( p=1 \).
$\epsilon_t$ is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values with the right hand side variables. All data are expressed in natural logs, with exception of interest rate. The estimation is conducted on quarterly data from 2002:Q2 to 2013:Q3.

We adopt the following order of endogenous variables:

$$RGDP_t = [RGDP_t, CPI_t, LEND\_RATE_t, M_{3t}, NER_t]$$

To characterize relationships between output, prices and policy related variables, stationarity properties of the data are important. The Augmented Dickey-Fuller (ADF) test show that all variables are I(1).

As in most VAR models of the monetary transmission mechanism, we do not perform an explicit analysis of the economy’s long-run behavior, because monetary transmission mechanism is a short-run phenomenon. Using the estimated VAR, we can analyze short-term dynamics based on variance decomposition and impulse response over the short to medium term (Favero, 2001).

### 3.2 Granger Causality Test

<table>
<thead>
<tr>
<th>Hypotheses(H0)</th>
<th>Probability</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEND_RATE does not Granger Cause LRGDP</td>
<td>0.42</td>
<td>H0 is accepted</td>
</tr>
<tr>
<td>LM3 does not Granger Cause LRGDP</td>
<td>0.09</td>
<td>H0 is rejected</td>
</tr>
<tr>
<td>LNER does not Granger Cause LRGDP</td>
<td>0.51</td>
<td>H0 is accepted</td>
</tr>
<tr>
<td>LEND_RATE does not Granger Cause LCPI</td>
<td>0.09</td>
<td>H0 is rejected</td>
</tr>
<tr>
<td>LM3 does not Granger Cause LCPI</td>
<td>0.3</td>
<td>H0 is accepted</td>
</tr>
<tr>
<td>LNER does not Granger Cause LCPI</td>
<td>0.31</td>
<td>H0 is accepted</td>
</tr>
</tbody>
</table>

*Source: My own calculations*
The results suggest that the monetary aggregate M3 has an impact on GDP and not on prices while the lending rate has an impact on CPI and not on GDP.

### 3.3 Impulse Responses

- **Response to Cholesky One S.D. Innovations ± 2 S.E.**

  - **Response of LRGDP to LEND_RATE**
  - **Response of LRGDP to LM3**

  - **Response of LRGDP to LNER**

  - **Response of LCPI to LEND_RATE**

  - **Response of LCPI to LM3**

  - **Response of LCPI to LNER**
The results from the impulse response test are showing the following results:

- The impact of the change in lending rate on output is not significant
- A change in monetary aggregate M3 starts to impact on output after two quarters and this impact dies after seven quarters
- A change in nominal exchange rate starts to have an impact on output after one quarter and this impact last for a long period
- There is no impact of the lending rate on price change
- The impact of an exchange rate shock starts after 12 quarters

**Challenges in the implementation**

The implementation of monetary policy faces major and persistent challenges. The imperfect knowledge of the production sector, coupled with inappropriate and unpredictable behavior of the main partners of the Bank has been the major challenges in the implementation process of monetary strategies.

An important share of the real sector of the Rwandan economy is made by informal activities, to the extent that the concerned ministerial department does not have required means to regularly follow-up the evolution and changes that occur in order to make proper interpretations.

The presence of excess liquidity inversely hampers the necessary development of the money markets since most banks have been having abundant funds and not using money markets to the fullest levels, and consequently the money markets are very thin.

Another big challenge that BNR is facing is the absence of the interest rate pass-through, as a policy transmission channel. The signal sent by the NBR through interest rate change does not translate into changes of banks’ lending
rates. Underlying causes for this are mainly structural and the lack of competition between existing banks.

There is still low competition among banks caused by factors such as high operational costs which lead to the asymmetry between the lending and policy rate.
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7.