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Foreword

The bi-annual publication of the economic review is intended to avail information to the public on economic matters, focusing on features and challenges of the Rwandan economy. This eleventh volume of the BNR economic review consists of four papers, with topical issues related with improving the understanding of monetary policy challenges in Rwanda and developing mechanisms to facilitate the transition towards a more modern forward-looking monetary policy framework. The papers aim at providing concrete evidence-based analysis and policy recommendations that can help to improve the effectiveness of monetary policy in Rwanda.

The review starts with a paper that analyzes the effectiveness of various monetary policy transmission channels and the responsiveness of the market interest rates to the adjustments in the policy rate. The paper starts by highlighting the challenges of the current reserve money based monetary policy framework, such as the instability of the money multiplier and money demand function owing to financial sector developments, notably the increased use of modern payment systems, and the limited controllability of reserve money by the Central Bank given that currency in circulation is still high. The paper then proceeds to assess the functioning of the various monetary policy transmission channels in Rwanda and concludes that while there is clear evidence that the monetary aggregates channel is active in Rwanda, the interest rate channel is still inactive, with incomplete pass through confirmed for only the deposit rate. In addition, findings show that the exchange rate channel has been strengthening in recent years. Moreover, banking concentration in loans, deposits and assets significantly has a negative impact on the interest rate pass through.

In light of these findings, the paper calls for concerted efforts aimed at further development of the financial markets to facilitate the smooth transition to an

interest rate based monetary policy framework. In this regard, the paper recommends the need to increase the participation of non-institutional investors in the T-bills market, capital market development, encourage banking sector competition and diversification of financial products and extension of formal financial services to less financed and often risky, albeit important sectors of the economy.

Building on the first paper, the second paper dwells on explaining the impact of Central Bank communication on the effectiveness of monetary policy in Rwanda. Communication is a very important element of a forward-looking monetary policy, thus attracting the attention of modern Central Banks. The paper notes that when a Central Bank communicates its intended policy actions and priorities to the public, it helps to reduce volatilities in asset prices, particularly in interest rates and exchange rates. After explaining the various BNR communication tools, the paper concludes that communication has had more impact in stabilizing the exchange rate than the interest rate in Rwanda. The study also proposes a questionnaire that can be used in future to collect views of economic agents on various aspects of monetary policy effectiveness.

The third paper estimates the Monetary Conditions Index (MCI), used to gauge the monetary policy stance. The MCI is a weighted average of the monetary policy variables, notably the exchange rate and the interest rate. For the case of Rwanda, the exchange rate dominates the MCI with a weight of 0.61. The paper also assessed the usefulness of the MCI in monetary policy analysis using Granger causality tests and VAR framework and results suggested that MCI can be a useful indicator as its movement can help to predict changes in key macroeconomic variables notably inflation and aggregate demand.

The last paper explains the link between monetary variables and a country's external sector variables. For the case of Rwanda, the paper reveals that monetary variables such as domestic credit and money supply are significant but negatively

related to the Balance of Payments position, broadly in line with the monetary theory of balance of payments. Other significant determinants of Rwanda's Balance of Payments include real gross domestic product and inflation. Thus, despite the fact that balance of payments is self-adjusting, the BNR is responsible for formulation of monetary policy to equilibrate money market conditions. In addition, the government should give attention to other policy adjustment mechanisms given that other non-monetary factors significantly affect the Balance of Payments.

Comments and questions can be sent to the Office of The Chief Economist (tkigabo@bnr.rw or Monetary_Policy_Res_Group@bnr.rw), KN 6 Avenue 4, P.O Box 531 Kigali-Rwanda.

Rwangombwa John

Governor

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Monetary policy framework in Rwanda: Moving from reserve money to interest rate based monetary policy

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Abstract

The objective of this paper was to assess the monetary transmission mechanisms in Rwanda and identify key actions to support the use of the interest rate as an operating target in BNR's monetary policy implementation.

Estimations on the interest rate pass through generally indicate that the interest rate channel is not active in Rwanda. Results show that the pass through to the deposit rates is incomplete with coefficients varying between 0.2 and 0.45, while the pass through to the lending rates is not statistically significant. With the exception of the relationship between deposit rates and one year Treasury bills rate, results also confirm the existence of adjustment, though limited, of deposit rates to change in Treasury bill rates and the speed of adjustment for deposit rates varies between -0.4 and 0.7. In addition, banking concentration in loans, deposits and assets significantly has a negative impact on the interest rate pass through. However, there is clear evidence that the monetary aggregates channel is active in Rwanda. A shock to M3 (or changes in the available amount of loans) has a significant, persistent and delayed effect on output, peaking after around 5 quarters. In addition, findings show that the exchange rate channel has been strengthening in recent years in Rwanda.

In the context of the above findings and the need to ensure a smooth transition to the use of the interest rate as an operating objective by 2018, this paper recommends that BNR and other stakeholders need to support the current trend in the development of financial market to increase the: (i) substitution between bank deposits and T-bills by increasing the participation of households and non-bank institutional investors in treasury bills of different maturities on the one hand; (ii) substitution between bank lending and other types of external finance like equity or bond markets on the other hand by developing the capital market; (iii) increase the competition in the banking sector not only by reducing concentration but also by diversifying financial products in the sector; (iv) extending the formal financial services to previously less financed yet important economic sectors such as the agriculture sector; and (v) allow more flexibility in the exchange rate policy.

I. INTRODUCTION

The National Bank of Rwanda (BNR) implements a monetary targeting framework, with base money (B) as an operating target and broad money (M3) as the intermediate target while the ultimate objective is price stability. Under this framework, the overall objective is to keep money supply close to its estimated demand level because significant excess or shortfall may lead to important deviations in outcomes of inflation and economic growth compared to their targets. The framework is based on the assumption that the money multiplier and money demand are stable.

Different studies show that the money multiplier and money demand in Rwanda have increasingly become unstable in recent years especially due to financial sector developments, such as the modernization of payment systems (Kigabo, R., & Irankunda, J., 2012). This has weakened the link between monetary aggregates and the real economy and thus forcing the BNR to think about switching from the reserve money program to a more based price monetary policy, using interest rate as operating target, by 2018.

If the money demand function is unstable and undergoes substantial unpredictable shifts, the velocity of money will be unpredictable, and the quantity of money may not be tightly linked to aggregate spending. In addition, the stability of the money demand function is also crucial for central banks, because it helps to decide whether the central bank should target interest rates or the money supply (Mishkin, 2007).

Another issue related to the use of the reserve money model is the controllability of reserve money by central banks. In literature, this is considered as given. However, it may not be necessarily true, particularly in developing countries with non-developed payment systems and higher levels of currency in circulation.

For example, in Rwanda, the share of currency outside the BNR in reserve money was 57.8% on average, between January 2006 and June 2017, though it has been declining overtime. This is a common characteristic in developing

countries. For example, in the same period, currency outside the central banks represented 53.3% and 63.6% of reserve money in Kenya and Tanzania, respectively.

The objective of this paper is to analyze channels of monetary transmission mechanism in Rwanda and identify key actions to be undertaken to ensure the effectiveness of the new framework. Indeed, a clear and precise understanding of how fast, and to what extent, a change in the central bank's interest rate affect prices is key to understanding and improving the effectiveness of an interest rate based monetary policy. More precisely, in this paper, we first document important features of monetary transmission mechanism channels before empirically identifying what channels work in Rwanda and propose actions to strengthen them aiming at increasing the effectiveness of BNR monetary policy. We focus on the most relevant channels for developing countries, namely the interest rate channel, exchange rate channel and the credit channel.

The rest of the paper is organized as follows. Section 2 presents a summary of literature on monetary transmission mechanisms. Section 3 presents the methodology used in this research. Empirical results are presented in section 4, before we conclude the paper.

II. Literature review

The most traditional channel for monetary transmission mechanism is the interest rate channel developed in IS-LM models. However, the observation that the interest rate channel cannot explain all output fluctuations has given birth to the credit channel. Finally, asset prices, such as the exchange rate, stock and real estate prices are also considered as important in assessing the link between nominal and real variables.

2.1 The Interest Rate Channel

The interest rate channel, summarized in the traditional IS-LM model, can be divided into two distinct stages: (1) the transmission from short-term nominal

interest rates to long-term real interest rates (interest rate pass through) and (2) the channel through which aggregate demand and production are affected by real interest rate developments.

Most of researches about that link use a marginal cost pricing model, where the price set by the bank (i^B) equals the marginal cost of funding approximated by a market interest rate (i^M) and a constant markup (De Bondt, 2002):

$$i^B = \mu + \beta i^M \quad (1)$$

The pass-through parameter β is equal to 1 under perfect competition and complete information. However, the degree of pass-through crucially depends on the presence of a unit interest rate elasticity of demand for both deposits and loans.

Different factors may cause the demand elasticities to become less than unity. Imperfect substitution between bank deposits and other investment facilities of the same maturity and flexibility (money market funds, T-bills and the like), and between bank lending and other types of external finance (equity or bond markets); low degree of competition between banks and between banks and nonbank financial intermediaries; switching costs; presence of asymmetric information; maturity mismatch between loan and deposit portfolio. The more long-run loans are covered by long-term deposits, the less pressure banks feel to adjust their lending rates (Weth, 2002).

Finally, macroeconomic conditions may also affect the pass-through. During periods of rapid economic growth, banks may find it easier to pass on changes in the interest rate to their lending and deposit rates more quickly. Higher inflation may also favor a more rapid interest rate pass-through, given that prices may be adjusted more frequently in a high-inflation than in a low-inflation regime. Importantly, the pass-through to loan rates is intimately related to the credit market in general and to the functioning of the credit channel in particular. In practice, the interest rate pass-through is usually

investigated using an error correction model (ECM) including two interest rate series, bank rate and market rates (deposit rates or lending rates).

The second stage is related to the impact of nominal interest rate changes on the real sector. Real interest rate movements affect spending as those movements reflect changes in the cost of capital and corporate investment. Changes in investment, housing and durable goods spending, i.e. aggregate demand, will eventually cause changes in output.

2.2 Exchange Rate Channel

Beside interest rates and asset prices, both nominal and real exchange rates play an important role in the monetary transmission mechanism. Monetary policy actions can bring about changes in the level of the exchange rate, leading to changes in prices, trade volume and investment. Different papers studying the impact of monetary policy actions on macroeconomic variables using VAR methodology analyze the impact of shocks in short-term interest rates on the nominal exchange rate. Those papers produce mixed results, since positive interest rate shocks can lead to an appreciation or depreciation of the exchange rate (the exchange rate puzzle).

In addition to changes in the short-term interest rate, monetary authorities may also influence short-run exchange rate movements by directly intervening on the foreign exchange markets. The view that foreign exchange intervention may be more effective in emerging and developing market economies than in well-established industrialized countries is well recognized because in those countries, central bank interventions on foreign market are not always fully sterilized and the size of interventions is large relative to market turnover in narrow foreign exchange markets. Moral suasion may play a bigger role, and central banks have a greater informational advantage over market participants (Canales-Kriljenko, 2003). Nominal exchange rate movements caused by monetary policy action have the potential to be translated into domestic inflation through imported final goods prices, and the price of domestically manufactured tradable and non-tradable goods.

A common practice in the literature is to estimate the exchange rate pass-through either relying on VAR models devised by McCarthy (1999) or using a single equation approach that incorporates differenced variables (Campa and Goldberg, 2002) or that employs single equations in which the deviation from the long-run equilibrium exchange rate is modeled (Frankel, Parsley and Wei, 2005).

2.3 The Credit Channel

According to Bernanke and Blinder (1988), the credit channel amplifies the interest rate channel. The credit channel can be decomposed into two distinct channels: (1) the bank lending channel and (2) the broad lending channel (also termed as the balance sheet channel or financial accelerator).

Central to the bank lending channel is the imperfect substitutability between credits and other financial assets in the banks' balance sheets on the one hand, and that between bank credits and other forms of financing on firms' balance sheets on the other hand. These two forms of imperfect substitutability cause monetary policy to impact on economic activity. Imperfect substitution in banks' assets ensures that a tightening (loosening) of monetary policy brings about a contraction (expansion) in banks' credit supply. Alternatively, banks could also issue bonds or collect deposits from households or from the corporate sector rather than decrease credit. However, the ability of some banks to borrow from financial markets may be limited by financial market imperfections.

For monetary policy to be transmitted to the real economy, it is necessary for some firms not to be capable of substituting bank credit for other forms of external funding on the capital markets (imperfect substitutability on the liability side of firms). In such a case, once credit supply has decreased (increased), investment spending will be cut back because of the lack of external financial resources (second stage).

In accordance with Kashyap, Stein and Wilcox (1993), while small banks cannot borrow on financial markets, larger banks definitely can. Similarly,

larger firms have access to capital markets and can escape bank credit supply contraction. This leads us to a larger concept, namely to the broad lending channel.

The existing literature on the effectiveness of monetary policy show that in emerging and developing countries the monetary transmission mechanism is limited by different factors including the underdeveloped financial markets and institutions (Hammond et al., 2009; Moreno, 2008), low levels of competition in the banking sector, high levels costs of information processing, evaluating projects and monitoring borrowers (Agenor and Aynaoui, 2010) and the small size of the formal financial sector (P. Mishra, P. J, Montiel and Antonio Spilimbergo (2012).

With exception of few studies using simple single equation, analysis of monetary transmission mechanism has been conducted using Vector Auto Regressive (VAR) framework because VARs explicitly recognize the simultaneity between monetary policy and macro-economic developments. VAR analysis is considered as a particularly useful tool to investigate the monetary policy transmission in developing economies with short data series and structural changes complicating the use of structural models (Charalambos Tsangarides, 2010).

It arises from the empirical literature that in the developed countries, the interest and exchange rates channels are most important in the transmission of monetary policy actions to influence aggregate demand and affect the central bank's ultimate objectives such as price stability, but vary from one country to another (Coudert and Mojon, 1995; Angeloni et al., 2002; Loayza, 2002).

Hericourt and Matei (2005) propose an empirical evaluation of the transmission mechanisms of the monetary policy in eight central and eastern European countries (Czech Republic, Hungary, Poland, Slovak Republic, Estonia, Lithuania, Latvia and Slovenia) and concluded that for the countries having maintained a fixed exchange rate regime, monetary aggregates channels are actives while countries with a flexible exchange regime have

heterogeneous behavior profiles. Empirical studies on exchange rate pass-through to the domestic prices conclude that in emerging economies, the exchange rate pass through is higher than in developed countries. In general, the pass through is higher in countries using exchange rate to anchor the inflation than in countries using inflation targeting as the framework of implementing the monetary policy (Soffer, 2008, Rossini and Vega, 2008).

A study conducted by Ramon Moreno (2008) has analyzed the monetary policy transmission in emerging markets where short term rates are used as operating instruments. A VAR model has been estimated to assess the importance of domestic policy and foreign factors in influencing long term rates. The study conclude that with some exceptions, external long rates are better predictors of long term yield in those countries than are short term interest rates. A study on the banking lending channel conducted by P. Disyatat (2010) shows that greater reliance on market based instruments enhances the importance of this channel and that banks could act either as absorbers or amplifiers of shocks originating in the financial system. This will depends on the strength of the balance sheets of those banks.

Studies on African countries show different results. For Cheng (2006), a monetary shock in Kenya has a very significant impact on production (GDP) and inflation and the interest rate shock has short-term effects on the nominal exchange rate and prices but not on production. Buigut (2009) concluded that changes in policy interest rates had small and not statistically significant effects on output and inflation in Kenya, Tanzania and Uganda and that monetary transmission mechanism is weak in these countries.

Mishra at al. (2010) conducted a study on monetary transmission mechanism in Low Income Countries (LIC) and found that the banking lending channel should be the dominant channel in these countries, the effectiveness of exchange rate channel depends on the exchange rate regime adopted by a country and that the interest rate channel is generally weak. A recent study conducted by Adam Mugume (2011) shows that there is no support for the credit and the exchange rate channels in Uganda. However, changes in the

amount of credit available resulting from changes in the stance of monetary policy have an impact on inflation.

The study conducted by IMF (Rania Al-Mashat and Andreas Billmeier, 2007) examined the transmission mechanism in Egypt and shows that the exchange rate channel is active while the bank lending and asset price channels are weak. The interest rate channel is underdeveloped but appears to be strengthening since the introduction of the interest rate corridor in 2005. Applied to the case of Mauritius, the VAR analysis conclude that a change in policy interest rate has an impact on inflation and not on output on one hand, and that monetary aggregates and exchange rate channels are active (Charalambos Tsangarides, 2010).

Uanguta and Ikhide (2002) analyzed the channel of monetary transmission mechanism in Namibia and found that changes in the South African Reserve Bank's policy rate (Namibia has a currency pegged to the South African rand) have an impact on lending rates in Namibia as well as on private investment. However, a study by Sacerdotal (2005) concluded that the transmission mechanism through the banking lending channel is weak in many Sub-Saharan African countries due credit market frictions.

III. Methodology

Before analyzing monetary transmission mechanism in Rwanda using the VAR model, we assess the interest rate pass through modifying the methodology used by Kigabo at al. (2016) by introducing the HHI to capture the impact of banking sector concentration on interest rate pass through. We initially specify the following model

$$i_t^m = \alpha + \beta i_t^p + \gamma HHI_t + \varepsilon_t \quad (1)$$

Where i^m is the market rate (loan and deposit rates), i^p is the policy rate, α is a markup and β is the elasticity of market rate with respect to policy rate, measuring the long run pass through. To allow a gradual adjustment of

market rates to the new policy rates we consider equation (1) as the long run relationship for which we specify the following error correction model:

$$\Delta i_t^m = \gamma_1 + \gamma_2 \Delta i_t^p + \gamma_3 (i_{t-1}^m - \beta i_{t-1}^p - \alpha) + \gamma_4 \Delta (HHI)_t + v_t \quad (2)$$

The coefficient γ_3 indicates the speed of adjustment of the short run dynamics to the long run equilibrium relationship described by the equation (1). A high level of γ_3 indicates a faster market response to the policy rate.

The specified VAR model describing the Rwandan economy is

$$H(L)Y_t = K(L)X_t + \varepsilon_t \quad (3)$$

The corresponding reduced form is

$$Y_t = A(L)Y_{t-1} + B(L)Z_t + \mu_t \quad (4)$$

Where Y_t is a vector of endogenous variables and Z_t a vector of exogenous variables. Y_t consists of constant GDP (y), Consumer Price Index (p), nominal effective exchange rate (e), monetary aggregates or total credit (m_t) and short term interest rates (i_t). We have used in this paper, the Treasury bill rates, albeit with different maturities. A(L) corresponds to matrices of coefficients to be estimated, with lag lengths determined by standard information criteria. The vector Z_t consists of exogenous variables used to control for changes in the global economy. In this paper we use international oil price because the Rwandan economy doesn't have an impact on its determination. All data are expressed in natural logs, with the exception of the interest rate. The estimation is conducted on quarterly data from 2000Q1 to 2017Q1.

We adopt the following order of endogenous variables[2]:

$$Y_t' = [y_t, p_t, m_t, i_t, e_t] \quad (6)$$

Before examining the relationship between output, prices and policy related variables, we use the Augmented Dickey-Fuller (ADF) to test for unit root in all variables used in the model. As in most VAR models of the monetary transmission mechanism, by estimating the VAR in levels, we implicitly allow cointegration relationships in the data.

All data are from BNR except data on GDP which are produced by the National Institute of Statistics of Rwanda (NISR) and data on oil prices are sourced from the IMF data base.

Based on the estimated VAR model we will examine the effect on both output and prices, of a one standard deviation shock to the interest rates (Treasury bill rates), monetary aggregates (M3 or credit to the private sector) and exchange rate. We estimate the reduced form VAR by computing the Cholesky factorization of the reduced form VAR covariance matrix. In this framework, it is assumed that the ordering of variables in VAR model, given by equation (6), a variable has no immediate effect on the preceding one. The relation between the reduced form errors (μ) and the structural disturbance (ε) can be presented as follow:

$$\begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^p \\ \varepsilon_t^m \\ \varepsilon_t^i \\ \varepsilon_t^e \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ e_{21} & 1 & 0 & 0 & 0 \\ e_{31} & e_{32} & 1 & 0 & 0 \\ e_{41} & e_{42} & e_{43} & 1 & 0 \\ e_{51} & e_{52} & e_{53} & e_{54} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^y \\ \mu_t^p \\ \mu_t^m \\ \mu_t^i \\ \mu_t^e \end{bmatrix}$$

The number of lags to be included in the model is determined using information criterion such as Akaike information criterion and Schwartz criterion. To check the robustness of our results, we have also used the

[2] We have used other ordering of variables to check the robustness of results such as

$$y_t = [y_t, p_t, r_t, e_t, m_t / cps_t]$$

generalized impulses (Pesaran and Shin, 1998) which are less restrictive than the Cholesky ones and are invariant to the ordering of variables in the VAR model.

IV. Empirical results

Results from the interest rate pass through estimations (see table 1 in appendix) show that the pass through to deposit rates is incomplete with coefficients varying between 0.2 and 0.45, while the pass through to lending rates is not statistically significant. Important to note also is that coefficients on HHI are negative and significant. The speed of adjustment for deposit rates varies between -0.4 and 0.7, except the adjustment in the relationship between deposit rates and Treasury bill rate for one year. This coefficient can be interpreted as an indicator to signal the effectiveness of the interest rate as an instrument of monetary policy, with a higher value of the coefficient signaling a faster market response. Thus, there is an adjustment, though limited, of deposit rates to changes in the Treasury bills rates.

In addition, banking concentration in loans, deposits and assets has a negative and significant relationship with the interest rate pass through, showing that an increase in banking sector competition (or a decline in banking sector concentration) will improve the interest rate pass through. These results indicates that the interest rate channel is not active in Rwanda.

The inelastic demand for both deposits and loans in Rwanda is explained by different factors including market power by few banks and not well developed capital and money markets. This limits the possibility for private companies to mobilize resources in capital markets as an alternative to loans from banks, and households to have access to alternative investment opportunities in addition to deposits, affecting the elasticity of deposit supply with respect to money market rates. Today in Rwanda, banks have 81.9% of total outstanding treasury bills while non-bank financial institutions have 18.01% and individuals have only 0.09%. The picture is different when considering

investment in treasury bonds: Banks have 37% of total outstanding against 59% and 4% for non-bank financial institutions and individuals respectively.

The implication of banks market power on monetary policy transmission is that imperfectly competitive banks may not pass on changes in policy rates. In that case, changes in policy rates will affect more the interest rate spread rather than market interest rates.

Deposit rates react more to policy rates than they do to loan rates. This may be due to more competition on the market for deposits than on loan markets. In addition, lending rates are determined by non interest factors such as operating costs and non-performing loans.

To estimate the VAR model, we first tested for unit root in all series using ADF tests. The results of ADF tests suggest that all series are integrated of order one in levels, that is, they are I(1) as indicated in the following table.

Table 1: Unit root tests

Variables	**Level**		**First differences**	**Conclusion**
	Lag	**ADF**	**ADF**	
GDP (y)	1	-2.74	-2.88***	I(1)
CPI (p)	1	-2.64	-4.89*	I(1)
M3[3]	0	-1.8	-10.3*	I(1)
T-bill rates	0	-2.9	-7.45*	I(1)
Repo rates	0	-0.96	-7.9	I(1)
Deposit rate	0	-0.32	-7.9	I(1)
Lending rates	2	-0.06	-8.01	I(1)
Exchange rate (e)	1	-2.06	-3.08**	I(1)
Credit to private sector (CPS)	0	-2.97	-9.03*	I(1)

*With *, **, *** denoting significance at 1%, 5% and 10%, respectively.*

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).

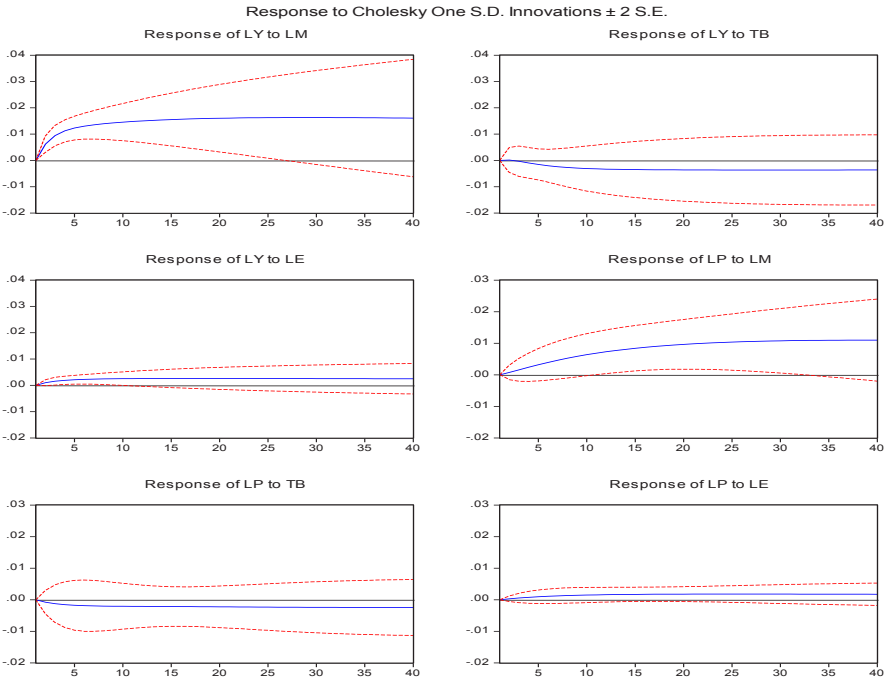
Lag length criteria indicate the use of 1 lag (table 1), the VAR is stable (table2 in appendix) and residual diagnostic tests in tables 3 and 4 in appendix suggest well-behaved residuals. In summary, the analysis for modeling the data suggests that the VARs are empirically well behaved and with good residual diagnostics.

Figure 1 presents impulse response functions indicating the impact of policy-related variables on output and prices, with the dotted lines representing 95% confidence intervals. Results indicate that a one standard deviation shock to the Treasury bills rates is associated with a drop in output and inflation. However, the effect is not statistically significant, confirming that the interest rate channel in not active in Rwanda

Estimated impulse functions show that a shock to M3 appears to have a rapid, significant and persistent effect on output which peaks after around 5 quarters. This is consistent with the real effects of monetary aggregates found in different studies in emerging and developing economies. In the case of Rwanda it may be a reflection of the increasing monetization of the Rwandan economy that has taken place over the period under review. This result indicates that changes in M3 (as well as in the amount of available loans to the private sector, resulting from changes in the monetary policy stance, have an impact on output and inflation.

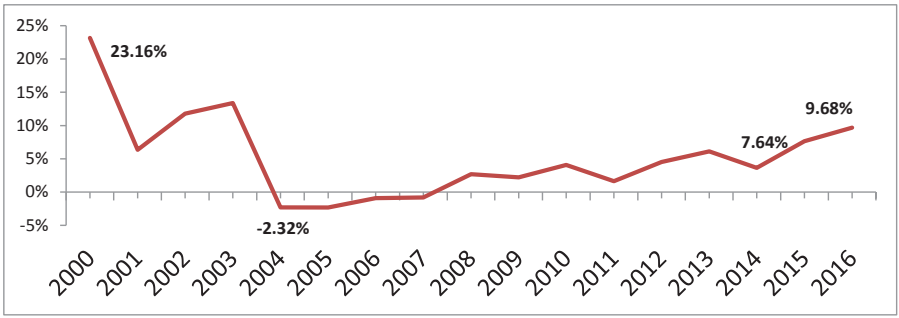
This result indicates that BNR monetary policy has been working through its impact on the volume of loans to the private sector (or amount of M3) than through the cost of loans.

Figure 1. Impulse Responses to One S.D. Innovations ± 2 S.E.)



As mentioned, monetary authorities may influence short-run exchange rate movements through changes in interest rates or by directly intervening on the foreign exchange markets. However, due to a smaller degree of integration with international capital markets, as in many emerging and developing economies, BNR influences exchange rate movements through its interventions on foreign exchange market given that the size of interventions is large relative to market turnover in narrow foreign exchange markets. Impulse response functions indicate that the exchange rate channel is not active when using data covering the period 2000Q1 to 2017Q1. This may be explained by the stability of the FRW exchange rate observed between 2000 and 2010.

Figure 2: Exchange rate development

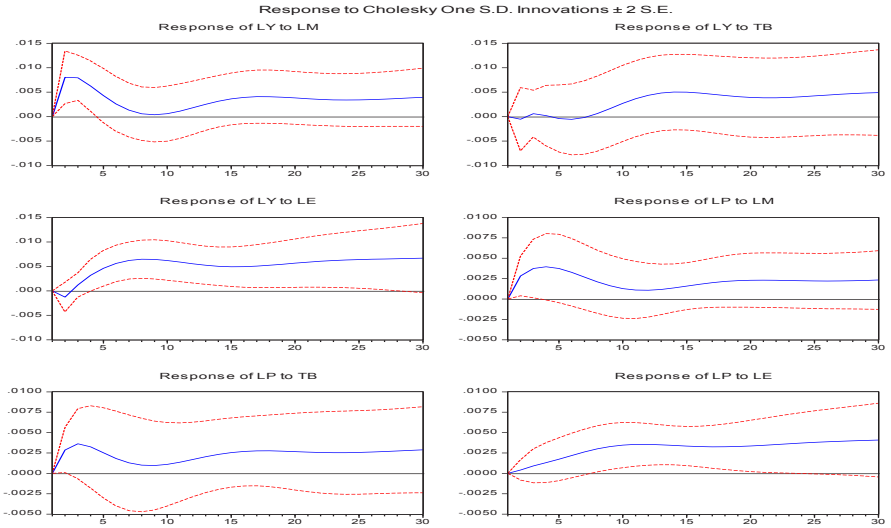


Source: BNR, Financial market department

However, recent developments in the monetary policy framework such as the use of the reserve money band since 2012 and the introduction of digital financial services, such as mobile payments, mobile banking and internet banking since 2010, as well as the depreciation of FRW exchange rate, observed in recent years due to external sector shocks and more flexibility in exchange rate policy, contributed to the improvement in the exchange rate pass through to domestic prices.

To capture those changes, we have estimated the impulse response functions in the sub-sample starting from 2010Q1. Figure 3 shows that a shock on monetary aggregates has an impact on both GDP and prices. In addition, prices and output react to changes in the nominal effective exchange rate, indicating that the exchange rate channel has been strengthening in recent years.

Figure 3. Impulse Responses to One S.D. Innovations ± 2 S.E.)



V. CONCLUSION AND POLICY RECOMMENDATIONS

The objective of this paper was to assess the monetary policy transmission mechanism in Rwanda and highlight policy recommendations to facilitate the use of the interest rate as an operating target by 2018.

Results show that the pass through to deposit rates is incomplete, with coefficients varying between 0.2 and 0.45, while the pass through to lending rates is not statistically significant. An important finding is that coefficients on HHI are negative and significant. The speed of adjustment for deposit rates varies between -0.4 and 0.7, except the adjustment in the relationship between deposit rates and Treasury bill rate for one year. This indicates the existence of adjustment, though limited, of deposit rates to change in Treasury bill rates. In addition, banking concentration in loans, deposits and assets has a negative and significant relationship with interest rate pass through. These results indicate that interest rate channel is not active in Rwanda.

There is clear evidence that the monetary aggregates channel is active in Rwanda. A shock to M3 or to credit has a significant, persistent and delayed effect on output, peaking after around 5 quarters. The effect of a shock to M3 on prices is positive and significant but appears late, after more than two years.

By estimating the impulse response function in the sub-sample starting from 2010Q1 to capture the possible impact of changes in monetary and exchange policy, financial system development and payment system development, results show that not only a shock on monetary aggregates (M3 and credit to the private sector) has impact on both GDP and prices but also prices and output react to changes in the nominal effective exchange rate. This indicates that the exchange rate channel has been strengthening in recent years in Rwanda.

Basing on the above mentioned findings, a successfully switch to the use of the interest rate as an operating objective by 2018 requires further

development of the financial markets to increase the: (i) substitution between bank deposits and T-bills by encouraging the participation of households and non-bank institutional investors in treasure bills of different maturities on the one hand; (ii) substitution between bank lending and other types of external finance like equity or bond markets on the other hand, by developing both primary and secondary capital markets; (iii) increase the competition in the banking sector not only by reducing concentration but also by diversifying financial products in the sector; (iv) extending the formal financial sector services to less financed yet important sectors such as agriculture; and (v) allow more flexibility in the exchange rate policy.

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Appendix

Table 1: Interest rate pass-through estimations[4]

Deposit rates (DR)	Tb1		Tb3		Tb6		Tb12	
	β	γ_3	β	γ_3	β	γ_3	β	γ_3
DR	0.3	-0.4						
DR1	0.2	-0.69	0.2	-0.7	0.2	-0.67	0.2	-0.66
DR6			0.45	-0.66	0.4	-0.64		
DR12							0.38	-0.2

Table 2: VAR Lag Order Selection Criter
Endogenous variables: lry lp lm tb lne
Exogenous variables: C OIL

Lag	LogL	LR	FPE	AIC	SC	HQ
0	126.1943	NA	1.52e-09	-6.115488	-5.684544	-5.962162
1	290.5240	268.1170	1.01e-12	-13.44863	-11.94033*	-12.91199
2	327.9223	51.17653*	5.78e-13*	-14.10117*	-11.51551	-13.1812*
3	350.7444	25.22443	8.15e-13	-13.98655	-10.32352	-12.68327

Table 3: Roots of Characteristic Polynomial

Endogenous variables: lry lp lm tb lne

Exogenous variables: C OIL

Root	Modulus
0.983234	0.983234
0.869303	0.869303
0.634919 - 0.037241i	0.636010
0.634919 + 0.037241i	0.636010
-0.070706	0.070706

No root lies outside the unit circle.

VAR satisfies the stability condition.

Table 4: VAR Residual Heteroskedasticity Tests:

Joint test:		
Chi-sq	Df	Prob.
182.2901	180	0.4383

Tab 5: VAR Residual Normality Tests

Orthogonalization: Residual Correlation (Doornik-Hansen)

Component	Jarque-Bera	df	Prob.
1	1.072675	2	0.5849
2	0.669157	2	0.7156
3	1.268359	2	0.5304
4	10.72069	2	0.0047
5	1.410507	2	0.4940
Joint	15.14139	10	0.1270

Impact of Central Bank communication on effectiveness of Monetary Policy in Rwanda

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I. INTRODUCTION

The effectiveness of monetary policy implies that the actions of the Central Bank can have an impact on the real economy as well as on the short-term and long-term interest rates. However, the degree of this impact is difficult to measure and analyze because of two reasons. First, is the transmission mechanism, i.e. how will a policy action achieve desired targets in the real economy. The second is the time lag i.e. the inevitable lagged adjustment of economic agents to changes in monetary policy (ADEGBOLA et al., 2010). The common practice for most Central banks is the regulation of liquidity by using either price or quantity targets. The price target involves the Central Bank setting the short-term (nominal) central bank rate, in line with the economic fundamentals, and therefore influencing money market and other interest rates in the economy. A complete interest rate channel implies that adjustments in the short-term nominal policy rate are transmitted to other interest rates in the economy and can therefore affect the real economy after a given time horizon. Conversely, the Central Bank can influence the real economy by setting the appropriate quantity targets, such as reserve money.

Under a monetary targeting regime, the effectiveness of monetary policy hinges on the assumptions of "*a stable velocity of money and a stable money multiplier*", which have been both discovered to be unrealistic as documented in some recent empirical studies about some East African economies (Adam C., & Kessy, P., 2011; Kigabo, R., & Irankunda, J., 2012) owing to different financial innovations. This has been fronted as the main reason as to why EAC central banks are committed to move to the interest rate based monetary policy, come 2018.

Since May 2008, BNR introduced the Key Repo Rate, whose level is decided upon by the Monetary Policy Committee (MPC), and communicated to the market as a signal of the BNR's monetary policy stance. The BNR has recently implemented a series of measures aimed at absorbing excess liquidity and improving the

interbank market. At the same time, the BNR has remained committed to attaining low and stable inflation by putting in place an informal target of 5 percent (Luisa et al., 2014). In a bid to improve the transmission mechanism of monetary policy, the BNR has been working on developing models, seeking to inform the decisions of the monetary policy committee (MPC). In addition, BNR has put in place a communication strategy that spells out tools used to transmit its decisions and actions to the public so as to better anchor their expectations. These tools include among others, the publication of the MPC's press release and MPC working document, the Governor's Monetary Policy and Financial Stability Statement (MPFSS) done in Kigali and across provinces and academic institutions, the publication of the quarterly inflation report and the publication of research papers in BNR's economic review. These reforms are expected to pave way to the successful adoption of a more forward-looking monetary policy.

1.1. Motivation

Central bank communication involves the "provision of information by the Central Bank to the public on matters such as the objectives of monetary policy, the monetary policy strategy, the economic outlook, and the outlook for future policy decisions" (Blinder et al. 2008). In doing so, the Central Bank can anchor the expectations of economic agents and this helps to improve the monetary policy transmission mechanism. Many authors agree that the need for Central Banks to make their actions and intentions understood has forced them to become more transparent and accountable to the public and this is only attained through building an efficient communication strategy (Blinder et al. 2001; Andersson et al. 2006; Blinder 2009; Ehrmann & Fratzscher, 2007). In view of the above, while the National Bank of Rwanda has put a lot of efforts in improving the communication of its decisions and intended actions to the public, no study has been conducted so far to assess whether this exercise has been fruitful in

terms of helping to improve the monetary policy transmission mechanism and this study comes to fill this gap.

1.2. Research objective

This paper first explores developments in BNR's communication to the public and relates this with monetary policy effectiveness in Rwanda. The study then estimates the impact of Central Bank communication on the effectiveness of monetary policy using GARCH-type models. To demonstrate the importance of qualitative information to the BNR monetary policy decision making process, the study presents some results of the assessment of the governor's monetary policy and financial stability statement. The study also proposes a questionnaire (see appendix) that can be used in future to collect views of economic agents on various aspects of monetary policy effectiveness.

After presenting the motivation and research objective in the introductory section, the rest of the paper is structured as follows: section two summarizes relevant literature on the impact of central bank communication on the effectiveness of monetary policy, section three highlights the BNR monetary policy communication tools, section four dwells on explaining the methodology used in this paper, section five presents the estimation results and interpretation thereof whereas section six gives the main conclusions from the study.

II. LITERATURE REVIEW

Central bank communication is defined as the provision of information by the Central Bank to the public regarding the objective of monetary policy, the Monetary Policy strategy, the economic outlook and the outlook for future policy decisions (Alan Blinder et al., 2008). This helps Central banks to become more transparent and accountable, which in turn helps the public to easily deduce the goals and intentions of the Central Bank from observable qualitative and quantitative data (Lars Svensson, 2001). Communication requires clarity from the central bank perspective and the ability and willingness to understand the audience's point of view (Issing, 2000).

Central Bank communication contributes to economic prosperity by facilitating well-informed decisions of households and businesses and by reducing economic and financial uncertainty. Clear communication also enhances the effectiveness of the monetary policy transmission mechanism by helping financial market participants and the general public understand how the stance of policy is likely to evolve in response to changes in economic and financial conditions. When a central bank keeps misinforming or not informing the public at all, the link between short-term and long-term rates will be lost and the monetary authority will find it increasingly harder to achieve its goals. Expectational bubbles may well be the result of inscrutable behavior by a central bank which prevents the markets from grounding their perceptions in any underlying reality (Blinder, 1998).

Central Bank communication may be used to guide private sector expectations. As such, it plays an important role in improving the effectiveness of policy and, in the end, the economy's overall performance. Trichet (2005) states that "under some conditions the central bank can regain control of private expectations without necessarily changing interest rates, but by being visibly and credibly

"alert," explaining and stressing its commitment to maintaining inflation at levels consistent with the price stability objective. The threat to act will be more effective the more credible the central bank has been over time in actually delivering price stability, as defined quantitatively."

Communication may be used to reduce noise in financial markets. Greater disclosure and clarity over policy may lead to greater predictability of central bank actions, which, in turn, reduces uncertainty in financial markets. There is a strongly held belief among central bankers nowadays that a high degree of predictability is important. As Poole (2001) put it: "The presumption must be that market participants make more efficient decisions... when markets can correctly predict central bank actions." There are many theoretical reasons why central bank communication should be expected to matter, and many of them imply that skillful communication can improve macroeconomic outcomes (Alan S. Blinder, Michael Ehrmann, Marcel Fratzscher, Jakob De Haan and David-Jan Jansen, 2008).

The old view of monetary policy as advanced by the neo-classical economists emphasized the "Say as little as possible and let the markets guess your intentions" philosophy that many central banks followed. This came forth with surprise Central Banks interventions. However, as time went on, Central Banks recognized that successful conduct of monetary policy hinges on the ability to control expectations (Lars Svensson, 2001).

Central banks also increasingly became convinced that for monetary policy to be understood by the markets, it had to be communicated to the general public. Indeed, communication is desirable for it enables Central Banks to gain the democratic legitimacy and independence (Blinder et al., 2008), helps to directly enhance macroeconomic performance by anchoring inflation expectations and limiting interest rate volatility as well as indirectly enhancing macroeconomic performance through promotion of credibility. Empirical studies have shown that

knowledge about the Central Bank's actions translates into realistic inflation expectations (Van der Cruijsen, de Haan, Jansen, 2013).

When the public doesn't have information but instead must estimate the Central Bank's reaction function, nothing can guarantee that the economy will converge to the rational expectations equilibrium because the public's learning process affects the economy's behavior. This leads to unstable or indeterminate outcomes which effective communication by the Central Bank can help to prevent.

The transition towards greater Central Bank communication has taken decades, progressing from Brunner's 1981 lament about central bankers' refusal to communicate, to Blinder's 1996 argument that more communication would enhance the effectiveness of monetary policy, to Woodford's 2001 claims that the essence of monetary policy is the art of managing expectations and that this was already received wisdom.

Prior to the 1990s, central banks were shrouded in mystery—and believed they should be. Conventional wisdom in central banking circles held that monetary policymakers should say as little as possible, and say it cryptically. In 1981, Karl Brunner (1981) wrote, with evident sarcasm that:

"Central Banking… thrives on a pervasive impression that [it]… is an esoteric art. Access to this art and its proper execution is confined to the initiated elite. The esoteric nature of the art is moreover revealed by an inherent impossibility to articulate its insights in explicit and intelligible words and sentences".

In his 1996 Robbins lectures at the London School of Economics, Alan Blinder (1998) expressed his view of what central bank communications should be—one that had been lurking around in the underbrush but was far from mainstream at the time. He stated that:

"Greater openness might actually improve the efficiency of monetary policy…[because] expectations about future central bank behavior provide the essential link between short rates and long rates. A more open central bank… naturally conditions expectations by providing the markets with more information about its own view of the fundamental factors guiding monetary policy…, thereby creating a virtuous circle. By making itself more predictable to the markets, the central bank makes market reactions to monetary policy more predictable to itself. And that makes it possible to do a better job of managing the economy".

Five years later, Michael Woodford (2001) told an audience of central bankers assembled at the Federal Reserve's 2001 Jackson Hole conference that: *"Successful monetary policy is not so much a matter of effective control of overnight interest rates… as of affecting… the evolution of market expectations... [Therefore,] transparency is valuable for the effective conduct of monetary policy… this view has become increasingly widespread among central bankers over the past decade".*

Several studies have explored the role of communication in monetary policy. The extent to which central bank communication has been successful is very much an empirical issue. Therefore, it is no surprise that the empirical literature on communication has seen major developments in recent years. According to Alan Blinder (1998), more openness might improve the efficiency of Monetary Policy since expectations about future Central Bank behavior give the essential link between short rates and long rates. A transparent Central Bank gives important information about its own view of the fundamental factors guiding Monetary Policy. In doing this, the Central Bank makes market reactions to MP more predictable to itself and this helps the Central Bank to manage the economy. Communication contributes to reduce uncertainty fronting economic agents owing to the presence of asymmetric information between MP makers and other economic agents (Geerat 2002).

Using a simple macroeconomic model, Guthrie and Wright (2000) analyzed the effect of communication by the Reserve Bank of New Zealand (RBNZ) on interest rates. Using articles from Reuters, they analyzed the statements of the RBNZ's statements and categorize them as: Tighten =1 if the statement suggests a desire by the RBNZ to have tighter monetary conditions; Tighten = -1 if the statement suggests a desire by the RBNZ to have looser monetary conditions; Signal = 1 if the statement is accompanied by a formal signal from the RBNZ. The formal signal is viewed as change in the structure of that day's open market operations; Surprise = 1 if the statement is a surprise statement, as opposed to part of a formal release of information, such as monetary policy statement or economic projections. Statements that are known in advance are coded as -1. Using these definitions and they define a dummy variable "ANNOUNCE" to develop a measure of communication, which they put into the Central Bank's reaction function. These researchers found that RBNZ utilized communication systematically and effectively in controlling short term interest rates.

A cross-country study done by Connolly and Kohler (2004) examines the impact of news related to the expected path of Monetary Policy on interest rates futures in six developed countries: Australia, Canada, Euro area, New Zealand, the UK and US. The panel data regression results show that both macroeconomic news and policy news, commentary with rate decisions, monetary policy report significantly affect interest expectations. Gerlach-Kristen (2004) find that publication of monetary policy committee voting records by the Bank of England has helped to make monetary policy more predictable.

Caldas (2012) concludes that Central Bank communication in Brazil, via minutes of monetary policy committee meetings influences the process of expectations formation for interest rates with different maturities. Filho and Rocha (2010) assess if a better communication from the Brazilian Central Bank makes the Monetary Policy more predictable and find that on the decision's

releasing days the interest rates go up, perhaps showing that the Central Bank communication has a conservative bias, and interest rates volatility decreases.

In Indonesia, Monetary Policy statements do not significantly affect interest rates volatility while in Thailand, they have a significant effects and the magnitudes of the effects are higher than one.

Lopez-Marmolejo (2013) built an index of Monetary Policy communication based on the Central Bank's written statements for analyzing if analysts and financial markets understand the Banco de Mexico communications' tone. By using data spanning from 2005-2011, they concluded that the Central Bank's communication gives signs to the market which helps it forecast the policy interest rate and that both financial markets and private economic analysts understand the communication' s tone and incorporate such tone into their interest rates expectations. In view of this, market expectations on interest rates are more consistent with Central Bank's view and are closer to their finally observed level.

III. MONETARY POLICY COMMUNICATION IN RWANDA

The need for the BNR to achieve greater communication with economic agents stems from two mutually entwined principles for maximizing monetary policy: **accountability and effectiveness**. The Central Bank's own autonomy requires greater accountability in delivering transparent information on its actions. In response to this challenge, the Bank's communication with the public must enjoy top priority on its agenda. To ensure an accurate interpretation of the rationale behind shifts, it is important that the public understand the Central Bank's actions and that the latter be systematic. Policy surprises should be the exception and not the rule, so the public can use the information available to predict the most likely path of monetary policy and thus enhance its effect.

The National Bank of Rwanda understands the importance of communication, especially since its goal is that of price stability. BNR has taken on various initiatives to increase the transparency of its monetary policy. BNR uses several channels to communicate to the markets and these are: press releases on MPC decisions done after every MPC Meetings; the Governor's bi-annual Monetary Policy Statements done at Serena Hotel and followed by similar statements across universities and provinces around the country; staff papers uploaded on the BNR website and in BNR Economic Reviews; the BNR website, which is a source of most information including monetary and financial data, and articles on topical issues especially those published in the Rwandan Banker; stakeholder forums; Quarterly meetings between BNR and CEOs of banks; feedback mechanism through the Communication Unit that facilitates information requests from the public; press conferences; social media for collating public views; monetary policy report; and, the BNR Research Day to disseminate the BNR staffs' research findings.

In addition to the above mentioned communication tools, whenever there is need to intervene on the foreign exchange market, BNR clearly communicates to the key market players, notably the commercial banks and forex bureaus, to make them aware of the intended objective of such interventions so as to avoid creating market distortions. Such communication also serves as forward guidance to all the players in the foreign exchange market.

Table 1: Key BNR communication tools and frequency of use

COMMUNICATION TOOL	FREQUENCY
MPC press release	Quarterly
MPC working document	Quarterly
Monetary Policy and Financial Stability Statement	bi-annual
Quarterly inflation report	Quarterly
Economic Review: Research papers	bi-annual
News/data on BNR website	Regular
The Banker	bi-annual
Meeting with CEOs of Banks	Quarterly

IV. METHODOLOGY

To assess the impact of central bank communication on the effectiveness of monetary policy, it is imperative to note that communication influences expectations of future short-term interest rates, which in turn influence long-term rates and other financial market prices. These prices, in turn, influence macroeconomic variables such as inflation and output. Literature shows that communication can affect financial variables, especially interest rates, exchange rates or asset prices (Roman HORVÁTH & Pavel KARAS, 2013).

Central Bank communication, just like monetary policy, affects financial markets very quickly, interest rates and asset prices affect the economy only gradually—with the proverbial long and variable lags. Also, the macroeconomic variables are influenced by many other factors, other than monetary policy but, at least over the narrow time windows used in many empirical studies, it is arguable that financial market variables are reacting only, or at least mostly, to central bank signals. The upshot is that it is a much easier econometric task to estimate the effects of central bank signals using high-frequency data from financial markets than using low-frequency data on macroeconomic performance (Alan S. Blinder, Michael Ehrmann, Marcel Fratzscher, Jakob De Haan and David-Jan Jansen, 2008). Thus, financial variables are often used as a representation of the real economy in the short-run. Just as the content of signals differs markedly across central banks, so does the choice of communication tools. Central banks can choose from a large menu of communication instruments, and each central bank uses its own mixture.

Several measures of communication have been used in the literature (Blinder, Jakob De Hann, 2008). Communications must be classified according to their content and/or likely intention, and then coded on a numerical scale. Negative (positive) values are assigned to communications that are perceived as dovish

(hawkish), and zero to those that appear to be neutral. Whereas some researchers restrict the coding to directional indications by using a scale between −1 and +1 (e.g., Jansen and De Haan 2005, Ehrmann and Fratzscher 2007), others assign a finer grid that is at least suggestive of magnitude (Berger et al. 2006; Rosa and Verga 2007; Heinemann and Ullrich 2007, and Musard-Gies 2006), e.g., by coding statements on a scale from −2 to +2. The most important weakness of the second approach is that it is necessarily subjective, and there may be misclassifications.

In the approach first suggested by Gürkaynak et al. (2005) and Gürkaynak (2005) and also implemented in Brand et al. (2006), indirect measures derived from financial market reactions are employed. Brand et al. (2006) make use of the timing details of the ECB's meeting day communications. The ECB announces its decisions at 1:45 P.M., without any explanatory statements, and then explains the decisions in detail in the press conference 45 min later. Because of that delay, the market reaction to the release of the decision can be separated from the market reaction to the forward-looking communication by using high-frequency data (Ehrmann and Fratzscher 2007). Other studies use a dummy = 1 if a communication is made and 0 otherwise (Roman HORVÁTH and Pavel KARAS, 2013).

Empirical literature shows that several studies used *GARCH type of models* (Connolly and Kohler, 2004), *event analysis* (Ehrmann and Fratzscher 2007) and *Taylor-type rules* (Rosa and Verga, 2007) to examine the impact of central Bank communication on financial variables, mostly on the volatility of interests rates and exchange rates.

For the case of Rwanda, we follow the methodology used by Roman HORVÁTH and Pavel KARAS (2013) to estimate the following GARCH model and to assess

the impact of central bank *communication on the volatility of interest rates and/or exchange rates*:

$Y_t = \mu + \varepsilon_t$ ……(1)

The equation above is for the mean process of the GARCH model for the time series Y_t and ε_t is the error term. Y_t is the first difference of interbank rate/exchange rate. Unlike in the ARCH model, the asymmetric GARCH model (i.e. TARCH model) ensures that the value of the variance σ_t^2 depends both the past values of the shocks, which are captured by the lagged squared residual terms (ε_{t-j}^2), and on past values of itself, which are captured by the lagged σ_t^2 terms.

$\sigma_t^2 = \mu_0 + \sum_{i=1}^{p} \gamma_i \sigma_{t-1}^2 + \sum_{j=1}^{q} \mu_j \varepsilon_{t-j}^2 + \beta_1 \sigma_{t-1}^2 + \beta_2 dummy$ ……(2)

d = 1 if $e_t < 0$, and = 0 if $e_t \geq 0$

Where dummy = *1 stands for the quarter during which BNR communicated to the public; 0=otherwise.* The definition of the dummy for communication is based on the time when the MPC started to communicate to the market its decision on the KRR. Since the MPC meeting is done on a quarterly basis and the KRR time series is available on monthly basis, we assume dummy =1 during the last month of the quarter: Thus, March, June, September and December are all eligible candidates. We also assign dummy = 1 during August 2008 and January 2009 since the MPC made announcements during these months. In the short-run, we assume that financial market variables are reacting only, or at least mostly, to central bank signals (i.e. dummy for communication) and thus include no other control variables.

As for the exchange rate, we define dum2 = 1 when the central bank intervenes on the exchange rate market and 0 otherwise, as in Ashima Goyal and Sanchi Arora (2010). The idea is that when the Central Bank increases its interventions,

it signals to the market the current and expected exchange rate pressures. This approach helps to construct a dummy variable to capture central Bank actions that lead to the volatility in the exchange rate market. Data on Central Bank interventions are available on monthly basis since January 2001. For this entire period, dum2 = 1. The EGARCH model, used to examine volatility in the exchange rate, allows the natural logarithm of the conditional variance to vary overtime as a function of the lagged error term rather than the lagged squared errors as follows:

$$\log \sigma_t^2 = w + \sum_{i=1}^{p} \alpha_i \left| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| + \sum_{j=1}^{q} \beta_j \log(\sigma_{t-j}^2) + \sum_{k=1}^{r} \gamma_k \frac{\varepsilon_{t-k}}{\sigma_{t-k}} \quad \text{.....(3)}$$

This method is adopted due to its intuitive appeal to the concepts of appreciation and depreciation. We can think of the change in the exchange rate as an asset return in the sense that when the currency depreciates it represents a capital gain to foreign currency holders and a capital loss to domestic currency holders. Thus we can describe our variable of interest as the exchange rate return.

We then estimate the TARCH/EGARCH model and check the significance of the dummy variable for communication. The autoregressive root which governs the persistence of volatility shocks is the sum of (μ+γ). In many applied settings this root is close to unity, so that shocks die out rather slowly. We use data on the interbank rate and exchange rate from January 1995 to May 2017.

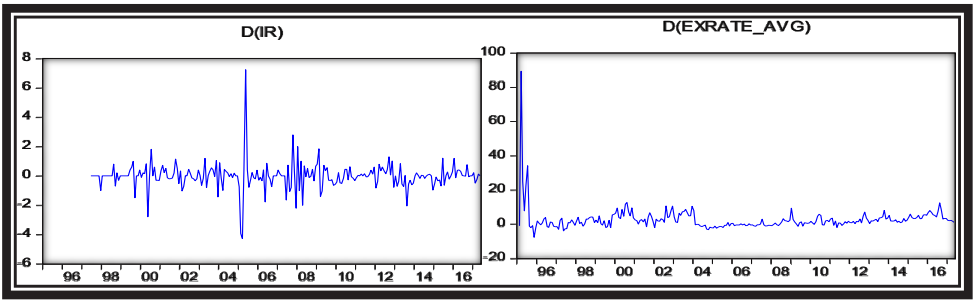
The interpretation of the effect of central bank communication on the effectiveness of monetary policy depends on the sign, magnitude and statistical significance of the dummy variable. A negative coefficient implies that communication has helped to reduce volatility in interest rates/exchange rates while a positive coefficient implies that communication has led to the increase in the volatility of the same variables.

V. RESULTS AND DISCUSSIONS

Over the past years, the BNR has focused on increasing open communication to the public about its policy actions and tracking feedback thereof. As an example, the BNR's Monetary Policy and Research Department distributes a small questionnaire to the participants of the Monetary Policy and Financial Stability Statement (MPFSS) and results are reported to the BNR management. This questionnaire focuses on the quality of the contents of the MPFSS, the kind of information that can be added to the MPFSS to meet the expectations of the public, how the information in the MPFSS has been used by the respondents and how, in general, BNR can be judged in terms of performing its core mandate. Generally, an average of 99% of the respondents in the 2015-2017 period confirmed that the BNR's performance against its core mandate can been judged as satisfactory and above (that is, satisfactory, very good and excellent).

The MPFSS questionnaire is one of the many other communication tools used by the BNR. As explained in section four, increased communication is expected to have a measurable impact on interest rates and the exchange rate and section five seeks to investigate this. Before estimating the GARCH models, we first test for the stationarity of the time series of interest: the first differences of the interbank rate, d(ir), and of the monthly average exchange rate, d(exrate_avg). Graphically the two series look broadly stationary as shown in figure 1:

Figure 1: First differences of the interbank rate and the exchange rate



Source: BNR, Monetary Policy and Research Department (2017)

Indeed, results show that the first differences of the interbank rate and of the exchange rate (table 2) are stationary. Despite showing some ups and downs, the series generally revert to the zero mean. However, the interbank rate looks to be more volatile than the exchange rate.

Table 2: ADF stationarity test

First difference of the interbank rate				
	t-value	**critical t-value**	**Prob.**	**Decision**
D(IR)	-13.2755	-2.575	0.0000	I(0)
		-1.942		
		-1.616		
First difference of exchange rate				
D(EXRATE_AVG)	-7.4384	-3.4549	0.0000	I(0)
		-2.8722		
		-2.5725		

Results of the TGARCH model show that the dummy variable for communication is significant at 10%. The sign of the coefficient on the communication dummy is negative, indicating that increased BNR communication of its policy stance has helped to reduce volatility in interest rates.

Table 3: TGARCH results for the interbank rate

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*DUMMY

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.034728	0.042267	-0.821640	0.4113
	Variance Equation			
C	0.160094	0.023403	6.840648	0.0000
RESID(-1)^2	0.579724	0.136664	4.241966	0.0000
RESID(-1)^2*(RESID(-1)<0)	0.683826	0.276853	2.469997	0.0135
GARCH(-1)	0.213351	0.047542	4.487606	0.0000
DUMMY	-0.075951	0.044712	-1.698668	0.0894

R-squared	-0.000557	Mean dependent var	-0.012823
Adjusted R-squared	-0.000557	S.D. dependent var	0.930655
S.E. of regression	0.930914	Akaike info criterion	2.176861
Sum squared resid	180.2529	Schwarz criterion	2.272813
Log likelihood	-221.4820	Hannan-Quinn criter.	2.215655
Durbin-Watson stat	1.939219		

Results of the EGARCH model show that dum2 is also significant at 10% and also with a negative sign, indicating that over the past years, the interventions of the Central Bank on the foreign exchange market have helped to smooth out excessive volatilities in the exchange rate. The coefficient C(6) is above 1, indicating that the effect of central bank interventions has had a significant impact in terms of stabilizing the exchange rate in Rwanda. As documented in Ashima Goyal and Sanchi Arola (2010), Central Bank communication about its intended interventions in the foreign exchange market creates news to the market players. With high-frequency data, such as daily data, these news can increase the volatility of the exchange rate. However, over longer periods, as for the case of monthly data, such communicated interventions can help to stabilize the exchange rate. This is because market players observe that the Central Bank is consistently biased towards stabilizing the exchange rate.

Table 4: EGARCH results for the exchange rate

Dependent Variable: D(EXRATE_AVG)
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 08/14/17 Time: 17:05
Sample: 2000M01 2017M05
Included observations: 209
Convergence achieved after 41 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)
*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1)) + C(6)
*DUM2

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.519347	0.178874	8.493939	0.0000
	Variance Equation			
C(2)	2.435640	1.042363	2.336652	0.0195
C(3)	0.637597	0.203274	3.136636	0.0017
C(4)	0.329493	0.154006	2.139483	0.0324
C(5)	0.167906	0.191859	0.875153	0.3815
C(6)	-1.362204	0.824624	-1.651910	0.0986

R-squared	-0.063663	Mean dependent var	2.311770
Adjusted R-squared	-0.063663	S.D. dependent var	3.148156
S.E. of regression	3.246820	Akaike info criterion	4.928974
Sum squared resid	2192.703	Schwarz criterion	5.024926
Log likelihood	-509.0777	Hannan-Quinn criter.	4.967768
Durbin-Watson stat	0.561903		

VI. CONCLUSION

This paper analyzed the effect of central bank communication on the volatility of short-term interest rates and exchange rates in Rwanda using the TARCH and EGARCH, respectively. Results show that in the interbank's volatility equation, the dummy variable for communication is significant at 10%. The sign of the coefficient on the communication dummy is negative, indicating that increased BNR communication of its policy stance has helped to reduce volatility in interest rates. Similar findings are obtained for the volatility equation of the exchange rate. Unlike for the case of interest rates, the central bank interventions, as a measure of central bank actions or signal, has had a huge impact in terms of stabilizing the exchange rate in Rwanda given that the coefficient on the dummy is above 1.

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APPENDIX: Proposed questionnaire to solicit feedback from the markets

A SURVEY ON MONETARY POLICY, CENTRAL BANK COMMUNICATION AND EXPECTATIONS

This questionnaire is intended to collect your views on the way BNR conducts its monetary policy, how this affects your decisions and the economy in general and also on how you expect the economy to behave going forward. The BNR appreciates the time you spend answering these questions. PLEASE TICK (OR FILL IN) THE APPROPRIATE ANSWER.

FEED BACK ON COMMUNICATION		
		Answer
1. Please rank your overall sense of how well the BNR communicates	a. 1 = not well	
	b. 2 = fairly well	
	c. 3 = well	
	d. 4 = extremely well	
2. How do you keep track of the BNR's policy decisions?	a. Governor's presentation	
	b. Monetary Policy Committee (MPC) report	
	c. MPC Press release	
	d. Inflation Report	
	e. Monetary Policy and Financial Stability Statement	
	f. Talk shows	
	g. Research day	
3. How well do you think the BNR performs on conveying its objectives?	a. 1 = not well	
	b. 2 = fairly well	
	c. 3 = well	
	d. 4 = extremely well	

FEED BACK ON COMMUNICATION		
4. During the last quarter, what do you think was the main concern of the BNR?	a. Stabilization of inflation	
	b. Supporting economic growth	
	c. Smoothing exchange rate volatility	
5. Which of the following central Bank communication impacts your planning decisions?		
	a. Inflation forecast	
	b. GDP growth projection	
	c. Exchange rate projection	
	d. Decision of policy rate for forthcoming quarter	
6. How well do you think the BNR performs on predictability?	a. 1 = not well	
	b. 2 = fairly well	
	c. 3 = well	
	d. 4 = extremely well	
7. How well do you rate BNR's credibility?	a. 1 = not well	
	b. 2 = fairly well	
	c. 3 = well	
	d. 4 = extremely well	
8. Do you think the BNR implements its monetary policy with independence?	a. 1 = not well	
	b. 2 = fairly well	
	c. 3 = well	
	d. 4 = extremely well	
9. How well do you feel that you understand what the BNR does in the economy?	a. 1 = not well	
	b. 2 = fairly well	
	c. 3 = well	
	d. 4 = extremely well	
10. When people in economics and media talk about monetary policy,	a. Not Much	
	b. Much	

FEED BACK ON COMMUNICATION		
do you have a good idea what they are talking about?	c. Very Much	
11. Total amount of money in circulation is determined by monetary policy. Who sets this monetary policy?	a. BNR	
	b. Ministry of Finance	
	c. President's office	
	d. Prime Minister's office	
	e. Parliament	
12. Which is monetary policy?	a. Change in government spending	
	b. Change in Key Repo Rate	
	c. Change in company profits	
13. What is the name of current central Bank Governor		
14. Do you easily understand the policy on interest rates?	a. Yes	
	b. No	
	c. Somehow	
15. Who has the greatest influence over how the economy performs?	a. BNR	
	b. Ministry of Finance	
	c. President's office	
	d. Prime Minister's office	
	e. Parliament	
16. Who or what do you think should get the blame for the economy?	a. BNR	
	b. Ministry of Finance	
	c. President's office	
	d. Prime Minister's office	
	e. Parliament	
17. Confidence in Fed's ability to turn around the country's economy?	a. Not at all	
	b. Somehow	
	c. Much	
	d. Very much	

FEED BACK ON COMMUNICATION		
18. Confidence in Fed's ability to promote financial stability?	a. Not at all	
	b. Somehow	
	c. Much	
	d. Very much	
19. Should BNR be:	a. More accountable to Congress?	
	b. Left independent?	
	c. Abolished	
20. Do you favor a law allowing Congress to conduct annual internal review of BNR?	a. Never	
	b. Yes	
	c. Not sure	
21. Rate your feelings toward BNR	a. Very bad	
	b. Bad	
	c. Good	
	d. Very good	
SURVEY OF EXPECTATIONS		
A. MONETARY CONDITIONS		
22. What is your perception of monetary conditions at the present moment	Very tight	
	Neutral	
	Very relaxed	
23. What expectation do you have for monetary conditions at the end of this year:	Very tight	
	Neutral	
	Very relaxed	
B. PRICES		
24. What quarterly % change do you expect in the Consumer Price Index (C.P.I) for the:		
Coming quarter:		
End-December:		

FEED BACK ON COMMUNICATION		
25. What annual % change do you expect in the Consumer Price Index (C.P.I) for the:		
End of this year		
End of next year		
C. INTEREST RATES		
26. What level of the Key Repo rate do you expect at :		
End of next quarter		
End of this year		
27. What level of the 91 days T-bills rate do you expect at :		
End of next quarter		
End of this year		
C. EXCHANGE RATES		
28. Relative to the following currencies, what spot exchange rate do you expect for the FRW the end of:		
Next Quarter		
This year		
D. GROWTH		
29. What is your expectation of the quarterly % change in real GDP for the end of:		
Next Quarter		
This year		
30. What is your expectation of the annual % change in real GDP for the end of:		
Next Quarter		
This year		
TIME AND DATE OF COMPLETION:		

FEED BACK ON COMMUNICATION
Thank-you for taking the time to complete this survey. If you have any queries concerning this survey, please forward them with this form or contact The BNR directly on +250788199000. A detailed report of the results with a summary of the main trends and highlights will be emailed to you shortly.

Estimating the Monetary Conditions Index (MCI) for Rwanda

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Keywords: **Monetary conditions, monetary policy**

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ABSTRACT

The objective of this paper is to estimate monetary conditions index (MCI) for Rwanda, using quarterly data spanning from 2006 Q1 to 2017 Q2. The monetary conditions index combines both interest rates and exchanges rates using estimated weights from IS equation. Results from OLS estimation of IS equation gave a weight of 0.39 for real T-bills rate and 0.61 for real effective exchange rate. In addition, this paper assessed the usefulness of MCI in monetary policy analysis using Granger causality tests and VAR framework and results suggested that MCI can be a useful indicator as its movement can help to predict changes in key macroeconomic variables notably inflation and output gap.

I. INTRODUCTION

One of the challenges which policy makers especially monetary authorities have been facing is to assess the stance of current monetary policy vis a vis their objectives of price stability and unemployment. Depending on the level of development in financial markets and relative strength of one or several monetary policy channels in a given economy, there are a number of indicators which can help to gauge the stance of monetary policy/conditions and guide policymakers in their policy deliberations. Among them are the short term money market rates, exchange rates, growth in monetary aggregates and the real monetary conditions index which is the weighted average of deviation of interest rate and exchange rate relative to their values in a given base period. One or several of these indicators may be deemed more appropriate depending on monetary policy framework and relative strength of transmission channels of monetary policy.

The basic idea behind the MCI is that in an open economy both the real interest rate and the real exchange rate are important factors in the determination of aggregate demand. This indicator captures changes in the stance of monetary policy. In addition to that, another advantage is that it can capture changes in the exchange rate that are not accompanied by changes in the interest rate (terms of trade shocks, loss of confidence, etc.) and also it records movements of the interest rate and exchange rate in opposite directions.

For the case of Rwanda, the National Bank of Rwanda (henceforth BNR) has been operating in a monetary targeting framework where a target of reserve money growth and broad money are set within a monetary program, broad money being a nominal anchor and reserve money an operating target to achieve the goal of price stability. Since 2013, this framework was modernized to make it more

flexible by introducing a band for reserve money target and allowing more freedom to influence short term money market rates. This is one step towards the adoption of inflation target framework in medium term. Besides, BNR sets the key repo rate which is supposed to be the reference in setting other interest rates in the economy. BNR change of key repo rate signals the orientation of monetary policy.

Operating with a monetary targeting makes the rate of money growth as one of the tools to diagnose the stance of monetary policy/conditions. However, the role of interest rates and exchange rates in policy transmission in Rwanda is non-negligible as on one hand Rwanda is an open economy and on the other hand, the ongoing modernization in financial sector and payment system is likely to weaken the link between monetary aggregates and other macro-economic variables notably real output and inflation. Thus, monetary conditions index (henceforth MCI) which combine both interest rate and exchange rate can be an additional and important indicator which would help in monetary policy analysis.

The MCI was introduced in 90s as an information tool which indicates the stance of monetary policy/conditions in the economy by combining interest rate and exchange rate into one single measurement (Osborne-Kinch & Holton, 2010). MCI can fulfill several roles in monetary policy. First it can indicates the stance of monetary policy, secondly it has been used as an operating targets by some central banks.

The usefulness of MCI is based on the fact that it considers not only the change in interest rate, but also the change in exchange rate, hence both interest rate and exchange rate channels and that is important in small open economy like

Rwanda where movement in exchange rate spills over in the domestic economy and especially on inflation.

Various countries have attempted to estimate real monetary conditions index and in some cases (Canada, New Zealand) included it in their policy framework as an operating target, although this was not fully successful and later abandoned. Nevertheless, the real monetary conditions index and its extended version namely financial conditions index are still widely used by policymakers and economic agents in their economic analysis. Some structural models for monetary policy analysis run by central banks also include real monetary conditions index.

One of the main challenge in using the MCI is the estimation of weights assigned to real interest rates and real exchange rates in deriving the MCI. Several approaches often used include single reduced form equation and multiple equations models (Qayyum, 2002) and gave mixed results. Generally, in developed markets, the estimated weights for real interest rate has been clearly higher than real exchange rate weights. In fact, in an economy where the responsiveness of real output on shock to interest rate is important, the weights assigned to real interest rate gap in MCI calculation is higher and vice versa.

The objective of this paper is to estimate real monetary conditions index for Rwanda and assess its usefulness as a tool for monetary policy analysis in Rwanda. The weights are obtained from a reduced form IS equation and suggest a ratio of 0.39 for real T-bills rate and 0.61 for real effective exchange rate.

Important to note that the semi structural macro model for monetary policy analysis currently used at BNR, a real monetary conditions index is included in its aggregate demand equation and indicate the stance of monetary policy.

The rest of the paper is organized as follows. Section 2 presents literature review and theoretical issues with emphasis on studies that have worked on the estimation of monetary condition index. Section 3 presents methodology used and empirical results and discussion and Section 4 entails conclusion and proposed policy recommendations.

II. LITERATURE REVIEW

Monetary Conditions Index was first introduced by the Central Bank of Canada (Freedman, 1995). Central Banks and different international institutions started to use the MCI as an index for the orientation of monetary policy and to check the effect of monetary policy actions on the economy. In fact, MCI can be used as an indicator of looseness or tightness of monetary policy.

Monetary Condition Index (MCI) is measured as a weighted average of changes in an interest rate and an exchange rate relative to their values in a base period. MCI synthetizes the two main channels of monetary policy namely exchange rate channel and interest rate channel and captures the degree of pressure that monetary policy exerts on an economy's aggregate demand through changes in the interest rate and exchange rate, and hence inflation (J.A Okello & J.Opolot, 2010)

Many researchers and economists have constructed monetary conditions index for different countries and using different approaches. Though they used different approaches but the aim was to estimate the weights for real interest rate and real exchange rate used for computing MCI. These weights were estimated using interest rate and exchange rate as independent variables and output gap or inflation as dependent variables.

One approach which has been widely used consists in single equation based MCIs. Another approach estimates those weights by using multiple equations model. There is also dynamic MCIs introduced by Battini and Turnbull in 2000 for the monetary policy committee of Bank of England (Qayyum, 2002).

Pei-Tha and Kian-Teng (2008) constructed a monetary conditions index for Malaysia. They applied ordinary least squares on quarterly data for the period 1995:Q1 to 2006:Q4 to estimate the relative influence of interest rates and exchange rate on the output gap. The estimated weights of real interest rate and real exchange rate used for the computation of the MCI. The resultant weights were 1.6:1, implying that influence of interest rate outweigh the one for exchange rate.

Kodra (2011) also estimated the IS equation with output gap as dependent variable using the ordinary least squares method on quarterly real interest rate and real exchange rate of Albania from 1998:Q1 to 2008:Q4. The results show that for the case of Albania, interest rate has higher weight with a ratio of 3.8:1, implying that the effect of an appreciation of the real exchange rate by 3.8 percentage points may be neutralized by a 1 percentage point increase in the real interest rate in Albania.

For the case of African countries, Gichuki and Moyi (2013), estimated monetary condition index for Kenya using quarterly data for the period 2000-2011. They used 91 day Treasury bill rate, real exchange rate but also included credit to private sector as another variable that may impact the aggregate demand in Kenya. Their result shown that a percentage point change in the exchange rate has more impact on aggregate demand than interest rate. Okello & J.Opolot (2010) had also found that for the case of Uganda, the exchange rate exerted more influence than the interest rates but their results were from a price equation.

Knedlik (2005) estimated monetary conditions index for South Africa using least square method on the equation with real interest rate and real effective exchange rate as independent variables and output gap as dependent variable with annual data from 1994 to 2003. His findings suggest a ratio of 1.9:1 as movement in real interest rates have 1.9 higher impact on monetary conditions than changes in real exchange rates. Knedlik (2005) recommended that MCI should form part of tools of analysis by the monetary authorities in the monetary policy formulation process.

Besides, for the case of South Africa, De Wet (2002) estimated monetary conditions index. However, the output gap was included among independent variables while using the inflation rate as the dependent variable. The results confirmed the importance of real interest rate weights in MCI. He concluded that for monetary policy analysis, MCI should be used with caution but also suggested that financial institutions can use it in their analysis.

A number of studies also opted for estimating MCI weights from a price equation. In the case of Turkey, Kesriyeli and Kocaker (1999) use price objective function to construct a monetary conditions index. The weights of the MCI in their approach are built to show the link between the operational target of monetary policy and the objective of price stability. The results from price equation highlighted the importance of exchange rate and its derived weight was higher than the interest rate weight. The derived MCI provides evidence in support of tight monetary policy throughout the studied period. Nevertheless the inflation and output had remained higher.

Lattie (1999) estimated a monetary conditions index for Jamaica using a small open economy model. The result showed that exchange rate have a stronger influence on prices than interest rates and the weight of the former was higher in deriving the MCI. In his finding he suggested that it will be useful to include

MCI as an auxiliary operating target as it had close association with domestic inflation.

In the case of Pakistan, Qayyum (2002) used the inflation rate was the dependent variable and average exchange rate and call money rate in nominal form as exogenous variables. He justified the choice of inflation as the dependent variable by the fact that it is the ultimate objective of monetary policy in Pakistan. The estimated results yielded coefficients of 0.736 for interest rate and 0.264 for exchange rate.

From empirical literature reviewed, the growth equation is the most widely to derive weights of interest and exchange rates used in the construction of monetary conditions index. One of the key observation is that for EAC countries with developing financial markets, the importance of changes in exchange rates outweighs the one for interest rates while for developed countries, the interest rate has a higher weight.

III. ESTIMATION OF MONETARY CONDITION INDEX FOR RWANDA

3.1. Methodology

The study follows a methodology that has been used by several studies that include Pei-Tha and Kian-Teng (2008), Kodra (2011), and Knedlik (2005) among others.

This methodology consist of estimating aggregate demand equation using the least square approach with interest rate and exchange rate as independent variables and the output gap as dependent variable to obtain the weights that will be used to derive MCI. In line with the assumption of linear homogeneity, the sum of weights should equal to one since it is assumed that only the exchange rate and the interest rate can be considered as monetary policy

variables. However, the magnitude of the coefficients for each variable included in the construction of MCI depend on its relative importance.

In its simplest form an aggregate demand relation can be modeled as follows:

$y_t = -a_1 r_t - a_2 e_t + v_t$[10] (1) $a_1,\ a_2 > 0$

Where:

$\boldsymbol{y_t}$ is the aggregate demand

$\boldsymbol{r_t}$ is the real interest rate

$\boldsymbol{e_t}$ is the real exchange rate

$\boldsymbol{v_t}$ represents other factors that influence aggregate demand

The size of $\boldsymbol{a_1}$ and $\boldsymbol{a_2}$ reflects the relative effect of the real interest rate and exchange rate channel on aggregate demand. These coefficients are used in MCI.

The MCI at a time t, is determined as the weighted sum of changes in the interest rate (i) and the exchange rate (e) from their levels in a base year (t=0), and can be written as:

$MCI = w_i(i_t - i_0) + w_e\ (e_t - e_0)$ (2)

Where:

$\boldsymbol{w_i}$ and $\boldsymbol{w_e}$ are respectively, the weights of the interest rate and the exchange rate.

$\boldsymbol{i_t}$ is the short term real interest rate at time t,

$\boldsymbol{e_t}$ is the real effective exchange rate at time t.

$\boldsymbol{i_0}$ and $\boldsymbol{e_0}$ are real interest rate and real effective exchange rate , respectively in a given base period.

[10] Alfred V. Guender , 2001

w_i and w_e are the weights of interest rate and exchange rate, respectively in the MCI.

Changes in the MCI reflect changing monetary conditions between two points in time. An increase (decrease) in the index indicates that monetary conditions have tightened (eased).

In this study we followed the methodology used by Oriela (2011) which applied the ordinary least squares method on quarterly real interest rate and real exchange rate for the case of Albania.

Besides, apart from deriving MCI weights and assessing its evolution, some authors such as Zulkhibri (2012) assessed the usefulness of MCI and its extension FCI (Financial conditions index) in predicting inflation. They used Granger causality and the results indicated that it is rather movement in inflation which would predict changes in MCI and FCI as the null hypothesis that changes in inflation explains changes in MCI and FCI could not be rejected. Gomez et Al. (2011) also performed almost the same exercise for the case of Colombia (using Granger causality, out of sample forecasting exercises, etc.) though they used FCI and after estimating the later, results from Granger causality show that FCI can be a good leading indicator as it granger cause GDP growth.

3.2. Data used

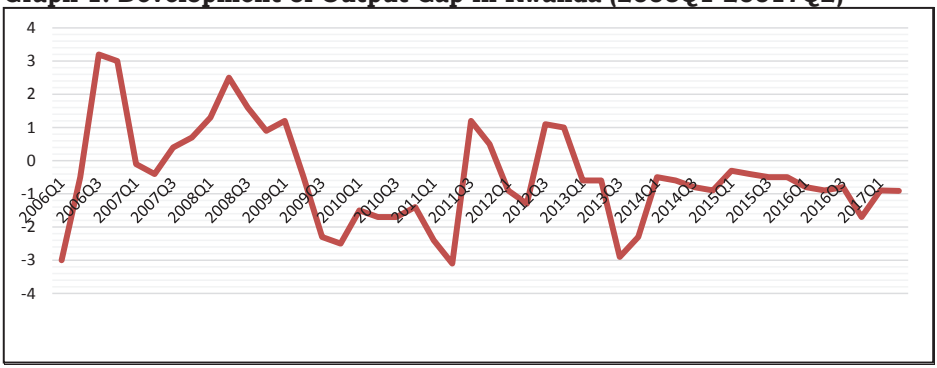
We use quarterly data from 2010Q1 to 2017Q2. The ADF test of stationarity confirmed that all variables were I(0).
The data considered are the following:

- **RGDP_gap**, the output gap computed as the deviation of the real GDP from the potential GDP;

- **RTBILLS_gap,** the real treasury bills rate gap, computed as deviation of 91 days real treasury bills rate from the base (HP trend);
- **REER_gap,** the real effective exchange rate gap, computed as deviation from its trend.

Those data were transformed according to the aforementioned models to be estimated. Firstly output gap which is the difference between current output and potential output was calculated after generating potential output using a Hodrick-Prescott filter[11] with a smoothness parameter of 1600. The generated potential output together with real GDP was converted into logarithms and the output gap was calculated as difference between log of real GDP and log of potential output.

Graph 1: Development of Output Gap in Rwanda (2006Q1-20017Q2)



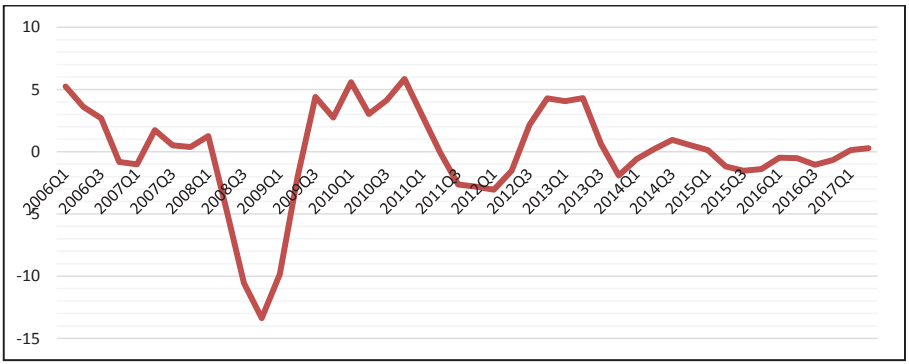
Source: *Authors' calculations based on NISR data*

[11] The Hodrick–Prescott filter (also known as Hodrick–Prescott decomposition) is a mathematical tool used in macroeconomics, especially in real business cycle theory, to remove the cyclical component of a time series from raw data. It is used to obtain a smoothed-curve representation of a time series, one that is more sensitive to long-term than to short-term fluctuations.

Real treasury bills rate (graph 2) was derived from the quarterly real treasury bills rate. We converted monthly data into quarterly data by calculating the average of three months of each quarter.

To derive the real treasury bills rate the quarterly inflation rate was subtracted from the quarterly 91 days treasury bills rate. We calculate deviations of the real treasury bills rate from its trend using the Hodrick-Prescott-filter technique. Differences between the actual real treasury bills rate and its trend were generated to derive the time series "Real treasury bills Rate gap". This time series is stationary.

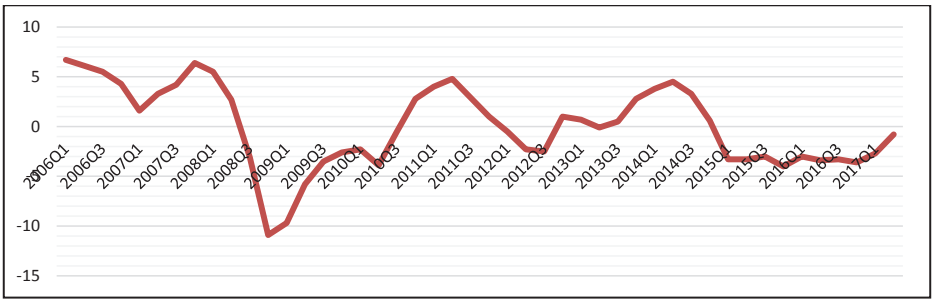
Graph 2: Development of RTBILLS_Gap in Rwanda (2006Q1-20017Q2)



Source: *Authors' calculations based on BNR data*

Real effective exchange rate (graph 3) was derived from the quarterly index of the real effective exchange rate. We used Kalman filter to derive base values of the real effective exchange rate. The gap was obtained taking the differences between logged real effective exchange rate and logged base (trend) values of the exchange rate

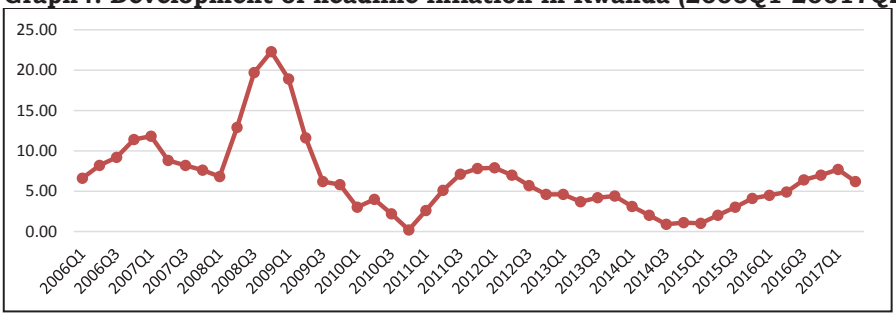
Graph 3: Development of RER_Gap in Rwanda (2006Q1-20017Q2)



Source: *Authors' calculations based on BNR data*

Quarterly inflation rate is the three months average inflation. Inflation hiked in 2007/2008 as result of commodity prices crisis.

Graph4. Development of headline inflation in Rwanda (2006Q1-20017Q2)



Source: *Authors' calculations based on BNR data*

IV. EMPIRICAL RESULTS

4.1. Estimation results

We first use ADF unit root test to identify stochastic properties of all used variables and we found that they are all I (0) as reported on Table 1 below.

Table 1: Results of tests for stationarity using Augmented Dickey-Fuller (ADF)

Variables	ADF test statistic	Critical values			Order of integration
		1%	5%	10%	
YGAP	-4.26	-4.17	-3.51	-3.18	I(0)
RTBILLS_91GAP	-4.30	-2.61	-1.94	-1.61	I(0)
RER_GAP	-2.99	-3.59	-2.93	-2.6	I(0)

Source: *Authors' estimations*

We have estimated the following equation using OLS because all variables in the model are I(0). Below is a table of the results of the OLS estimation:

Table2. Results of estimated equation

Dependent Variable: YGAP

Included observations: 46 after adjustments

YGAP=C(1)+C(2)* RER_GAP+(1-C(2))* RTBILLS_91GAP

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.481776	0.596703	-0.807396	0.4238
C(2)	0.612992	0.147850	4.146047	0.0002

Source: *Authors' estimations*

From the estimated equation, the weight of interest rate is (1-0.61) which equals 0.39 and the weight for real effective exchange rate is 0.61. The interest rate has a lower weight compared to the exchange rate meaning that a percentage point change in interest rate has lesser effect on output than a one percentage change in the exchange rate. This finding is consistent with Peng's (2000) finding that estimates for small open economies produce smaller ratios of the real interest rates compared to the exchange rates. Besides, this is in line with results obtained by studies earlier conducted for regional countries (Okello & J.Opolot (2010) for the case of Uganda and Gichuki and Moyi (2013) for the case of Kenya). Using those weights, we computed the MCI.

The MCI equation for Rwanda can be written as:

$$MCI_t = 0.39(i_t - i_0) - 0.61(e_t - e_0)$$

Where:

$\mathbf{0.39}$ and $\mathbf{0.61}$ are respectively, the weights of the 91 days treasury bills rate and the real exchange rate in MCI.

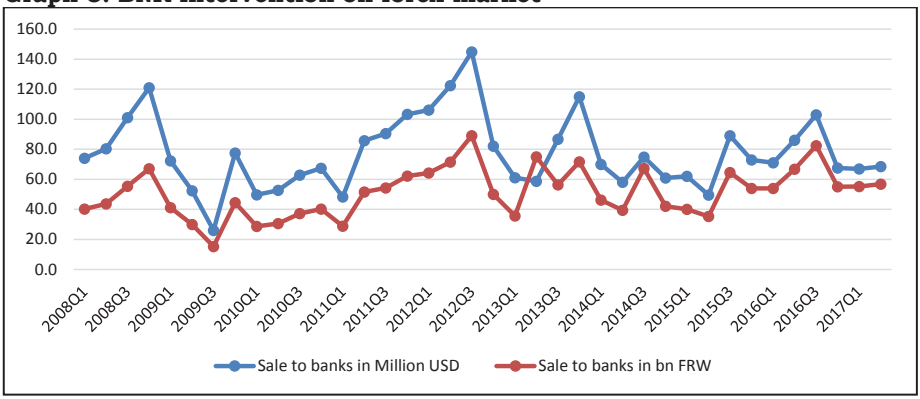
$\boldsymbol{i_t}$ is the real 91 days treasury bills rate at time t,

$\boldsymbol{e_t}$ is the real exchange rate at time t.

$\boldsymbol{i_0}$ and $\boldsymbol{e_0}$ are real 91 days treasury bills rate _trend and real exchange rate_trend

One implication from the above results is that exchange rate development should be monitored keenly given their influence on monetary conditions in Rwanda. In an economy where intervention of Central Bank in forex market is important (see graph 5), each sell of foreign currency to commercial banks is equivalent to mop up of domestic liquidity.

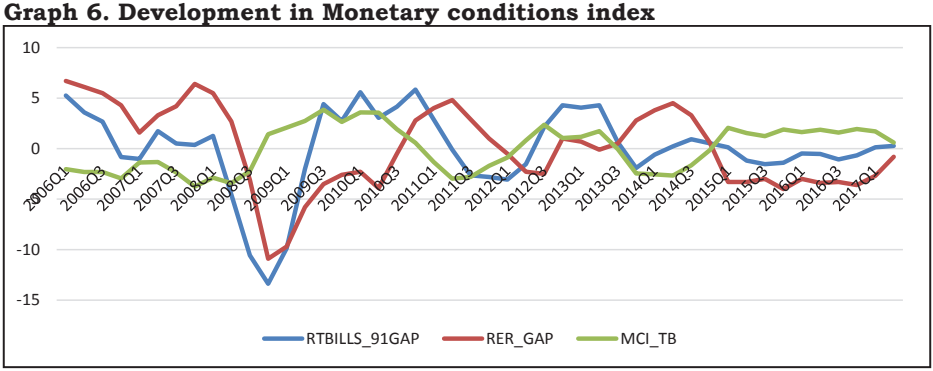
Graph 5. BNR intervention on forex market



Source: *Authors' calculations based on BNR data*

The results as presented on the graph 6 below shows that monetary conditions have been less volatile except in 2008-2009 and have become more stable since 2014. In the recent period from 2015Q1, the index is showing moderately tight monetary conditions. However, in Q2 2017, there is a mild loosening compared to 2016 amid some depreciation pressure from real effective exchange rate gap. This chart below show the prominent role of exchange rate (as indicated by its weight in MCI) in influencing movement in MCI.

Graph 6. Development in Monetary conditions index



Source: *Authors' estimations*

4.2. A useful indicator?

Currently it is part of semi structural model for monetary policy analysis and is already taken into consideration in policy deliberations.

On that we used Granger causality and VAR framework to gauge how strong is the relationship between MCI and other key macro variables in BNR monetary policy framework notably CPI inflation and broad money using quarterly data from 2006 Q1 to 2017 Q2. The relationship with output gap is straightforward given that MCI weight are derived from IS equation.

Results from Granger causality test indicate that there is a causality in Granger sense from MCI to broad money, output gap and change in CPI. In short, this suggests that change in MCI can help to predict change in broad money, output gap and CPI.

Table 3. Granger causality results

Null Hypothesis:	Obs	F-Statistic	Prob.
LM3 does not Granger Cause MCI	38	1.00896	**0.3756**
MCI does not Granger Cause LM3		3.67342	**0.0363**
Y_GAP does not Granger Cause MCI	38	0.01009	**0.99**
MCI does not Granger Cause Y_GAP		8.26385	**0.0012**
DLCPI does not Granger Cause MCI	38	1.84383	**0.1741**
MCI does not Granger Cause DLCPI		3.35347	**0.0472**

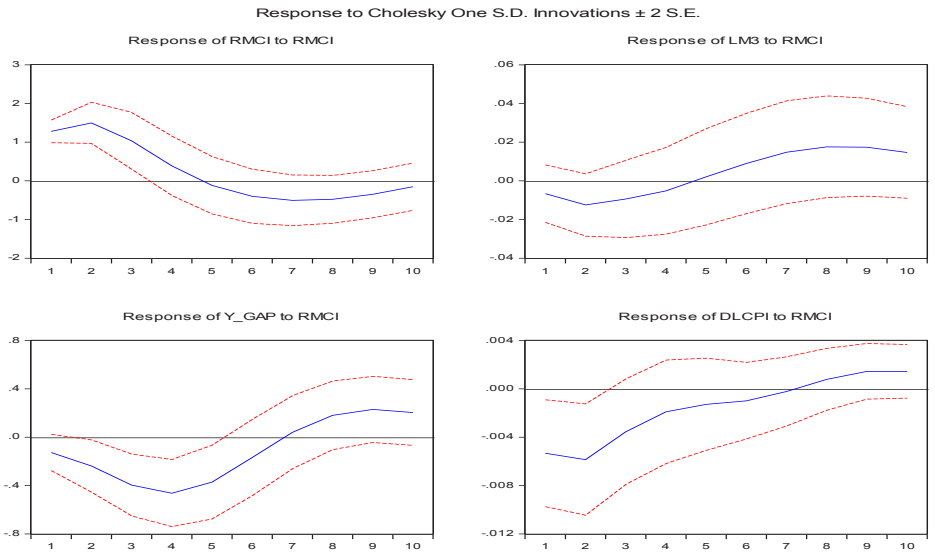
Source: *Authors' estimations*

Since broad money, output gap and CPI are important variables in BNR monetary policy framework, this result show that MCI can be a good indicator in monetary policy analysis.

Secondly, we used a small VAR model for monetary policy, consider the MCI as the policy instrument, and assess how an exogenous shock to MCI would affect

in broad money, output gap and CPI. On identification, we use Cholesky ordering as in Sims (1992). This involves shock identification via short run restrictions (Cholesky decomposition of innovation covariance matrix, with variable ordering based on exogeneity structure) and obtain impulse response functions. As indicated by granger causality tests, impulse response function support the idea that MCI would be a good indicator in monetary policy analysis.

In summary, the following impulse response functions show that a positive shock to MCI (which can be interpreted as contractionary stance), will negatively affect broad money, output gap and CPI inflation. This is well in line with the economic theory and despite the fact that the model estimated is the simplest one. Thus, this also would support the usefulness of MCI in monetary policy analysis.



V. CONCLUSION

In this study we calculated MCI in Rwanda using quarterly data covering the period 2010Q1-2017Q2. The estimated weights for exchange rate and interest rate were 0.61 and 0.39 respectively. These ratios proved the importance of real exchange rate and according to Knedlik (2005), the weight of exchange rate is sometimes larger than the weight of interest rate in smaller countries. Results from previous studies in African countries such as Uganda, Kenya and Nigeria have confirmed the importance of exchange rate contrary to results obtained in developed and larger economies such as US, UK and Japan.

Results from Granger causality and impulse response have proved the usefulness of MCI as an indicator for monetary policy stance analysis in Rwanda.

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Empirical analysis of Balance of Payments in Rwanda using the Monetary Approach

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Keywords: Balance of payments, monetary approach, Rwanda, Cointegration

JEL classification numbers: F32, E 52

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Abstract

The paper empirically assesses the validity of monetary approach to balance of payments (MABP) in Rwanda. Following the reserve flow equation, the empirical analysis builds on quarterly data spanning the period 2000Q1 – 2016Q4 and uses multivariate Johansen cointegration and parsimonious error correction mechanism to estimate the specified model.

The empirical results show that domestic credit, real gross domestic product, money supply and inflation are found to be statistically significant in explaining balance of payments measured by international reserves. However, the major finding reveals that monetary variables such as domestic credit and money supply are significant but negatively related to balance of payments position, this finding is broadly in line with monetary theory of balance of payments.

The study further reveals that in addition to monetary variables, some other factors such as economic growth proxied by RGDP as well as inflation rate cause disequilibrium in Rwanda's balance of payments position.

The policy implication arising from these findings is that despite the fact that balance of payments is self-adjusting, the central bank has a key role to play through formulation of monetary policy to equilibrate money market conditions. On the other hand, the government should also give attention to other policy adjustment mechanisms instead of relying solely on monetary policy tools to achieve stability in balance of payments position.

I. INTRODUCTION

One of the major macroeconomic goals of stabilization policy in any country is to maintain a healthy balance of payments position in order to safeguard the external value of national currency.

Organizations such as the International Monetary Fund (IMF) have been giving a great deal of attention to stable balance of payments situations (Fleermuys 2005) because maintaining a healthy and stable balance of payments and promoting trade, drives the overall economic growth. Therefore, the management and sustenance of balance of payments equilibrium is key for developing countries to pursue.

Rwanda like many other developing countries, has over time faced an overall balance of payments deficit which has given rise to many questions on how this external imbalance could be corrected. This is a cause for concern because, Rwanda like any other developing economy aims at maintaining a stable balance of payments position as one of the key objectives of sound macroeconomic policy. Several factors account for the persistent balance of payments deficit including poor export performance, huge service account deficits, external debt amortization, low inflow of foreign direct investment, excessive domestic monetary and credit expansion, large fiscal deficits, price distortions and a deterioration in the terms of trade (Ogiogio 1996;
Obioma 1998).

It is widely acknowledged in the mainstream macroeconomics that the balance of payments phenomenon is monetary in character. According to this theory, a sustained excessive credit creation will lead to a sustained loss of reserves of equal size. This suggests that the deficits or surpluses in this account can be corrected by changing the money stock in the economy (D Salvatore, 2008). Since

the external balance is thus claimed to be corrected or maintained by changes in the money stock in the economy, this process is termed as Monetary Approach to Balance of Payments (MABP). The stock of money supply is thus considered as the sole contributing element that brings about disturbance and adjustments in the nations' external balance or BOP account in the long run.

Although the monetary approach has been commended for explaining the balance of payments well, it has attracted criticism from other scholars as an approach that ignores other parts of international trade in determining the balance of payments. The MABP has been blamed for disregarding the fiscal and real factors that influence changes in the balance of payments, whilst concentrating only on monetary factors (Umer, *et al.,* 2010).
Others are of the view that it does not ignore other factors but mainly contend that balance of payment should be analyzed and observed from monetary theory. (Valinezhad, 1992).

Despite a big chunk of literature on the empirical analysis of balance of payments using monetary approach in different countries, no similar study has been conducted for the case of Rwanda. This underpins the need to assess the impact of monetary variables on external sector balance.

The main objective of this paper is therefore to examine the monetary approach to the balance of payments (MABP) in Rwanda, which argues that the balance of payments is a "monetary phenomenon" by looking at what factors that bring about balance of payments disequilibrium in Rwanda and find out whether monetary and credit variables are solely responsible for balance of payments deficit.

The rest of this paper is structured as follows: Section 1 entails the introduction, motivation of the study and objectives of the study. Section 2 includes an overview of Rwandan economy as relates to balance of payments developments, section 3 includes both theoretical and empirical literature as relates to the study, section 4 describes the methodology, and section 5 reports empirical results and section 6 presents discussion of results, conclusion and recommendations.

II. OVERVIEW OF RWANDA'S BALANCE OF PAYMENTS POSITION

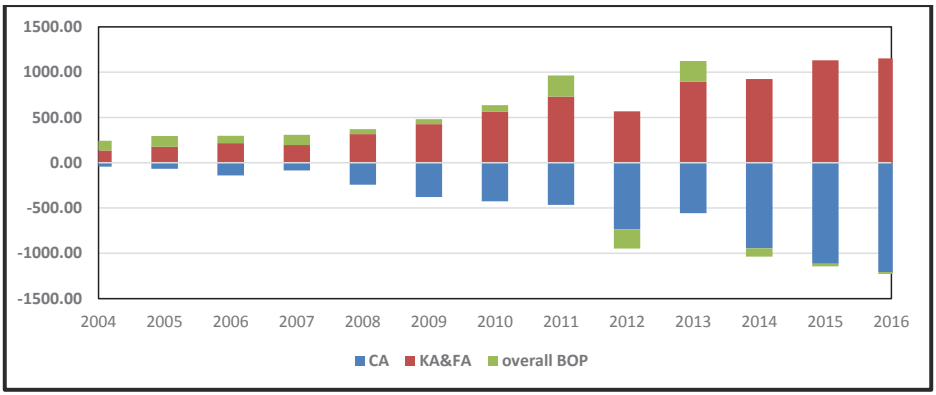
Rwanda is a small open economy which trades both goods and services, it is open to

Inflows and outf1ows of financial and fixed capital investment, with large dependence on imports of both investment and consumption goods. Primary commodities are the main source of foreign exchange for the country. This section therefore analyses balance of payments developments over the recent past.

Rwanda's balance of payments has been driven more by financial flows related to donor funds than trade in goods and services. Over the last decade, Rwanda has received substantial aid flows and as result, the overall balance was in a surplus, followed by a large deficit in 2012 (- USD 212.4 million) due to the decline in the financial account balance by 25.5 percent particularly due to aid shock. In the following year, 2013, the overall balance recorded a surplus (USD 228.5 million) which was specifically due to the increase in budgetary grants and a huge increase (463 percent) in long term public sector capital under financial transactions account, from USD 93 million in 2012 to USD 523 million in 2013. These increases reflect the resumption of donor funds in the first half of 2013 and the issuance of the USD 400 million Eurobond in 2013. In the period 2014

to 2016, the overall balance was in a deficit again even though capital and financial account balance continued to grow, this is because the current account deficit worsened due to the deteriorating trade balance and declining services net as well as net factor income. The figure below shows developments in the overall balance.

Figure 1: Developments in overall BOP (in USD Millions)



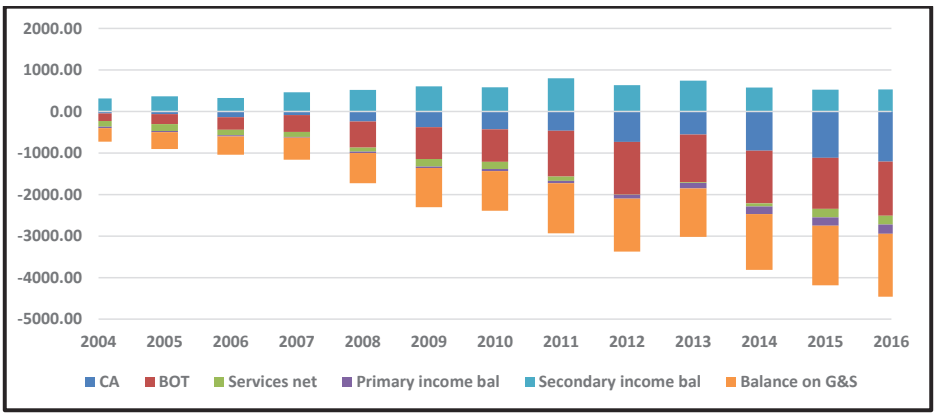
Source: BNR, Statistics Department

Rwanda's current account deficit averaged 13% of GDP in 2015, its highest level since mid-1990s. The major reasons for this poor performance are strong growth in imports while exports remain vulnerable to price fluctuations and lack of diversity as well as declining official transfers balance mainly due to the decline in budgetary grants and worker's remittances.

The decrease in imports and an increase in exports in 2016 were related to the recovery in mining sector on the export side and the decline in all import categories on the import side. Whilst modest performance in the mining sector have adversely impacted Rwandan exports, there have been commensurate price declines in the oil sector which have reduced the total import bill. However, trade

balance continued to deteriorate because of imports of big projects like RwandAir and Kigali Convention center in the most recent period. The figure below depict developments in current account and its major components.

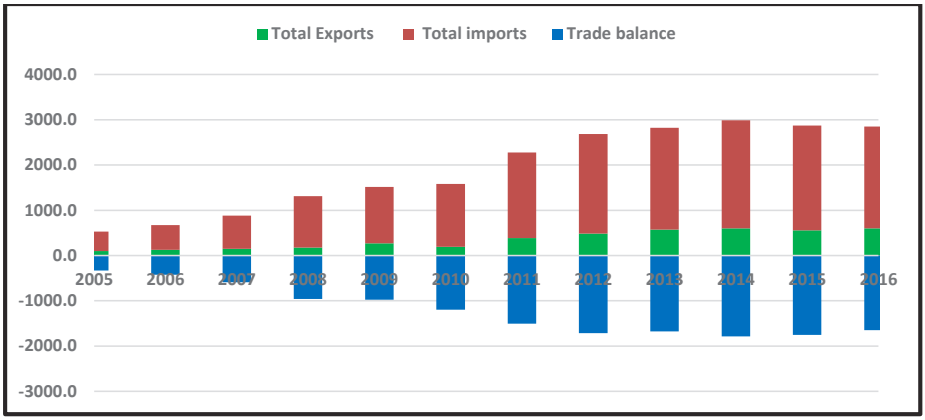
Figure 2: Developments in Current Account Balance (in USD Millions)



Source: BNR, Statistics Department

Over the period under review, Rwanda's trade balance has been deteriorating due to the fact that export growth has not kept up with the growth in imports. While exports have partly been affected by the fluctuations in international commodity prices, imports have continued to expand on the account of the increasing demand for foreign goods particularly investment and consumption goods. This implies that exports receipts have not been sufficient to finance imports leading to persistent trade deficit which has affected the overall balance of payments position. The increased demand for imports have led to reserve outflows resulting into high drawdowns on international reserves.

Figure 3: Developments in Trade Balance (USD million)



Source: BNR, Statistics Department

BNR foreign assets have been declining since 2012 with the declines in financial flows and export earnings coupled with rising demand for imports that has led to high demand for foreign exchange to finance imports, leading to the decline in reserve months of imports. On the other hand, commercial banks foreign assets have increased substantially in the recent past until 2015 when it started to decline due to decreasing exports while imports were increasing.

III. LITERATURE REVIEW

3.1 Theoretical Literature

Different schools of thoughts on monetary approach to balance of payments have emerged from time to time. When a country experiences disequilibrium in balance of payments, authorities often devise ways to correct it. Whether authorities can actually do something to remedy such a situation for example, through policy actions or whether there are self-adjusting mechanisms in place is often a point of debate. Throughout the years different adjustment mechanisms to such disequilibria in a country's balance of payments have been

identified (Du Plessis *et al.*, 1998). Three of these mechanisms are the monetary approach, the elasticities approach, and the absorption approach but the current research focuses on the monetary approach to balance of payments because while elasticities and absorption approaches concentrate on the current account of the balance of payments, the monetary approach to balance of payments focuses on the overall balance of payments including the capital and financial accounts.

The monetary approach was developed as the modern approach focusing on role of monetary variables on balance of payments adjustment. This approach contends that BOP disequilibrium represents an imbalance between the supply and demand for money. Excess supply of money encourages imports, which results in foreign exchange reserves flowing overseas , the continued outflow of international reserves reduces the money supply until the money market equilibrium is restored (Carbaugh ,2004).

Literature on the theoretical foundations of the MABP in a given country has been generated by scholars such as Dornbusch (1971), Frenkel (1971), Johnson (1972), Laffer (1969), and Mundell (1968, 1971). Mundell (1968) emphasized that monetary factors, not real factors, exert the most influence on the balance of payments through their effects on the current and capital accounts of a country. This approach contends that disequilibrium in a country's balance of payments shows an equivalent discrepancy between that economy's money demand and supply (Alawode, 1997).

The Monetary approach to balance of payment (MABP) which regards the balance of payments as a monetary phenomenon, expresses the relationship between a country's balance of payments and its money supply (Chacholiades 1990). MABP shows that the overall balance of payments measured by international reserves is influenced by imbalances prevailing in the money market.

According to Salvatore (1998) and Fleermuys (2005), the monetary approach to the balance of payments is a "monetary phenomenon". They further argued that the monetary approach focuses on how the demand and supply of money affect the balance of payments and the exchange rate. Their argument is based on the view that since the exchange rate is the price of currency, movement in this rate is basically a monetary phenomenon, and can be explained by concentrating on the market for money.

Lachman (1975), in a study on South Africa, found basic grounds for the MABP. He concluded that monetary authorities would definitely be able to predict the extent to which increases in money supply would augment imports.
Jimoh (2004) used both the Nigerian monthly and annual data between 1987 and 2001 to determine the relevance of the monetary approach to floating exchange rate regime implemented in Nigeria since 1987. Fitting some of the most commonly used models for testing the relevance of monetary approach to floating exchange rate analysis on Nigerian data, He found that those monetary models provided an adequate representation of the Nigerian data.

3.2. Alternative Approaches to Balance of Payments Adjustment

There are two alternative approaches to balance of payments adjustment mechanism: the elasticities approach, and the absorption approach.

3.2.1. Elasticities Approach

The elasticities approach focuses on how the responsiveness of exports and imports to changes in exchange rate determines the extent to which devaluation can improve trade balance. The elasticities approach applies the marshall-lerner condition which states that the sum of elasticities of demand for exports and imports must be greater than unity in absolute terms (Du Plessis et al 1998). It assumes that devaluation/depreciation lowers the price of a country's exports

abroad and raise the price of imports in the domestic market resulting into a shift to home produced goods. This shift is called expenditure switching. However, one might expect very little to happen to volumes of exports and imports initially demanded as consumers take some time to shift from consumption of imported goods to domestically produced goods.

Similarly, foreign consumers may also take time to adjust from domestic goods to foreign exports in this respect, the balance of payments may actually worsen soon after devaluation, before improving at a later stage, and this is known literature as J-curve effect.

For Rwanda which still faces unfavorable terms of trade coupled with limited scope for expenditure switching as a result of production constraints and high propensity to import[14], the elasticity approach becomes ineffective in correcting imbalances in Rwanda's balance of payments.

3.2.2. Absorption Approach

This approach is premised on the Keynesian school of thinking and was propounded by Alexandar (1952) to highlight the importance of income changes to the adjustment process (Du Plessis et al 1998). The approach states that if a country experiences a balance of payments deficit, it implies that people are absorbing more than they produce. In other words, domestic expenditure on consumption and investment is greater than national income. The absorption approach is based on the national income identity denoted by production or income (Y) is equal to consumption (C) plus domestic investment (I) plus autonomous government expenditure plus the trade balance (X-M), all in real in terms as an extension of the Keynesian Income/Output model.

[14] *See Nuwagira and Muvunyi (2016) , Exchange rate and external sector competitiveness in Rwanda*

That is; Y = C + I + G+ (X -M) ..... (1)

Assume total domestic absorption(C+I+G) is designated by A and the trade balance (X-M) is designated by B thus the equation becomes

Y = A + B ..... (1.2)

By subtracting A from both sides of (1.2), we obtain;

Y-A=B ..... (1.3)

This formulation implies that balance of payments on the current account is the difference between national income (Y) and total absorption (A). If total absorption exceeds income, then imports will exceed exports, resulting in a balance of payments deficit. If the opposite occurs, then the balance of payments will be in surplus.

In case of a deficit, balance of payments can be improved by either increasing income or reducing absorption and this is done through exchange rate devaluation given that it increases exports and reduces imports, thereby increasing the national income while reducing absorption.

Both the elasticities and absorption approaches have been criticized mainly for not taking into account the capital and the financial accounts of the balance of payments. Both these mechanisms concentrate only on the current account and, thus, ignore the particular impacts of capital movements on the overall balance of payments (Coppin, 1994)

3.3. Empirical Literature

Many studies on monetary approach to balance of payments (MABP have followed the reserve-flow equation in which, the explained variable is change in reserves whereas explanatory variables are different for different researches. They can include income, price level, the interest rate, government expenditure,

money multiplier, money stock, the exchange rate, and demand for nominal and real money balances (Umer, et al., 2010). This section therefore, reviews different contributions made in the empirical literature on the subject matter.

Ajayi (2015) examined the determinants of balance of payments in Nigeria between 1970-2010.The study employed the co-integration method to assess the long run impact of macroeconomic variables and found a significant negative relationship between monetary policy instruments and balance of payments. The study concluded that a larger exchange rate depreciation and a lesser monetary policy rate will raise the balance of payments of the Nigerian economy. Boateng and Ayentimi (2013) examined monetary approach to balance payment in Ghana using annual data set that covered 1980-2010. Using ordinary least squares estimation methodology, the empirical results showed that the balance of payments in Ghana is not entirely a monetary phenomenon although they found that monetary variables of domestic credit, inflation, interest rate have a significant impact on balance of payments proxied by net foreign assets.

Danjuma (2013) studied whether excess money supply played a significant role in the balance of payment disequilibrium in Nigeria during the period 1986-2010. Using Johansen Cointegration, Vector Error Correction Mechanism and the Impulse Response Function as well as Variance Decomposition, the results confirm that balance of payment in Nigeria is not purely monetary phenomenon.

Ali (2010) examined the monetary approach to the Pakistan's balance of payments for the period 1990–2008 employing the reserve flow equation and by using co-integration tests and error-correction modelling. He tested whether excess money supply played a significant role in influencing balance of payments disequilibrium and therefore concluded that monetary variables do not play a key role in determining Pakistan's balance of payments. The study also revealed that balance of payments is not a purely monetary phenomenon. This implies

that disequilibrium in the Balance of payments cannot be adjusted only through monetary policy actions.

In their study on the Monetary Approach to Balance of Payment in West African Monetary Zone , Adamu and Itsede (2010), using Fixed-effects OLS and Differenced GMM found that GDP had a positive effect on the change in net foreign assets implying that a country's income plays a significant role in its net foreign assets. The results also showed that the change in domestic credit has a significant negative relationship on net foreign assets. This implies that an increase in domestic credit worsens the balance of payment, this result is consistent with theory. Their conclusion for both within-country and cross-country effects suggest that the approach is indeed relevant.

In his study Fleermuys (2005) investigated monetary approach to Namibia's balance of payments for the period 1993–2003, the empirical results showed that monetary variables do not solely play a significant role in Namibian balance of payments. The results showed that, although some variables suggested by the monetary approach play significant roles on balance of payments and this implies that balance of payments disequilibrium can, therefore, not be corrected only through monetary actions by the authorities.

Dausa (2005) examined the Malaysian balance of payments with data covering the period 1974Q1 to 1995Q4, based on both the Keynesian and the monetary theories of balance of payments. Two tests were carried out based on the Polynomial Distributed Lag (PDL) model, namely the test of signs coefficients and the test of speed of adjustment (test whether the real account (TB) or monetary account (ORTB) has preeminence in international accounts). The two tests were applied both on the Malaysian Trade Balance (TB) and Official Reserve Transactions Balance (ORTB) accounts. The results show that signs of regressors of the Trade Balance (TB) equation support the Keynesian view while signs of

regressors of the Official Reserve Transactions Balance (ORTB) equation support both Keynesian and Monetary views. It is also found that the ORTB dominates the TB in terms of quickness of adjustment, so the ORTB is an autonomous account and the TB is an accommodating account.

Leon (1998) using reserve-flow and sterilization equations in both single and simultaneous equation models examined the validity of monetary approach to balance of payments in Jamaica and found strong evidence of MABP.

Dhliwayo (1996) tested the monetary approach to Zimbabwe's balance of payments during the period 1980 to 1991 using multivariate co-integration and error-correction modelling. The results suggest that money played a significant role in determining the balance of payments and concluded that balance of payments disequilibrium can be corrected through appropriate financial programming and monetary targeting.

A study by Jimoh (1990) also found strong evidence of the MABP in Nigeria. His suggestion was that "monetary authorities in Nigeria must pay adequate attention to domestic credit creation in any of their attempts to control balance of payments in Nigeria". Aghevli and Khan (1977) performed an empirical test on the MABP for 39 developing countries and found highly significant results, maintaining that the mechanisms underlying this approach held strongly for these countries.

3.3.1: Critical Review of the Literature/ The appraisal of literature

A big chunk of both theoretical and empirical literature reviewed on the subject have yielded mixed results. From the theoretical view point, the monetary approach is based on a simple idea that the balance of payments surplus or deficit is caused by the disequilibrium in the money market implying that the

balance of payments is a monetary phenomenon and as such this issue should be examined through the tools of monetary policy**.**

From the empirical literature, we observe that monetary approach to balance of payments was adopted as an alternative to elasticity approach and absorption approach given that monetary approach focuses on the entire balance of payments rather than trade balance.

In the context of Rwanda such a relationship is still unknown to the best of our knowledge save for the related study that was conducted in 2016 on exchange rate and external sector competitiveness in Rwanda in which we tested the validity of Marshall-Lerner condition which follows the elasticity approach.

Despite the fact that monetary approach to balance of payments have been admired for the implications it has on the balance of payments, it is often criticized for neglecting errors that transpire in the balance of payments as well as concentrating on changes in international reserves in determining a country's external position while disregarding fiscal and real factors that also impact balance of payments. In response to the criticism different authors such as (valinezhad, 1992) and (Lanciaux, 1990) point out that the item net errors and omissions is more of balancing item to fill the gap in the double entry book keeping system followed by the balance of payments and does not influence external adjustment measures. With regard to disregarding other factors particularly fiscal, they argue that since there is interaction between fiscal policy and credit creation, the government's budget constraint is not excluded therefore, balance of payments being a monetary phenomenon does not mean that the MABP claims all other factors are not important in this respect, the current study includes other factors.

From the methodological perspective, though literature is not unanimous to which econometric model is the best to estimate such relationship, the most recent studies have followed reserve flow equation using maximum likelihood to cointegration and error correction modelling as the estimation methods.

IV. METHODOLOGY

4.1. Theoretical Model

The theoretical foundations of monetary approach to balance of payments is based on a simple expository model comprised of the following 3 key equations-

M_s=R+D..... (2)
M_d=f(Y, P, I)..... ..... (3)
M_s=M_d..... (4)

Equation 2 which is the money supply identity defines the money stock in terms of assets backing it, such as domestic credit D and foreign exchange reserves R acquired through the balance of payments. Equation 3 expresses the demand for money M_d as a stable function of real income Y, inflation P and real interest rate I. Equation 4 is the monetary equilibrium condition according to which money supply M_s is equal to money demand M_d so that the market for cash balances clears. The equilibrium in this case is attained through flows of money through the balance of payments.

Substituting equation 2 and 3 into equation 4, we obtain

R=f(Y, P, I)-ΔD..... (5),

this implies that R must adjust to offset changes in real output, price level , the rate of interest and domestic credit, this is known as reserve flow equation which states that international reserve flows through the balance of payments adjustment to maintain equilibrium in the face of autonomous shift in the determinants of money supply and money demand. This forms the basis for the monetary approach to balance of payments.

4.2. Empirical Model

To test monetary approach to balance of payments in Rwanda, we followed the model used by Magee (1976) with some modifications in terms of choice of variables. The empirical analysis builds on quarterly data covering the period 2000Q1-2016Q4 and the estimation procedure used is Maximum likelihood method to cointegration and error correction models. The model is therefore specified as follows-

$$\ln NFA = \beta_0 + \beta_1 lnGDP_t + \beta_2 lnCPI_t + \beta_3 lnM3_t + \beta_4 lnOPEN_t + \beta_5 lnDOM\_CRDT_t + \mu_t \quad \ldots\ldots\ldots\ldots\ldots (6)$$

Where $\ln NFA$ is natural logarithm of net foreign assets, $lnGDP_t$ is natural logarithm of real gross domestic product, $lncpi_t$ is log of consumer price index , $lnM3_t$ is money supply, $lnopen_t$ is log of degree of economic openness, $lnDOM\_CRDT_t$ is natural logarithm of domestic credit and μ_t is the stochastic term.

4.3. Data sources and Construction of Variables

The data used to conduct this empirical analysis is essentially secondary data sourced from National Bank of Rwanda (BNR), Ministry of Finance and Economic planning (MINECOFIN) and National Institute of Statistics of Rwanda. The variables used are net foreign assets, gross domestic product, inflation rate, broad money, degree of openness and domestic credit.

Net foreign assets (NFA) equals the sum of international reserves by the monetary authority and commercial banks; domestic credit (DOM_CRDT) is the sum of net claims on government and claims on the private sector by the monetary sector; gross domestic product (GDP) is used for the level of domestic income; the consumer price index represents the domestic price (CPI); M3 is used for money supply; The degree of economic openness measures the extent of trade liberalization and is measured by the ratio of exports plus imports divided by the gross domestic product, (X+M/GDP). Prior to the estimation all variables are transformed into natural logarithm except for inflation rate.

4.3.1: Expected signs

The expected signs of the coefficients based on theoretical explanations are as follows-

- β_1**>0:** the expected sign is positive because an increase in real income increases demand for money generating excess demand for money which leads to reserve inflows
- β_2**<0:** the expected sign is negative because that an increase in price level reduces demand for real money balances, creating excess supply of money which leads to reserve outflows.
- β_3**<0**: the expected sign is negative due to the fact that excess money supply induces increased expenditure hence increased demand for foreign goods and services and this has to be financed by running down foreign reserves thereby worsening the balance of payments.
- β_4**>0:** the expected sign is positive because when countries are open, they are in a better position to exploit market opportunities through product diversification and differentiation.

- **β_5<0:** the domestic credit is expected to carry a negative sign because when monetary authorities expand domestic credit to meet demand for nominal balances, the public increases expenditure over income, thereby creating balance payments deficit resulting into foreign reserves decline.

V. EMPIRICAL RESULTS

5.1. Unit root test

The empirical analysis starts with assessing the stationarity of data series given that regression analysis based on time series data assumes that the underlying series are stationary. This indicates that the mean variances of the variables are time invariant. For the purposes of this study, conventional Dickey-Fuller class of unit root tests was used.

Table 1: Results of Unit root test

Variables	ADF statistic (Absolute values)	Critical values 1%	5%	10%	Order of integration
LNNFA	-7.50	-4.10	-3.48	-3.16	I(1)
LNDOM_CRDT	-5.42	-4.10	-3.47	-3.16	I(1)
LNM3	-3.30	-4.11	-3.48	-3.16	I(1)
LNOPEN	-5.08	-4.11	-3.48	-3.16	I(1)
LNRGDP	-7.02	-4.11	-3.48	-3.17	I(1)
LNCPI	-7.40	-4.10	-3.48	-3.16	I(1)

Source: Authors' estimation

The results from the above table indicate that all other variables become stationary after the first difference given that the absolute values of Augmented Dickey-Fuller test are greater than the critical values at all the thresholds.

5.2. Cointegration

Cointegration among variables reflect the presence of long-run relationship in the system, the basic idea being that individual economic time series variables wander considerably, but certain combinations do not move far apart from each other. Generally, if variables are integrated of order "n" and produce a linear combination which is integrated of order less than zero then the variables are said to be cointegrated and thus long-run relationship exist. In context of this study, we applied Johansen's cointegration technique to test for the existence of long run relationship between net foreign assets as a proxy for overall balance of payments position and explanatory variables specified in the model. The tables below indicate that both trace statistic and maximum eigenvalue indicate four and one cointegrating equations respectively.

Table 2A: Unrestricted Cointegration Rank Test (Trace)

Series: LNNFA LNM3 LNDOM_CRDT1 LNOPEN LNRGDP LNCPI				
Lags interval (in first differences): 1 to 2				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.522747	129.4268	117.7082	0.0074
At most 1	0.350514	84.30453	88.80380	0.1011
At most 2	0.309540	57.97852	63.87610	0.1418
At most 3	0.262393	35.38426	42.91525	0.2296
At most 4	0.162950	16.81923	25.87211	0.4286
At most 5	0.093218	5.969042	12.51798	0.4642

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 2B: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.522747	45.12228	44.49720	0.0427
At most 1	0.350514	26.32601	38.33101	0.5755
At most 2	0.309540	22.59427	32.11832	0.4481
At most 3	0.262393	18.56502	25.82321	0.3354
At most 4	0.162950	10.85019	19.38704	0.5288
At most 5	0.093218	5.969042	12.51798	0.4642
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Source: Authors' Estimation

From the above tables 2A and 2B, the maximum eigenvalue and the trace statistics are both greater than their critical values and their associated p-values are significant thus, the null hypothesis of no cointegration is rejected at 5% level of significance implying that there exists long run relationship between balance of payments measured by net foreign assets and its explanatory variables. The most desired outcome is a case of a single cointegration vector in this case, the cointegrating relationship identified by both trace and max-eigenvalue statistics is used to describe the long run relationship between net foreign assets as a proxy of overall balance of payments and its regressors.

5.3. Estimation Results

The cointegrating relationship identified by both trace and max-eigenvalue is used to establish the long run relationship between net foreign assets as a proxy for overall balance of payments and its explanatory variables. In the context of this study, the first cointegrating vector is thus used to describe the long run relationship between balance of payments proxied by net foreign assets and its explanatory variables. By normalizing with respect to international reserves, we obtain the long run model presented as follows-

Table 3: Normalized Coefficients of the long run model

LNNFA	LNM3	LNRGDP	LNOPEN	LNDOM_CRDT	LNCPI	C
1	1.53	-1.28	0.04	1.38	0.50	1.09
	(4.52)	(6.64)	(0.69)	(4.11)	(2.52)	(2.27)

Source: Authors' Estimation

Note: the numbers in parenthesis are T-statistics

In equation form, the normalized vector can be expressed as follows:

$$lnfa_t = 1.09 + 1.28 lnrgdp_t - 1.53 lnm3_t - 1.38 lndom\_crdt_t - 0.04 lnopen_t - 0.50 lncpi_t$$
$$(2.27) \quad (6.64) \quad (4.52) \quad (4.11) \quad (0.69) \quad (5.27)$$

From the above estimation results, except the degree of economic openness, all other variables specified in the model are correctly signed, statistically significant and emerge with plausible magnitudes.

The coefficient of RGDP is positive and statistically significant implying that growth in real income improves Rwanda's external position. This is because economic growth increases demand for money reducing excess supply of money and thus restricting expenditure and improving overall balance of payments.

The coefficient of M3 is negative and significant indicating that autonomous increase in money supply induces increased expenditure, hence increased demand for foreign goods and services which has to be financed by running down foreign reserves thereby worsening the balance of payments.

The coefficient of DOM-CRDT is negative and statistically significant implying that domestic credit has expanded over the recent past to meet demand for nominal balances as a result the public have increased expenditure over income thereby creating balance of payments deficit resulting from foreign reserves decline.

The coefficient of inflation is negative and statistically significant insinuating that an increase in inflation reduces demand for real money balances, creating excess supply of money which leads to reserve outflows.

5.4. Parsimonious error correction model

The short run balance of payments disequilibrium in Rwanda is best modelled by using a parsimonious error correction mechanism (ECM). The results in the table 4 below indicate that the RGDP and broad money carry the burden of adjustment of Rwanda's balance payments position given that all other variables appear statistically insignificant and this implies that the short run changes in other variables do not have significant effect on net foreign assets as a proxy for the overall balance of payments.

The estimated coefficient of error correction term is negative and significant (-0.35) which indicates that the deviation in balance of payments from the long run equilibrium is corrected gradually through a series of partial short run adjustments. The partial adjustment of short run disequilibrium is corrected for in the period closer to 3 quarters.

Table 4: Parsimonious error correction model

Dependent Variable: D(LNNFA)				
Method: Least Squares Sample (adjusted): 2 64 Included observations: 63 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNM3)	0.656	0.288	2.273	0.026
D(LNOPEN)	-0.056	0.116	-0.490	0.625
D(LNRGDP)	0.729	0.278	2.616	0.011
D(LNDOM_CRDT)	-0.735	0.510	-1.440	0.625
D(LNCPI)	-0.118	0.462	-0.256	0.798
ECT(-1)	-0.349	0.111	-0.314	0.0027
C	0.030	0.029	1.026	0.308

Source: Author's estimation

VI. CONCLUSION AND POLICY IMPLICATION

Over the recent past, there has been renewed debate on whether or not a country's balance of payments is a monetary phenomenon and hence the policy adjustment mechanism to be adopted. Consequently, the major aim of this study was to examine the validity of monetary approach to balance of payments in Rwanda. The specific objective of the study was to assess whether monetary variables such as domestic credit and money supply are solely responsible for balance of payments disequilibrium.

Using multivariate Johansen cointegration and the associated error correction mechanism to test for the validity of monetary approach to balance of payments in Rwanda, we found that an increase in domestic credit to the private sector and money supply leads to loss of international reserves. This implies that the reserve flow experience is broadly in line with monetary theory of balance of payments.

The policy implication arising from this finding is that monetary authorities should pay special attention to domestic credit creation as one of the adjustment policies to correct balance of payments disequilibrium. Another key policy implication is that although monetary variables emerged statistically significant, other variables such as economic growth have significant positive impact on net foreign assets implying that balance of payments is not purely a monetary phenomenon and as such the government should give equal attention to other policy adjustment mechanisms to attain stable external sector position.

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