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Foreword

In recognition of the importance of effective communication in pursuit for sustainable macroeconomic stability, the twice a year publication and dissemination of policy oriented research studies on the Rwandan economy remains a high priority on the agenda of the National Bank of Rwanda. Indeed, BNR believes that evidence-based findings contained in these papers helps to illuminate both economic actors and the general public on the structure, key features and some challenges of the Rwandan economy. In this tenth edition of the BNR economic review, four research papers are published.

Mindful of the impact that the banks' motive to hold excess liquidity can have on the effectiveness of monetary policy, the first paper examines the potential determinants of precautionary excess liquidity in the Rwandan banking system and its optimal level above or below which the excess liquidity becomes a constraint to monetary policy transmission. The paper also reveals that the reserve requirement, change in demand for cash, as well as the previous levels of the excess liquidity are important determinants of precautionary excess liquidity in the Rwandan banking system. The paper estimates the optimal level of excess liquidity to be around FRW 34 billion, out of which the excess reserves accounts for arround FRW 14.3 billion. As a result, the optimal levels obtained by this study are suggested to serve as a benchmark to guide BNR's interventions on the money market to influence liquidity conditions, save for being considered as target.

Cognizant of the possible impact of external shocks on effectiveness of monetary Policy, the second paper aims at investigating how the propagating effects of external shocks can often induce unpredictable variations in domestic macroeconomic variables. The findings of the paper reveal that such external shocks have indeed had destabilizing effects on the Rwandan economy. Also after

using the shutdown methodology, the study clearly shows that the response of monetary policy to some exogenous shocks that have hit the Rwandan economy over the recent period were effectively managed by the National Bank of Rwanda, with the help of other stakeholders. The study therefore recommends Policy coordination especially between fiscal and monetary policies in the endeavor to manage turbulent forces from the rest of the world.

In line with the BNR's commitment to adopt an inflation targeting framework by 2018, the third paper aims at assessing the extent to which BNR has fulfilled the necessary preconditions for the adoption of an inflation targeting framework. The findings of this study indicate that BNR fulfils many of the analysed preconditions, notably it has: (1) price stability as the primary objective; (2) a well-developed information inclusive forecasting and policy analysis systems; (3) independence to choose monetary policy instruments and; (4) a fairly developed communication strategy; (5) no symptoms of fiscal dominance over the conduct of monetary policy. However, BNR should continue its advisory role with a focus on sustainable solutions to the external sector deficit, which is reported to be the main challenge to the inflation targeting framework. Moreover, BNR has to be mindful that although not classified among major preconditions to IT, international experience has shown that well developed financial markets as well as a sound and stable financial system are also imperative for a successful inflation targeting regime.

Lastly considering the importance of knowing the possible determinants of non-monetary Poverty in poverty reduction, the fourth paper puts forth the determinants of non-monetary poverty in Rwanda. After essential estimations of the Rwandan data, the paper finds that age, gender, education level of the head of household, and other household characteristics like roofing quality, number of children among others are important explanatory variables that help to explain the deprivation status of a particular household as well as its intensity.

It is essential to acknowledge valuable contributions for the successful

accomplishment of this tenth edition of the BNR economic review. With this note, I would like to express my sincere appreciation not only to our team of researchers who have been tirelessly contributing to this publication but also to those who paid their time to improve the quality of the papers here published.

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RWANGOMBWA John

Governor

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Excess liquidity and monetary policy in Rwanda

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ABSTRACT

Excess liquidity has been an important feature of banking system in most developing economies. This paper has sought to examine the potential determinants of precautionary excess liquidity in Rwandan banking system during the period 2004 – 2016 and its optimal level above or below which the excess liquidity becomes a constraint to monetary policy transmission. In so doing, the study used FMOLS autoregression approach to estimate the determinants of precautionary excess reserves. For ease of interpretation of coefficients, the sum of coefficients was also estimated using the dynamic Least Squares (DOLS) method with the lag operator set to one. For optimal excess liquidity level, Kernel Density estimation was used to estimate the probability density of the estimated precautionary excess liquidity. To avoid sample dependence of the optimal level obtained, bootstrap method was also used to obtain confidence interval of the values computed.

The results obtained from the regressions suggest that the reserve requirement, change in demand for cash proxied by the output gap, as well as the lagged value of excess liquidity are important determinants of precautionary excess liquidity in Rwandan banking system. Using the summation of coefficients, the lagged values of cash to deposit ratio, discount rate, as well as the foreign exchange exposure are also found with significant positive relationship. Secondly, considering the first and second conditions of liquidity minimization, the optimal level of excess liquidity is found at around FRW 34 billion out of which the excess reserves are found to be around FRW 14.3 billion. The estimations were conducted based on assumption that the existing reserve requirement is optimum. As a result, the optimal level obtained by this study can serve as a benchmark to guide the BNR's interventions on money market to influence liquidity conditions, save for being considered as target.

Keywords: *Excess liquidity, monetary policy, Rwanda*

JEL classification: *E51, E52, O55*

1. INTRODUCTION

One of the main missions of the National Bank of Rwanda (BNR) is to ensure and maintain price stability. Excepting in the second half of 2008 where banking system in Rwanda experienced a liquidity crunch over the period 2004 and 2016, the Rwandan banking system has experienced a significant excess liquidity as result of the several combined factors. These include prudent macroeconomic policies which contributed to economic stability, high real growth, improvements in the business climate as well as the foreign aid for budget support and foreign direct investment which allowed a build-up of international reserves to comfortable levels.

This persistent excess liquidity over the long period is said to have implications on the effectiveness of monetary policy. However, not all excess liquidity held by banks above the minimum level of the required reserves are excessive and harmful to the effectiveness of monetary policy such as that held for precautionary motives. Instead, for the liquidity beyond the level deemed necessary could only make banks reluctant to transact with the central bank as to meet liquidity requirements. In another sense, the central bank's ability to influence interest rate and credit growth in the market is weakened and can reach the level where the transmission mechanism can break down.

Consequently, the central bank is required to create the basis under which the bank lending channel is reactive to changes in monetary policy as to facilitate the effectiveness of its transmission channel. In other words, the monetary authorities at all means must be able to influence the supply of credit by changing the amount of available liquidity in the banking system. However, there is an expectation that monetary policy can still be effective in situation when banks hold excess liquidity mostly for precautionary purpose. But, the conditions seem challenging to monetary authorities in absence of the measure of banks' optimal level of excess liquidity necessary to hold for transaction and precautionary motives as well as understanding of drivers of the excess liquidity. In overall, though some studies have been undertaken in the same field as in this study for the case of Rwanda, neither has thoroughly attempted to shade light on the above challenges.

Thus, the aim of this paper is to examine the potential determinants of precautionary excess liquidity in Rwandan banking system during the period 2004 - 2016 and its optimal level above (below) which the excess liquidity becomes a constraint to transmission of monetary policy. In so doing, the findings obtained by this study can help the BNR to improve its liquidity management by supplying more efficiently the funds to commercial banks for effectiveness of monetary policy.

The rest of the paper is organized as follows: section 2 explores some stylised facts about the banking excess liquidity in the literature. In section 3 presents past and recent trends, composition and motivation of hoarding excess liquidity in the Rwandan banking system. Section 4 outlines the econometric methodologies used to estimate the determinants of excess liquidity for precautionary motive as well as its optimal level in Rwandan banking system. Before using the study's main findings and policy implications in section 6, section 5 encompases the interpretation of the empirical results.

2. LITERATURE REVIEW

The subject of banks' demand for hoarding excess liquidity has been an issue which attracted a stream of studies in the economic history. Such include studies by Caprio and Honohan (1993), Arestis and Demetriades (1999), Freedman and Click (2006), Saxegaard (2006), Gentil and Fatima (2012) to mention. These studies contend that the persistence of excess liquidity has been critical issue and has acted to displace the increase in financing of private sector credit. World Bank (2007) as well as Nketcha and Lucie (2014) add in the same suggestion for African countries.

Honohan and Beck (2007), explain that the build-up of excess reserves is mostly associated to credit market deficiencies such as poor quality information related to individual borrowers' risks, weak legal, judicial and contract enforcement. In fact, other scholars including Stigliz and Weiss (1981) and Jaffee and Stigliz (1990) used credit rationing model to propose the possible ways to address the issue of credit market deficiencies to improve the level of financial intermediation. Moreover, Arestis and Demetriades (1999) demonstrate that under perfect loan market, excess liquidity and bank loans become substitute at zero loan rate. The reason

that they substitute at higher loan rates especially in developing economies is an indication of low competitively in the banking system.

This built-up of excess liquidity precisely in low developing countries has attracted several studies such as Fielding and Shortland (2002) for Egypt, Aikaeli (2006) for the case of Tanzania, Khemraj (2006) for Guiana, Saxegaard (2006) for CEMAC, Nigeria and Uganda, Moumni and Nahhal (2014) for Morocco, Gichondo and Nizeyimana (2010) for Rwanda as well as Karen (2011) for Jamaica. In addition, Agénor et al. (2004), and Agénor and Aynouti (2009) distinguished the banks' motives for hoarding excess liquidity. Indeed precautionary and involuntary motives have been distinguished following the degree of excess reserves hoarded by banks. The precautionary excess reserves are defined as those balances above the minimum requirement which banks need to meet withdraws of deposits and other tentative payments. Whereas involuntary excess liquidity are referred as those balances which are in excess of the precautionary needs.

In contribution by Gentil and Fatima (2012), the persistence of excess liquidity for both precautionary and involuntary purposes is due to inadequate development of financial markets, high level of risk aversion as well as high capital inflows. In such an economic environment, the accumulation of excess reserves raise the distress on banks' profitability, inflationary pressures, as well as on transmission mechanism of monetary policy and its effectiveness.

Concerning the demand for precautionary excess liquidity as our area of interest, several scholars curiously attempted to identify the reasons to why banks prefer to hoard the excess of unremunerated reserves. Frost (1971), Santomero (1984), Allen (1998), Dow Jr (2001). Keister and McAndrews (2009) stipulate that the cause for precautionary excess reserves is determined by central bank decisions instead of lending rates of the banks. Supported by Nautz (1998) that the banks' demand for hoarding excess reserves depends on access to central bank credit and expected future refinancing conditions. In this context, if the access to the central bank funds is restricted with expected future refinancing conditions to become more expensive, the banks resort to increase their demand for liquid assets large enough to curb anticipated liquidity shocks.

Consistent with the modern theory of financial intermediation as confronted by Bryant (1980); Diamond and Rajan (2001); and Tirole (2011); among others, Nketcha and Lucie (2014) advocate that the banks are prompted to large amounts

of liquid reserves as a strategy used to guard against high exposures to liquidity risk. The theory suggests that the share of deposits channeled to credit is influenced by risks associated to the liquidity services of depositors. In fact, Nketcha and Lucie used an indicator developed based on distribution of deposit inflows to capture the bank's exposure to liquidity risk. The relevance of the theory has also been acknowledged by EIB (2013) for Sub-Saharan African context that the excess liquidity in banking system is a result of the scarcity of credit-worthy among borrowers. In such conditions, monetary policy as a tool for influencing lending activities become relatively ineffective.

The same literature classifies several determinants of involuntary excess liquidity into structural and cyclical factors. Regarding structural determinants, Saxegaard (2006) and Agénor and Aynouti (2009) assert that the banks strong demand for involuntary balances as a consequence of low developed interbank market, high operational costs, underdeveloped public bonds market and non-existing remunerative alternatives for excess balances. Mishkin (2001) state that banks decide to accumulate excess reserves for reasons related to safety measures against the operational costs. He notes that the higher the costs related to deposit outflows, the more excess reserves are held.

Moreover, high risk aversion has been also identified to make banks charge high risk premiums which results to lower demand for private sector credit. Numerous authors associate risk aversion with macroeconomic instability. Saxegaard adds on that asymmetric information and poor competition in the banking sector contribute to weak offer of credits by banks. This in turn leads to accumulation of banks reserves.

Other determinants of excess liquidity result due to cyclical factors including huge capital inflows, increasing inflation as well as uncertain economic environment. Agénor and Aynouti explain that rising inflation leads to uncertainty in volatility of relative price levels which prompts banks to charge high interests on loans following the intensification of risk in investment projects. They continue stipulating that high interests on project loans block the demand for credit which in turn raises the excess liquidity.

In the same context, the liberalisation of capital flows to non-residents and increase in foreign aid inflows attracts huge capital inflows to large in form of foreign direct investments (FDIs). Removing non-conforming measures to

foreigners coupled with the privatization of public parastatals results to expansion of foreign capital inflows intermediated by banks.

During economic crisis banks are prompted to hoard excess liquidity than lending seen as a riskier activity due to high level of uncertainties in the economic environment. The evidences are provided by Agénor *et al.* (2004) for Thailand during East Asia financial crisis that reduction in bank lending was a reflection of a supply phenomenon. Ashcraft *et al.* (2009) for USA between 2007 and 2008 financial crisis. During these periods, banks accumulated excess reserves while lowered their lending activities as a buffer to mitigate the risk of liquidity shortage. Dollar and Hallward-Driemeier (2000) the build-up of excess liquidity in East-Asian countries during the crisis was a result of the reduction in the demand for credit, which itself was a result of the contraction in aggregate demand that accompanied the crisis.

Empirically, some of the aforementioned studies have used models including GMM estimator, TSLS, ARDL and VAR to estimate the consequences of excess liquidity on effectiveness of monetary policy. To mention Saxegaard (2006) used the nonlinear structural VAR model to investigate the consequence of the banks in holding excess liquidity on effectiveness of monetary policy in CEMAC region, Nigeria and Uganda. Extending the model by Agénor et al. (2004), the Saxegaard incorporated the component of explanatory variables for involuntary excess reserves which had not been used in the prior study. His findings suggest that the excess liquidity limit the effectiveness of monetary policy transmission causing the monetary authorities to lose the ability to influence the demand conditions in the economy.

Using the same model for Morocco, Moumni and Nahhal (2014) obtain the same findings. Their uniqueness for Morocco was that the effect is manifested in the long run. In addition, Gichondo and Nizeyimana (2010) for the period 2004-2008, found that the push of banks to money market on which they are net lenders resulted from plentiful supply of deposits, coupled with limited ability to expand their loanable funds and underdeveloped financial markets. These as a result limit the ability of monetary policy to influence short term interest rates on deposits and lending rates.

Using the same vector models, Gouteron and Szpiro (2005) in their study on excess monetary liquidity and asset prices, found liquidity developments not explaining

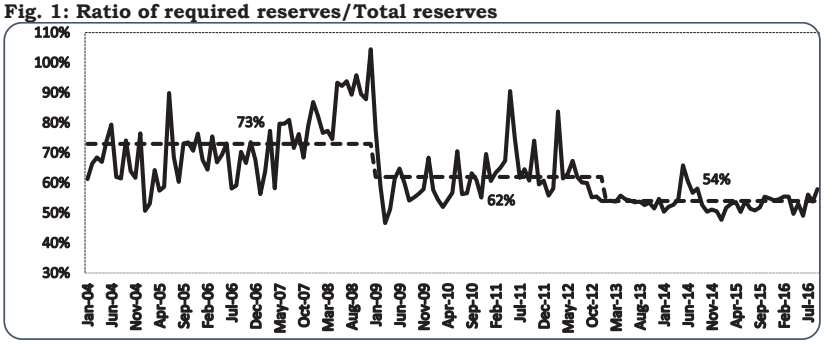
the variations in asset prices. Thus complicates the role of the monetary authorities, as cannot predict the changes in asset prices which in turn may affect the transmission of monetary policy.

In another paper Khemraj (2006), proposed two different hypotheses that work simultaneously to explain why non-regulated commercial banks in Guyana demand large quantities of excess liquidity. One is on banks' desire of a minimum rate of interest in the loan market and the government security market before respectively investing in private sector loans or government securities. While the second is on banks' intention not to invest all excess reserves in a safe foreign asset because the central bank creates a foreign currency constraint by accumulating foreign exchange reserves. He notes that given the openness of the Guyanese economy as well as the abandonment of foreign exchange control, bank managers are subject to suitable adjustments for exchange rate risks of the prevailing interest rate on foreign assets.

3. RWANDAN BANKING SYSTEM LIQUIDITY: TRENDS, COMPOSITION AND MOTIVATION

During the period 2004 to September 2016, the Rwandan banking sector has been characterized by high excess reserves above the statutory reserve requirement from 17 percent between 2004 and 2008 to 38 percent in 2009-2012 and 46 percent in 2013-2016. The drivers were mainly large capital inflows including foreign aid and foreign Direct Investments (FDIs), government outlays, and inadequate development of financial markets among others.

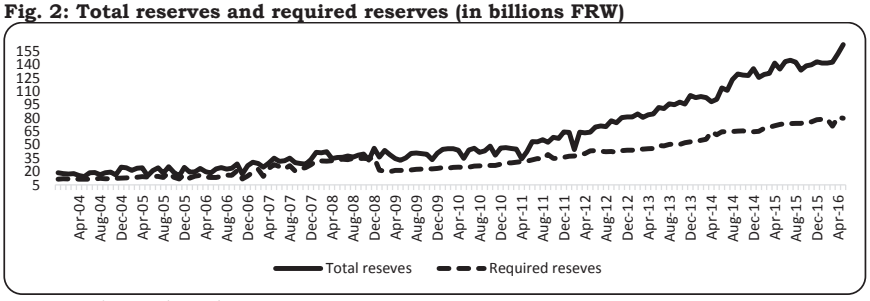
Fig. 1: Ratio of required reserves/Total reserves



Sourece: Financal Markets Department

Since 2004, Rwanda has been enjoying increased foreign exchange inflows, related mainly to aid inflows. In fact, total disbursements for both budget and project supports increased by 131.9 percent between 2004 and 2015 standing at USD 518.5 million in 2015 against 223.6 million in 2004. This is also evidenced by a high share of Net Foreign Assets in broad money which averaged around 72.1 percent during the same period under review. Indeed, increasing remittances, foreign direct investments, debt relief under Highly Indebted Poor Countires (HIPC) Intiatives (in 2005) as well as the country's privatization programme of the state-owned interprises contributed to money creation through domestic government and households' expenditures, and played a major role in building up high banking liquidity.

Fig. 2: Total reserves and required reserves (in billions FRW)



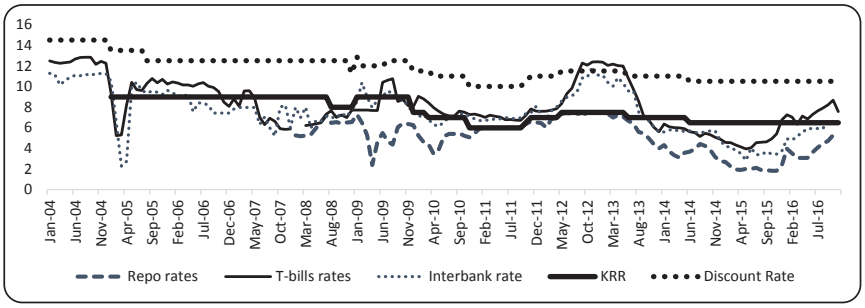
Source: Financal Markets Department

The composition of deposits mobilized by commercial banks is dominated by demand deposits which account for an average of arround 40 percent of the total deposits while the provision for loans needs ressources for medium or long term muturity. This mismatch in maturity of deposits and loans funds pushed banks to

hold more precautionary cash deposits to withstand any unexpected withdrawal by thier clients which also deems to have contributed to the build-up of excess liquidity.

Moreover, there was also accommodative policy measures undertaken since 2000 including the reduction of the reserves requirement ratio, revision of reserve requirement maintenance period, introduction of different financing facilities notably the long term government facility of five years and downward revision of BNR policy rate, coupled with the accumulation of liquidity in the banking system. All these policy measures exacerbated the building-up of the excess liquidity which led to low money market interest rates and several times disconnected to the central bank rate. However, during some periods, the money market interest rates showed an upswing trend resulting from different economic shocks especially the liquidity crunch in 2008 coupled with global financial crisis and aid suspension and delays. These uncertainities drove the government to rely on domestic borrowing creating the stock of T-bills to almost triple standing at FRW 171.6 billion in 2013 from FRW 62.5 billion in 2012.

Fig. 4: Interest rates developments



Source: Financial Markets Department

Given these differing structural breaks during the period under review, the high level of banking liquidity can be better analyzed by clustering those structural breaks into three sub-periods, notably: from 2004 - 2008, 2009 – 2012, and 2013 – 2016.

3.1. Period between 2004 and 2008

Since late 1990s, BNR started using open market operations: weekly tender for liquidity injection or mop up, and issuance of Treasury bills. However, the management of the liquidity in banking system became more challenging over time, particularly after the 2003 presidential elections when business confidence and aid inflows increased significantly. This was further intensfied by a US$ 1.4 billion debt relief in 2005 under HIPC initiative. In the same period, BNR was undertaking accommodative policy right from 2000 whereby the reserve requirement was lowered to 8 percent from 10 percent, while the reserve requirement maintenance period was revised from one week to one month since 2001.

Owing to sound economic policies, reduced debt burden together with sizable donor support, the Rwandan economy was recording good economic performance with real GDP rates ranging between 7.4 percent in 2004 to 11.2 percent in 2008. The external position strengthened as foreign capital inflows offset the trade deficit allowing a build-up of international reserves to comfortable levels. Hence, improved the level of liquidity in the banking system following the monetization of these inflows. The main recent macroeconomic developments are illustrated as follows:

Table 1: Recent economic developments

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Real GDP Growth (in percent)	7.4	9.4	9.2	7.6	11.2	6.2	7.3	7.8	8.8	4.7	7.0	6.9
Exports (YoY, percent change)	55.4	27.6	14.0	24.1	51.5	-28.0	32.0	52.4	24.5	18.7	4.7	-6.8
Imports (YoY, percent change)	19.4	29.9	35.2	35.8	54.0	9.9	11.4	36.1	16.3	2.2	6.6	-3.2
Export cover	31.7	31.1	26.3	24.0	23.6	15.5	18.3	20.5	22.0	25.5	25.1	24.2
Months of imports	7.6	6.8	7.0	5.1	6.3	7.2	7.0	6.7	4.8	4.5	4.4	4.6
Total Grants (YoY, percent change)	68.9	27.8	2.8	22.6	35.0	24.2	14.4	11.5	-22.0	32.9	-8.1	-11.2
Budgetary grants (YoY, percent change)	77.6	20.2	-34.0	82.1	39.3	25.8	18.1	9.1	-49.8	52.2	-34.6	2.7
Capital grants (YoY, percent change)	50.3	47.1	78.9	-22.8	27.2	20.9	6.8	16.9	36.9	18.0	18.3	-21.8
Public debt (y-o-y % change)	15.0	-10.3	-56.9	20.4	4.5	12.7	10.2	21.1	9.8	33.2	16.0	16.8
Public debt (% of GDP)	92.7	67.3	24.1	23.9	19.6	20.0	20.5	22.1	21.5	27.5	30.4	34.5
Inflation	10.2	5.6	12.1	6.6	22.3	5.7	0.2	8.3	3.9	3.6	2.1	4.5

Source: Monetary Policy Directorate

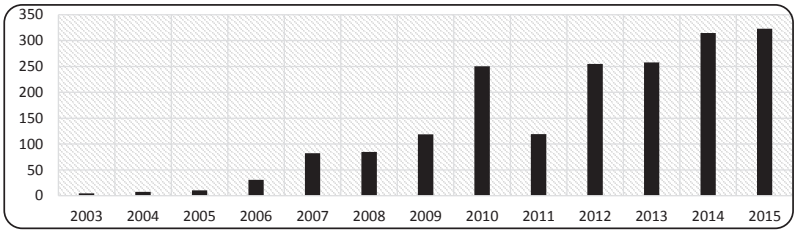
3.2. Period between 2009 and 2012

Despite the developments observed above, in late 2008 as priorly mentioned, number of factors plunged the banking system into a liquidity crunch which lasted for a few months. Deposits in the banking sector declined from FRW 400.5 billion in November 2008 to FRW 358.9 billion in February 2009 beyond which the deposit levels began to rejuvinate. All these contributed to short-term liquidity problem whereby some banks under stress accessed the BNR's lender-of last resort facilities. Consequently, the liquidity crisis and the fast deteriorating external environment emanated from global financial crisis during the period significantly impacted the real economy. As result, the real GDP growth decelerated from 11.2 percent in 2008 to 6.2 percent in 2009.

Following the shock, different policies were implemented including the reduction of the reserve requirement from 8 percent to 5 percent in February 2009, introduction of 3 to 12 months BNR liquidity faciility, while all T-bills were not rolled over at thier maturities. Similarly, FRW 22.4 billion long term government facility of five years was given to seven banks to increase their capacities to deliver long-term loans. As result, the liquidity situation began improving so that total deposits of commercial banks increased from FRW 366.6 billion end March 2009 to FRW 783.1 billion end December 2012.

Apart from the effect of both monetary and fiscal policies which rebuilt up the banking system liquidity, Rwanda recieved a lot of foreign direct investments which also contributed to accumulation of the banking liquidity during the subperiod under review.

Fig. 5: Evolution of Foreign Direct Investments (in millions of USD)



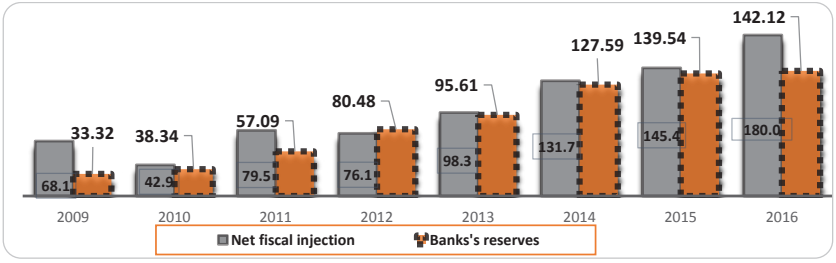
Source: Statistics Department

3.3. Period between 2013 and 2016

During the second half of 2012, the suspension and delays of budget support caused total grants to contract by 22 percent from an increase of 11.5 percent in the previous year of which budgetary grants plunged by 50 percent from 9 percent growth.

The Rwanda fiscal authorities responded to the aid shock by tightening policies and drawing their reserves to mitigate the impact on the economy. In this course, the government spending decisions were re-phrased and reduced through suplementary budget which was approved by the parliament in February 2013. However, it was observed that fiscal operations (government expenditures) continued to contribute to the creation of more liquidity in the banking system during the sub-period under review. The below figure 6 depicts how the net fiscal injection has been increasing over time.

Fig. 6: Net fiscal injections (in billions of FRW)



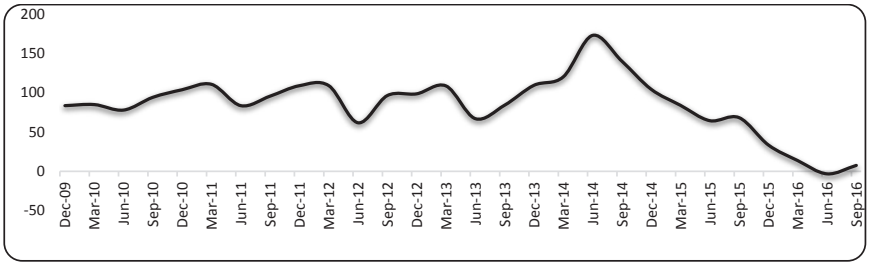
Source: Statistics and Currency and Banking Operations Departments

At the same time, BNR undertook the same policy stance (tightening) by slowing reserve money growth and conceding real interest rates to rise. Meanwhile, the use of reserves to mitigate growing pressures in the foreign exchange market contributed to a reduction of the reserve cover to 3.4 months of potential imports by end 2012.

Despite the measures undertaken, foreign exchange market continued to deteriorate allowing a continued demand for foreign exchange currency by commercial banks to respond to thier clients' demand especially for importation purposes. In fact, the ongoing faltering of the global economy with a steep fall in commodity prices continued to exacerbate trade deficit resulting to the progressive decline in forex inflows. This in turn intensified pressures on domestic foreign

exchange market. In same vein, net foreign assets of commercial banks fell by 92% between December 2012 and September 2016.

Fig.7: Trends on Commercial banks' net foreign assets (in Billion FRW)



Source: BNR, Statistics Department

In this context, banks were prompted to hoard excess liquid assets large enough for safety measures against foreign exchange risks during intervention by the Central Bank.

In breif, the excess liquidity in banking system has been peristent and above the statutory reserve requirement. The key drivers are consistent with those stipulated in the literature. These include large capital inflows, large government spending manifested by persistent increasing net injection, huge aid inflows, accomodative measures undertaken by BNR, as well as reduction in commercial banks foreign exchange reserves.

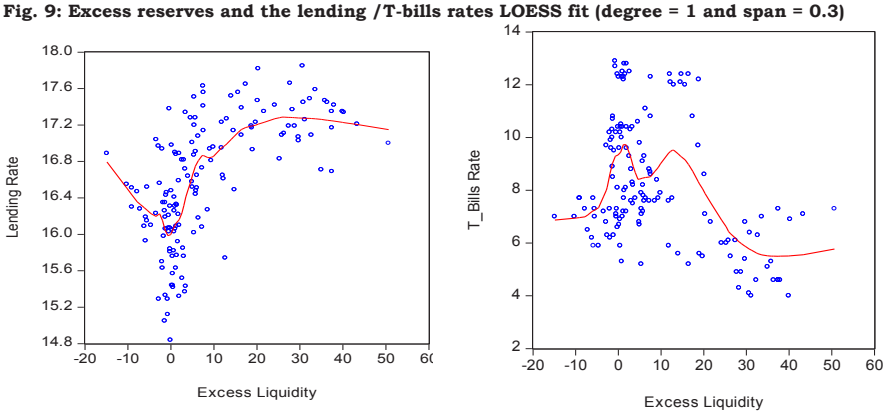
3.4. Banks' motives for holding excess reserves

In view of the above trends in the Rwandan banking liquidity, there is an outstanding puzzle why banks choose to hold non-renumerated reserves than make loans to private sector or invest in securities. As pointed out by Khemraj (2006), banks desire a minimum rate to compensate for the marginal cost of transacting and risks that are peculiar to the loan market and goverment securities before they make loans to private sector or buying Treasury bills. The respective minimum rate in both markets causes banks to passively hold non-renumerated excess reserves.

As observed, using locally weighted polynomial regressions (LOESS) of degree one of the monthly data ranging from 2004 to 2016, the liquidity preference against

lending rate and Treasury bill rate becomes flat at approximetly 17.2% for lending rate and 5.6% for T-bills.

Fig. 9: Excess reserves and the lending /T-bills rates LOESS fit (degree = 1 and span = 0.3)



Source: BNR, Monetary Policy Directorate and authors computation

The charts above, show that the excess reserves and lending rate as well as T-bills become substitutes at a high rate of interest. High level of interest rate on loan market is an indication of lack of competition in banking sector as in competitive and pure concurrence loan markets excess liquidity and loans are subsititutes at zero loan rate. Simular results were found by Gichondo and Nizeyimana (2010) which allow us suggest the possibility that the Rwandan banking sector is still oligopolistic.

In T-bills market, the subsititute is at arround 5.6%, the minimum rate which banks demand before they bid for T-bills, on average. This means that there is no liquidity trap in which securities fall to zero and as a result money and goverment securities become perfect substitutes (see Khemraj, 2006). Fry(1997) notes that the development of Tresary bills market can have several advantages such as providing a reference rate in form of market yields determined on Treasury bills. However, he notes that, if the government security rate is not competitive, then by extension, the other rates will also be determined by oligopolistic forces thereby open market operations will exert limited influence on interest rates.

4. METHODOLOGY

This study adopts the use of two econometric models to estimate the determinants of precautionary excess liquidity and its optimal level above (below) which the banks' reserves for precautionary purpose become exessive (deficiency). Therefore, the results from the two models would help to hypothesize the possible policy implications on effectiveness of monetary policy.

4.1. Determinants of precationary demand for Excess Liquidity

The estimation of demand for precuationary excess reserves is undertaken by regressing excess liquidity on its hypothesised determinants. This empirical part builds on the works reviewed herein particulary done by Agénor et al. (2004) in an extension of the simple model of reserve management as proposed by Baltensperger (1980). Their conceptual framework suggested here is based on the notion of a single representative bank whose deposits D are given exogenously. Consequently, the bank has to decide upon the level of noninterest-bearing reserve assets, R, and non-reserve assets which takes the form illiquid loans, L that are consistent to sustain its profitability. The bank balance sheet is therefore given by:

$$R + L = D \quad (1)$$

Where Reserves, R, are prerequisite as the bank is exposed to liquidity risk and deposit flows, u, occur randomly[1].

When net cash outflows surpass the reserves, the bank is exposed to illiquidity costs which are proportional to the reserve deficiency *max(0,u-R)*. In such circumstance, the bank is obliged to borrow the missing reserves at a penality rate q. In this case, the bank's profit is given by:

$$\Pi = r_L L - r_D D - q\max(0, u - R) \quad (2)$$

Where rL is the interest rate on loans and rD the deposit rate.

Therefore, the bank's expected profit is:

$$E(\Pi) = r_L L - r_D D - q\int_R^{U_H} (u - R)\phi(u)du \quad (2')$$

[1] U is a random variable which and its probability $Pu \in [u_L, u_H] = \int_{U_L}^{U_H} u\phi(u)du$

Using equation (1) to eliminate L, equation (2') becomes:

$$E(\Pi) = (r_L - r_D)D - r_L R - q\int_R^{U_H} (u - R)\phi(u)du \quad (3)$$

So, the optimal level of reserves is determined by maximizing the expected profits, $E(\Pi)$, and the necessary condition is given by:

$$\frac{\partial E(\Pi)}{\partial R} = 0 \Leftrightarrow -r_L + q[1 - \Phi(R)] = 0 \quad (4)$$

$$R^* = \Phi^{-1}\left(\frac{q - r_L}{q}\right) \quad (5)$$

The above equation points out that the marginal opportunity cost, r_L, of holding an extra unit of reserves is associated to the marginal reduction in liquidity costs. Hence, the optimal reserves is negatively related to the lending rate r_L but positively related to the penalty rate q.

By considering that the demand for loans L is negatively related to the lending rate r_L and positively related to the expected output Y^e while the supply of deposits D by the public is considered positively related to the deposit rate r_D as well as to the expected output Y^e, equation (2) can be rewritten as:

$$\Pi = [r_L f(r_L) - r_D g(r_D)]Y^e + r_L R - qq\max(0, u - R) \quad (6)$$

Where $L = f(r_L)Y^e$ *and* $D = g(r_D)Y^e$

To meet unexpected demand for cash, also the bank cannot only borrow at a penalty rate, q, but rather may also use its excess reserves, $Z = R - \theta D = (1 - \theta)D - L$, to meet those unexpected withdrawals. So, the expected reserve defiency may be written as $Emax\,[0, C - ((1 - \theta)D - L)]$ and this allow to come up with the following banks profit expected profits:

$$\Pi = [r_L f(r_L) - r_D g(r_D)]Y^e + r_L R - qE\max(0, ((1 - \theta)D - L)] \quad (7)$$

Out of the above developments which express commercial banks behevior, Agénor provides three essential propositions:

Firstly, penalty rate has positive relationship with deposits, lending rates and excess reserves held by commercial banks. This implies that for a high enough level of the penalty rate, excess reserves exceed expected withdrawals ($Z - u > 0$).

Secondly, the effect of volatility of output and liquidity shocks is ambiguous on deposit rate, lending rate, and excess reserves. But if the initial level of the penalty rate is suitably high, a positive change in volatility impacts positively all the three variables.

Lastly, an increase in the reserve requirement rate explicitly has a positive effects on lending rate while negative on excess reserves.

According to Agénor, combining the three assumptions with commercial banks's behevior of maximizing profit, the demand function for precaunary excess reserves is derived as also a ground of the following dynamic empirical model:

$$\ln\left(\frac{EL}{D}\right) = a_1(L)\ln\left(\frac{EL}{D}\right) + a_2(L)\ln\left(\frac{RR}{D}\right) + a_3(L)CV_{C/D} + a_4(L)CV_{Y/YT} + a_5(L)\ln\left(\frac{Y}{Y_T}\right) + a_6(L)r + a_7(L)EXPO + v_t \quad (8)$$

Where v_t denotes the error term and L is the lag operator.

The estimation under this benchmark specification is undertaken with a somehow general dynamic setting to enable the model to capture the dynamics present in the data related to precautionary demand for excess reserves. The dependent variable is the ratio of the logarithm of excess liquidity held by banks, *EL*, to total deposits, *D*. The explanatory variables are current and lagged values of the logarithm of dependent variable; logarithm of the ratio of required reserve assets, *RR*, to total bank deposits, *D*, coefficient of variation of the cash-to-deposit ratio, *C/D*, and the deviation of output from trend, *Y/YT*; discount rate, r, which corresponds to the penalty rate; as well as the exchange rate exposure. In particular, the dynamics of adjustment of the demand of *EL/D* is captured by the lagged values of *ln(EL/D)* in the regression.

— ***Ln(RR/D)*** captures the impact of reserve requirement set by the Central bank.
— $\boldsymbol{CV_{C/D}}$ **and** $\boldsymbol{CV_{Y/Y_T}}$ account for the impact of volatility and liquidity risk.
— The penalty rate, ***r***, is proxied by two interest rates notably the discount rate and money market rates. The prior accounts for the cost of the last resort facility for banks while the second captures the cost of liquidity in the market.

— ***Ln(Y/YT***) in the regression serves as a proxy for changes in the demand for cash by banks. This implies that in case of any cyclical shock up/down would alternate banks anticipate performance related to demand for currency by the public and this would therefore lead them to accumulate/decrease their holdings of excess reserves. The lags account for the possibility of a gradual impact of funding costs and cyclical movements in output on the demand for excess reserves.

— ***EXPO*** is incorporated with the idea that banks that are exposed to currency depreciation and may be tempted to hold more cash than required in anticipation to satisfy unexpected withdrawals following the possibility of an increase in the domestic-currency value of debt service payments. To capture this effect, EXPO is defined as the difference between foreign-currency liabilities and assets over the total bank deposits times the rate of nominal depreciation.

4.2. Determining the banks optimal level of liquidity

The second model of this paper that estimates the optimal level of precautionary excess liquidity hinges on the approach developed by Tinang (2012) and applied to CEMAC region to estimate the banks' optimal level of excess reserves desired by minimizing the cost function of each commercial bank as well as to the entire banking system.

The liquidity management costs as to Baltensperger and Milde (1976) have been grouped into three categories which are not positively correlated; reducing one would increases the other. The first one is related to the opportunity cost that results by holding reserves that could have been invested in other income generating assets. The second is the cost of adjustment which results from demand for excess liquidity above the amount of reserves held by the bank. The third is the cost banks incur when seeking for articulate understanding of behavior of customers' future withdrawals and deposits.

Considering a financial system mainly dominated by commercial banks and under control of the central bank, a commercial bank faces a net withdrawal of liquidity u from its customers which is a random variable with density function f and it holds a liquidity reserve stock (R) and security stock in the form of bonds (S).

By chosen an approach for cost minimization, Tinang (2012) pointed out four scenarios that arise as result of a change in net withdrawals of liquidity u during a given period:

- First, the net withdrawal of liquidity is negative, which is a net deposit of cash by customers. This deposit is then distributed by the bank between new loans, a fraction β is placed at the Central Bank in form of bonds and another fraction α is kept as excess reserves, all with an opportunity cost $(\alpha r_c + \beta(r_c - \beta(r_c - r_s)u)$ to which will be added to the initial opportunity cost $r_c R + (r_c - r_s)S$;

- Second, the net withdrawal of liquidity is positive but less than the amount of reserves held by the bank. In this case, the bank reserves are used to meet customer demand, which reduces the opportunity cost incurred by the bank when holding such reserves $r_c(R-u)$. The opportunity cost of holding securities remains the same $(r_c - r_s)S$;

- Third, the amount of net withdrawals is positive, higher than the bank reserves but less than the sum of reserves and bank securities. The bank then sells its securities to meet up with liquidity demand of the customer; this by undergoing an adjustment cost that is m should be less than or equal to the cost of refinancing on the interbank market, otherwise it is better for the bank to go on the interbank market. The total cost of this operation is $m(u-R)$.

- In the last case, the net withdrawals are greater than the sum of reserves and securities of the bank. The bank then uses all its reserves, sells all its shares and uses the Central Bank facilities to meet the liquidity demand of customers. The opportunity cost of holding reserves is then zero, but the adjustment costs associated with the sale of securities and loans with penalty from the Central Bank are added: $mS + r_p(u - R - S)$.

Thus, the total expected cost (TC) by the bank which accounts for opportunity and adjustment costs can be expressed as follow:

$$E(TC) = \int_{-\infty}^{0} [r_c R + (r_c - r_s)S - (\alpha r_c + \beta(r_c - \beta(r_c - r_s)u]f(u)du$$

$$+\int_0^R [r_c(R-u)+(r_c-r_s)S]f(u)du$$
$$+\int_R^{R+S} m(u-R)f(u)du \qquad (9)$$
$$+\int_{R+S}^{+\infty} [mS+r_p(u-R-S)]f(u)du$$

The first order condition where the opportunity cost equals to adjustment cost is given by:

$$r_c P(u \le R)+(r_c-r_s)sf(R)=mP(R<u\le R+S)+r_p P(u>R+S) \qquad (10)$$

Thus, the optimal level of reserves the bank requires to hold in order to minimize the cost holding liquidity is that value of reserves which balance the opportunity cost of holding reserves to the adjustment cost incurred by the bank's demand for liquidity to cover the customers' demand for cash.

To determine the optimal level of reserves, the estimation importantly adopts the probability function of the random variable of net withdrawal of liquidity by the users, ($f(u)$). As derived by Tinang, to estimate density function we also opted for a non-parametric approach to estimate an empirical density function as proposed by (Silverman, 1986).

$$\hat{f}(x)=\frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x-x_i}{h}\right) \qquad (11)$$

Where h is the smoothing parameter or bandwidth and K is the Kernel estimator which gives the sum of individual bumps placed at the observations.

Out of this approach, we can derive the optimal level of excess reserves of the entire banking system by adding up all the individual commercial banks' optimal levels of excess reserves obtained. Consequently, the amount of reserves held involuntarily by commercial banks can also be obtained by dividing total reserves of each bank into three categories of statistics notably: the reserves required by regulation, precautionary excess reserves, as well as the involuntary excess reserves imposed through external shocks such as large capital inflows, government borrowing from the central bank, as well as the undeveloped financial system among others.

5. EMPIRICAL RESULTS

5.1. Data and unit root test.

The study used monthly data ranged from January 2004 to September 2016. Using ADF tests, we find that all variables are stationary, except LnRRD, LnCD and DISC_RATE.

Table 2: ADF Unit root test results

Series	Prob.	Lag	Max Lag	Obs
LNELD	0.0008	1	13	151
LNRRD	0.1485	2	13	150
LNCD	0.8691	12	13	140
LNYC	0.0116	0	13	152
YGAP	0.0000	13	13	139
DISC_RATE	0.2770	1	13	151
INTBANK_RATE	0.0205	0	13	152
EXPO	0.0001	1	13	151

Source: Authors, using data from BNR, Monetary Policy Directorate

As ADF do not have strong power, we performed the decision by using KPSS test. In this case we compare the test statistic value with the critical value on the desired significance level and we found that all test statistics are lower than their corresponding critical values. Therefore, we accepted the null hypothesis which for KPSS tests assumes stationary of the variable of interest.

Table 3: KPSS Unit root test

		LnRR	Disc_Rate	LnCD
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.245851	0.107566	0.379013
Asymptotic critical values*:	1% level	0.739000	0.216000	0.739000
	5% level	0.463000	0.146000	0.463000
	10% level	0.347000	0.119000	0.397000

Source: Authors, using data from BNR, Monetary Policy Directorate

5.2. Estimating the demand function for precautionary excess liquidity

As pointed out in the previous section, the estimation of demand equation for excess reserves by banks is expressed by autoregression using FMOLS approach with a cointegrating equation capturing both contemporaneous and lagged effects. However, for easy interpretation of coefficients, we estimated the sum of coefficients by using the dynamic Least Squares (DOLS) method and then setting the lag operator at 1.

Tables 4a and 4b below summarize the estimations of excess liquidity with results of the sum of coefficients and their probabilities. The dependent variable is the logarithm of the excess reserves' ratio over total bank deposits.

Table 4a: Determinants of excess liquidity

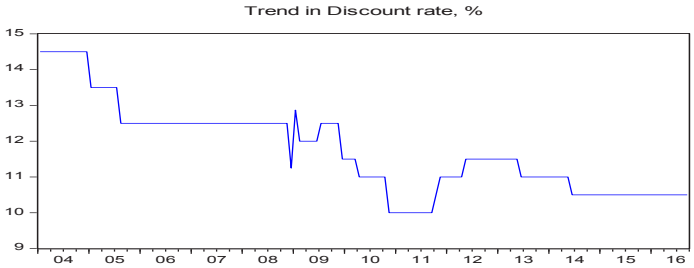
		Estimation using	
		Discount rate	**Interbank rate**
LNELD(-1)	Coefficient	0.402059	0.488082
	Probability	0.0197	0.0004
LNRRD	Coefficient	-0.967941	-0.539797
	Probability	0.0490	0.0765
LNCD	Coefficient	-0.317147	-0.116556
	Probability	0.3120	0.5818
LNYC	Coefficient	-1.467120	-1.632213
	Probability	0.0054	0.0038
YGAP	Coefficient	0.018048	0.020210
	Probability	0.0349	0.0049
Penalty: DISC_RATE/Interbank rates	Coefficient	0.099925	0.019843
	Probability	0.3107	0.3777
EXPO	Coefficient	2.772586	0.781119
	Probability	0.6979	0.9174
C	Coefficient	-8.368315	-5.693429
	Probability	0.0206	0.0005

Source: Authors, using data from BNR, Monetary Policy Directorate

In the two regressions, the estimated results obtained with the discount rate are not different to these obtained using interbank rate> Results suggest that reserve requirement (*LnRR*), as expected has a significant and negative impact on excess liquidity while the effect of lagged excess reserve (*lnELD(-1)*) and the volatility of output gap (*YGAP*) indicate a dynamic adjustment by commercial banks for excess liquidity and anticipation of demand for cash by the public respectively have significant and positive effect.

The effect of volatility of *lnYC* as proxy of liquidity risk is significant and incorrectly signed. As pointed out by Agénor (2004), an increase in volatility of output and liquidity shocks has ambiguous effects on excess reserves, except if the initial level of the penalty rate is sufficiently high, an increase in volatility has a positive effect on excess reserves. Indeed, the figure below shows that, since 2004 the discount rate has been accommodative (see chart below) and thus vividly supports the ambiguity of the observed non-expected sign of *LNYC* on excess liquidity.

Fig 10: Trend in discount rate in %



Source: Authors, using data from BNR, Monetary Policy Directorate

Conversely, the results on variation of cash to deposit ratio *(LnCD*), the penalty rate proxied by the discount and interbank rates as well as the foreign exchange exposure (*EXPO*) have expected signs but are not statistically significant. Indeed, in an environment of persistent excess liquidity, the impact liquidity risks on reserves is not very much important and this can explain why the effect of these variables is statistically not significant. For easier interpretation of coefficients, we used the sum of coefficients which hides the effects of individual coefficients. Then, estimating an autoregression equation results suggest that coefficients of lagged variation of the cash-to-deposit ratio *(LnCD(-1))*, the lagged discount rate *(DISC_RATE(-1))* and the exchange rate exposure (*Expo*) are statistically significant and positively related to excess liquidity.

Table 4b: Determinants of excess liquidity

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNELD(-1)	0.433005	0.058887	7.353104	0.0000
LNRRD	-0.605881	0.210048	-2.884487	0.0046
LNRRD(-1)	-0.478544	0.208308	-2.297292	0.0231
LNCD	-3.409041	0.639835	-5.328004	0.0000
LNCD(-1)	2.876400	0.631820	4.552564	0.0000
LNCY	-0.746923	0.572782	-1.304027	0.1944
LNCY(-1)	-0.397785	0.558858	-0.711782	0.4778
YGAP	-0.011898	0.006037	-1.970936	0.0507
YGAP(-1)	0.010634	0.006068	1.752454	0.0819
DISC_RATE	-0.105502	0.085448	-1.234703	0.2191
DISC_RATE(-1)	0.279258	0.083369	3.349669	0.0010
EXPO	47.87552	18.36249	2.607246	0.0101
EXPO(-1)	-47.71602	17.23882	-2.767940	0.0064
C	-9.432783	1.407102	-6.703695	0.0000

Source: Authors, using data from BNR, Monetary Policy Directorate

In brief, the results obtained from the two regressions suggest that the reserve requirement (*LnRR*), change in demand for cash proxied by the output gap (*YGAP*) as well as the lagged value of excess liquidity (*lnELD(-1)*) are important determinants of precautionary excess liquidity. The effect of volatility as proxy of liquidity risk (*LnYC*) is ambiguous with an incorrect sign. While using the summation of coefficients, the lagged values of cash to deposit ratio (lnCD (-1)) and discount rate (DISC_RATE (-1)) and foreign exchange exposure (EXPO) are also positive and significantly related to excess liquidity.

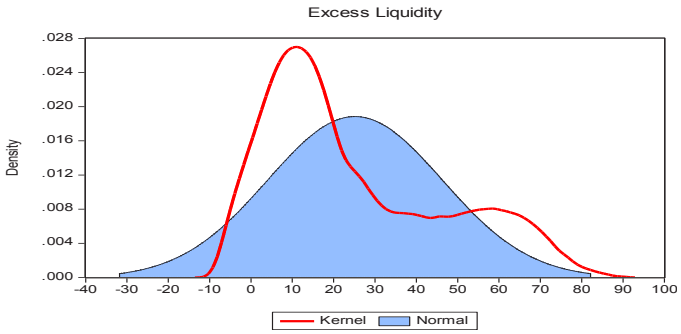
5.3. Estimating the optimal level of precautionary excess liquidity

As pointed out by Saxegaard (2004) and Tinang (2012), all the liquidity held by commercial banks beyond the reserve requirement can not be considered as excessive and detrimental to the effectiveness of monetary policy especially if it's for transaction and precautionary purposes rather than speculative or involontary motives. So, for the effectiveness of monetary policy, monetary authorities need to measure the optimal level of excess liquidity necessary for banks hold for transaction and precautionary motives.

The key element for determining the optimal level of reserves as pointed out by Tinang (2012) is the probability function of the random variable (*f(u)*) which captures the net withdrawal of liquidity. We implemented the proposed model using the estimated precautionary excess liquidity. To avoid the optimal level

obtained from largely depending on the sample, we simulated bootstrap samples to have a good approximation of the distribution of the test statistic as well as the accurate inferences and confidence intervals for values computed.

Fig. 11: Kernel and normal distributions



Source: Authors, using data from BNR, Monetary Policy Directorate

Taking into account the first and second conditions of the minimization of the function, the monthly optimal level of excess liquidity in the Rwandan banking system is estimated at arround FRW 34 billion but not exceeding FRW 61 billion. This optimal level of excess liquidity includes cash in vault which on average represents arround 58% of the total excess liquidity during the last five years. Therefore, the optimal required excess reserves by commericial banks at BNR which balances the opportunity cost of holding reserves to the adjustment cost incurred by the bank's demand for liquidity to cover the customers' demand for cash should lie between FRW 14.3 billion and FRW 25.6 billion.

However, these results should be taken with cautiousness because we performed estimations on an assumption that during the period under review the reserve requirements are set at their appropriate optimal levels in relation to liquidity conditions that prevail in the banking system. Since this instrument has been introduced at the National Bank of Rwanda, it underwent various adjustments by changing the reserve base, the maintenance period and the required reserves ratio. But, since 2009 the reserve requirement ratio has been kept unchanged despite economic and financial environments that have been significantly changing over time. Therefore, the optimal level obtained by this study can serve as a benchmark to guide the BNR's interventions on money market to influence liquidity conditions, other than being considered as target.

6. CONCLUSION AND POLICY IMPLICATIONS

Excess liquidity has been an important feature of banking system in most developing economies. This paper has sought to examine the potential determinants of precautionary excess liquidity in Rwandan banking system during the period 2004 – 2016 and its optimal level above (below) which the excess liquidity becomes a constraint to monetary policy transmission. In so doing, this study used two separate econometric models as to be able to hypothesize the possible policy implications on effectiveness of monetary policy. Therefore, sudy used FMOLS autoregression approach to estimate the determinants of precautionary excess reserves, however for ease of interpretation of coefficients, the sum of coefficients was also estimated using the dynamic Least Squares (DOLS) method while set the lag operator at 1. For optimal excess liquidity level, Kernel Density estimation was used to estimate the probability density of the estimated precautionary excess liquidity. To avoid sample dependence of the optimal level obtained, bootstrap method was also used to obtain confidence interval of the values computed.

The results obtained from the regressions suggest that the reserve requirement, change in demand for cash proxied by the output gap, as well as the lagged value of excess liquidity are important determinants of precautionary excess liquidity. While using the summation of coefficients, the lagged values of cash to deposit ratio and discount rate, as well as the foreign exchange exposure are found also positively related to excess liquidity. The effect of volatility as proxy of liquidity risk is ambiguous. This is consistent to the proposition of persistent excess liquidity as stipulated by Agénor (2004), unless initial level of the penalty rate is sufficiently high and is opposite to Rwanda's case whose rate has been consistently accommodative during the sample period.

Secondly, taking into account the first and second conditions of liquidity minimization, the result obtained estimates the monthly optimal level of excess liquidity at arround FRW 34 billion. This optimal level of excess liquidity includes cash in vault which on average represents arround 58% of the total excess liquidity during the last five years. Therefore, on average the excess reserves should be arround FRW 14.3 billion. The limitation with these findings regarding the optimal level is that the estimations were conducted based on assumption that the existing

reserve requirement is optimum. Therefore, the optimal level obtained by this study can serve as a benchmark to guide the BNR's interventions on money market to influence liquidity conditions, save for being considered as target.

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The Impact of external shocks on effectiveness of monetary policy in Rwanda

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ABSTRACT

This paper aims at investigating how the propagating effects of external shocks (such as a shock to foreign income, international commodity prices and foreign monetary policy) can induce often unpredictable variations in domestic macroeconomic variables, posing challenges to the domestic monetary policy authorities in terms of ensuring macroeconomic stability. Using a structural VAR methodology, the study reveals that such external shocks have indeed had destabilizing effects on the Rwandan economy. Using the shutdown methodology, it is clearly shown that the response of monetary policy is always needed to mitigate the effects of external shocks. This corroborates to what is presented in section 2 showing that the effects of some exogenous shocks that have hit the Rwandan economy over the recent period were effectively managed by the National Bank of Rwanda, with the help of other stakeholders. Policy coordination especially between fiscal and monetary policies remains at the forefront in the endeavor to manage turbulent forces from the rest of the world.

Key words : Monetary Policy, Rwanda

JEL Classification: E51, E58

I. INTRODUCTION

1.1 GENERAL BACKGROUND

The effectiveness of monetary policy implies that a Central Bank can regulate the amount of liquidity to affect the real economy (i.e. inflation and output). Central banks control liquidity by using either price or quantity targets, which are basically two sides of the same coin. The first side of the coin is the price target, which 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. The second side of the coin is the quantity target whereby for example the central bank targets reserve money, instead of the short-term nominal interest rate, to regulate money supply and influence the real economy thereafter. A country's monetary policy framework depends on which side of the coin the central bank chooses to act from- acting from the price side implies the implementation of the interest rate regime whereas acting from the quantity side is what is known as the monetary targeting framework.

At present, the National Bank of Rwanda conducts its monetary policy under the monetary targeting regime whereby reserve money (and recently, a reserve money band) is the operational target; M3 is the intermediate target whereas price stability is the ultimate objective. In practice, the level of broad money (M3) for a particular year is set in line with the targets on inflation and economic growth assuming ***a stable velocity money***. The reserve money target is also set in line with the estimated M3, ***assuming a stable money multiplier***. The monetary targeting framework therefore assumes that for the real economy to be affected by monetary policy actions, the assumptions of a stable money velocity and a stable money multiplier must hold.

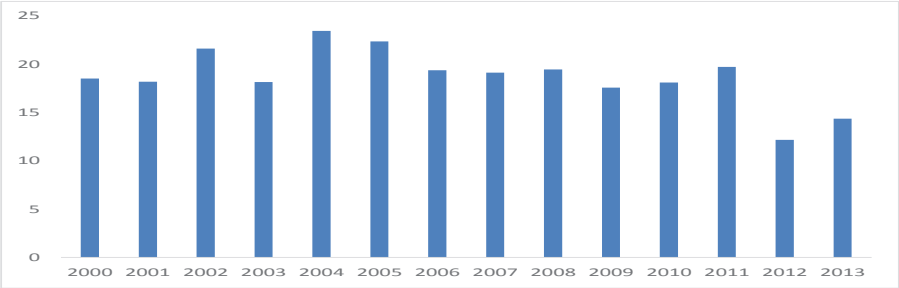
However, recent empirical evidence shows that the assumptions of the stability of the money multiplier and money velocity are unrealistic, implying increasing breakdown of the link between the real economy and monetary aggregates (Adam C., & Kessy, P., 2011; Kigabo, R., & Irankunda, J., 2012; Kigabo 2001; David Hauner and Gabriel Di Bella, 2005; Musoni, 2008) and this has been fronted as the main reason as to why EAC central banks agreed to shift to the use of the interest rate by 2018. Important to note is the fact that all the previous studies about the monetary policy transmission mechanism did not take note of the possible contagious effects of external shocks.

2. AN OVERVIEW OF KEY MACROECONOMIC DEVELOPMENTS IN RWANDA

Since 1994, Rwanda has been implementing sound macroeconomic policies that helped to attract sizable donor support. However, the country still faces challenges related with the limited flow of FDI and a widening trade deficit, largely attributable to the narrow export base dominated by low value products like coffee and tea.

Robust growth, averaging around 8% in real terms, recorded especially after the 1994 war and genocide was primarily driven by public investments. The latter was made possible by the fact that Rwanda attracted huge sums of official development assistance (ODA), in the range of 15-25 percent of GDP since 2000.

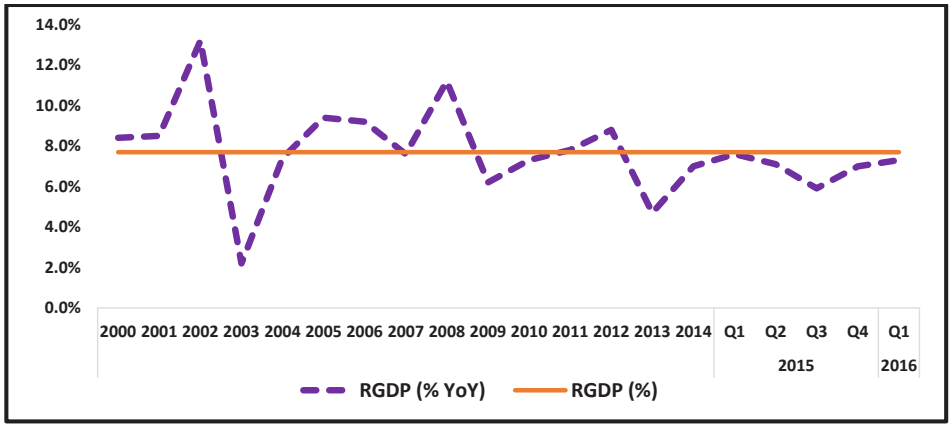
Figure 1: Rwanda Official Development Assistance (ODA) as % of GDP



Source: Own calculations using World Bank & NISR data

Being a small open economy, Rwanda has been hit by some external shocks as mentioned in Luisa et al. (2014) and Karangwa et al. (2015) who point out some recent external shocks such as: (1) the 2008 and 2011 increase in international commodity prices, especially for oil and food; (2) the demand shock due to the financial crisis (2009) and due to an aid shock (2012-13); and recently, (3) the plunge in international commodity prices in 2015-16.

Figure 2: Rwanda's economic growth

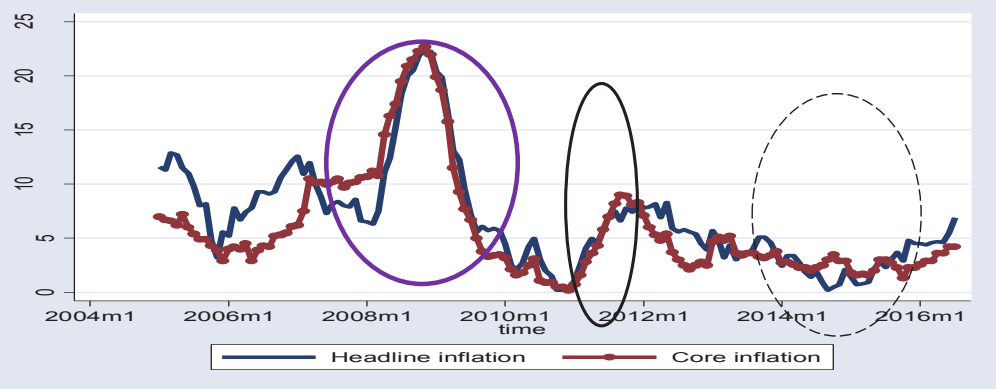


Source: Own calculations using World Bank & NISR data

In terms of economic growth, the sensitivity of the Rwandan economy to external shocks was for example witnessed in 2013 when real GDP growth slowed to 4.7% from 8.8% recorded the previous year following the delays and cuts in foreign aid implemented in the second half of 2012.

In terms of price developments, some inflation episodes can be linked to external shocks. For example in 2008 and 2011, inflation was rising partly due to the impact of rising international food and oil prices. Conversely, in 2014-15 inflation was declining due to the general decrease in international commodity prices, particularly food and oil prices.

Figure 3: Inflation developments in Rwanda



Source: Own calculations using NISR data

Despite the widening trade balance and meagre FDI flows, the FRW has historically remained relatively stable especially due to the fact that Rwanda has over the past years enjoyed a stable flow of foreign aid. However, the impact of the 2012-13 aid shock resulted into increasing depreciation though the central bank stepped into the market to smooth out excessive exchange rate volatility. Following exchange rate pressures observed since last year, the exchange rate pass through to domestic prices increased from 0.3 in 2006Q1-2014Q4 to 0.43 in 2006Q1-2016Q3.

In view of the above, the incorporation of external shocks in the analysis of the effectiveness of the monetary policy transmission can be quite illuminating and perhaps inform policy makers whether this has contributed to the breakdown of the link between monetary aggregates and the real economy.

Thus, the main objective of this study is to examine the impact of external shocks on domestic macroeconomic stability (i.e. stability in output growth and maintenance of low and stable inflation). Specifically, the study aims at investigating the impact of external shocks (i.e. shocks to foreign monetary policy, international commodity prices, budgetary grants and foreign income) on domestic monetary policy variables (M3 and nominal effective exchange rate). The study is expected to extend the already known monetary policy transmission mechanism literature by incorporating the possible effect of external shocks.

3. LITERATURE REVIEW

After the great depression of the 1930's, economists around the world recognized the importance of understanding and mitigating both internal and external shocks to smooth economic fluctuations. Since then both theoretical and empirical literature has documented various kinds of economic shocks though with some disagreements. The initial approach to mitigate the impact of shocks, especially in the post-1960 period, was the use of fiscal policy as a stabilizing tool, advocated for by Keynesian economists (Shazia Kousar et al., 2016). However, this proved to be impractical at later stages, especially for developing countries that lack well-knit tax policies and are therefore always prone to huge budget deficits as their fiscal policies were mostly pro-cyclical and thus aggravating rather than stabilizing business fluctuations (A. Alesina et al., 2008). Later, monetarists strongly attacked the Keynesian approach and stressed the importance of monetary policy as a stabilizing tool (E.M. Gramlich et al., 1971).

In low income countries, economic activities are greatly unstable and influenced by both internal and external shocks. The importance attached to these shocks is varied, with some studies attributing a big portion of macroeconomic fluctuations to external shocks and others citing internal shocks as most significant (Buckle, R. A. et al., 2007; and, C. Raddatz et al., 2007). According to Jean Pierre Allegret et al. (2011), developing and emerging economies are exposed to the adverse effects of external shocks via three main channels: ***the trade channel, the financial channel and the pass through channel***.

Firstly, the trade channel implies that developing and emerging economies are dependent on the economic activities in industrialized economies. According to the IMF's World Economic Outlook (2007), past U.S. recessions usually coincide with significant reductions in global growth. For example, when the big economies are not performing well, global demand for commodity exports declines (IMF World Economic outlook, May 2016), which adversely affects growth in developing and emerging economies. The shocks to international food and oil prices fall under this category. Secondly, developing and emerging economies depend a great deal on international sources of financing to finance their domestic investments such that when for example foreign direct investments to a particular developing nation declines, its investment plans may be harmed. Thirdly, CPI inflation for most developing countries remains prone to exchange rate fluctuations, hence the pass through channel. Exchange rate fluctuations may be caused by shocks to foreign monetary policy, such as monetary policy tightening in the US.

Pioneer studies on the impact of shocks on macroeconomic fluctuations used the SVAR approach on the US economy and these include Sims (1986), Blanchard and Quah (1989), Gali (1992), Gordon and Leeper (1994), Christiano et al. (1996), Bernanke and Blinder (1992), Bernanke and Mihov (1998), and Sim and Zha (2005). Given that the US economy is large enough and therefore less influenced by other economies around the world, these studies use a closed

economy SVAR approach to examine the impact of monetary policy shocks on economic activity.

Mindful of international economic linkages especially for small open economies, some studies such as Cushman and Zha (1997), Brischetto and Voss (1999), Dungey and Pagan (2000), Parrado (2001), and Buckle et al. (2007) examined the effect of monetary policy shocks by using an open economy SVAR approach. Most of these studies use the block exogeneity assumptions to model the international economic linkages for a small open economy.

Using a SVAR approach with block exogeneity, Cushman and Zha (1997) imposed two blocks in the structural equation model; a block for the international economy and a block for the domestic economy (i.e. Canada). These researchers consider four foreign sector variables, namely, the US industrial production, the US consumer prices, the US federal fund rate, and world total commodity export prices. Their identification scheme implies that the domestic interest rate is assumed to react contemporaneously to foreign interest rate and commodity market, but not on contemporaneous output and that the exchange rate is assumed to respond contemporaneously to all shocks whereas foreign variables were treated as a separate block, that is, block (exogenous) for the domestic (small open) economy. Their study revealed that the Canadian monetary policy responds significantly and contemporaneously with home interest rates, exchange rate, foreign interest rates and foreign price levels.

Conversely, Dungey and Pagan (2000) included five international variables, namely real US GDP, real US interest rates, the Australian term of trade, the Dow Jones Index deflated with the US consumer price index, and real exports. They assume that the Australian monetary policy (cash rate) follows a standard Taylor-rule, responding contemporaneously to Australian gross national expenditure and inflation.

Most of the literature dwells much on the assessment of the impact of external shocks on domestic macroeconomic fluctuations (Ivo Krznar and Davor

Kunovac, 2010; Thi Lien Hoa Nguyen et al., 2014) or on the impact of monetary policy shocks on macroeconomic stability (Zulkefly Abdul Karim et al., 2016). External shocks induce fluctuations in domestic macroeconomic variables and monetary policy reacts to stabilize the economy by mitigating the impact of these shocks. However, severe and frequent shocks can limit the effectiveness of monetary policy as was the case for the US and other big economies after the 2009 financial crisis up to present. Using the conventional monetary policy tools, these economies failed to achieve the desired outcomes, thus resorting to unconventional monetary policy (i.e. quantitative easing) which is also facing challenges (Shazia Kousar et al., 2016).

A few studies have addressed the impact of external shocks on the effectiveness of monetary policy. For example, Zulkefly Abdul Karim et al. (2016) use the ***shutdown methodology*** to evaluate the effectiveness of monetary policy as a stabilization policy, in particular, to minimize the negative effect of foreign shocks on domestic macroeconomic variables. The results of their study indicate that foreign shocks appeared to play a prominent role in influencing domestic macroeconomic and monetary policy variables and that monetary policy plays a pivotal role in minimizing the negative effect of external shocks to the domestic economy. It is important to note that this study compares the magnitude of the impact of external shocks with and without monetary policy reaction. Once monetary policy reaction succeeds in minimizing the impact of external shocks, it is then considered to be effective. This approach simply suggests that the macro-level modeling approach, treating monetary policy as endogenous, is the right way to measure the impact of external shocks on the effectiveness of monetary policy in presence of shocks.

4. METHODOLOGY

4.1. Data and Variables description

All the data used are in quarterly frequency spanning the period 2006Q1-2016Q1. Data for domestic variables are collected from the NISR, BNR and MINECOFIN while data for the foreign sector are collected from the IMF WEO and IFS databases. The variables used in the SVAR model are as follows:

- LCOMMODITY: The log of the international commodities' price index
- $LRGDP^{us}$: The log of US real GDP as a proxy for the global economy
- FFR: The Federal Funds Rate, a proxy for foreign monetary policy
- LBGRANTS: The log of budget grants. This variable is intended to capture the effect of a shortfall in foreign inflows not related to domestic economic fundamentals (such as interest rate differentials, high export revenues, remittances etc.) but rather to other exogenous factors such as the global economic slowdown.
- $LRGDP$: The log of real GDP for Rwanda, a proxy for domestic income
- $INFL\ is\ the\ domestic\ inflation\ rate$
- LM3 is the log of M3
- $LNEER$ is the log of the nominal effective exchange rate. This takes into account ten trading partners.

4.2. SVAR modelling

Since Rwanda is a small-open economy, we specify a SVAR model and include variables from two blocks: (1) the foreign block; and, the domestic block. The general representation of the SVAR model is:

$$A_0 Y_t = \Gamma_0 D_0 + A(L) Y_t + \varepsilon_t \quad (1)$$

Where: A_0 is an invertible square matrix of coefficients relating to the structural contemporaneous interaction between the variables in the system

- Y_t is a (8x1) vector of the variables in the SVAR system. All the variables, except FFR and INFL, are transformed into logs. The QoQ change in the log for each variable is then considered to be the percentage change of that variable.

  $(\Delta LCOMMODITY\ \Delta LRGDP^{us}\ FFR\ \Delta LBGRANTS\ \ \Delta LRGDP\ \ INFL\ \Delta LM3\ \ \Delta LNEER\ )'$

- D_0 is a vector of deterministic variables (constant, trend)

- $A(L)$ is the k[th] order matrix polynomial in the lag operator L such that $A(L) = AL - A_2 L^2 - \ldots A_k L^k$

- ε_t is a vector of structural shocks for the variables in the system, satisfying the condition that:

$$E[\varepsilon_t] = 0; E[\varepsilon_t \varepsilon_s^{'}] = \Omega_\varepsilon = I; t = s \quad (2)$$

We follow the SVAR model proposed by Amisano and Giannini (1996) to model the impact of external shocks on both domestic macroeconomic fluctuations and on the effectiveness of monetary policy in Rwanda. In matrix form, it can be presented as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31}^0 & a_{32}^0 & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{41}^0 & a_{42}^0 & a_{43}^0 & 1 & 0 & 0 & 0 & 0 \\ a_{51}^0 & a_{52}^0 & a_{53}^0 & a_{54}^0 & 1 & 0 & 0 & 0 \\ a_{61}^0 & a_{62}^0 & a_{63}^0 & a_{64}^0 & a_{65}^0 & 1 & 0 & 0 \\ a_{71}^0 & a_{72}^0 & a_{73}^0 & a_{74}^0 & a_{75}^0 & a_{76}^0 & 1 & 0 \\ a_{81}^0 & a_{82}^0 & a_{83}^0 & a_{84}^0 & a_{85}^0 & a_{86}^0 & a_{87}^0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{\Delta LCOMMODITY} \\ \mu_t^{\Delta LRGDP^{us}} \\ \mu_t^{FFR} \\ \mu_t^{\Delta LBGRANTS} \\ \mu_t^{INFL} \\ \mu_t^{\Delta LM3} \\ \mu_t^{\Delta LNEER} \\ \mu_t^{\Delta LRGDP} \end{bmatrix} = \begin{bmatrix} \varepsilon_t^{\Delta LCOMMODITY} \\ \varepsilon_t^{\Delta LRGDP^{us}} \\ \varepsilon_t^{FFR} \\ \varepsilon_t^{\Delta LBGRANTS} \\ \varepsilon_t^{INFL} \\ \varepsilon_t^{\Delta LM3} \\ \varepsilon_t^{\Delta LNEER} \\ \mu_t^{\Delta LRGDP} \end{bmatrix}$$

For a small open economy like Rwanda, it is quite plausible to assume that foreign variables are completely exogenous to the domestic variables (i.e. Foreign variables does not respond to changes in the domestic variables).

Instead of using the recursive Cholesky decomposition that depends on the ordering of variables, we opt to use the structural decompositions that depend on short-run restrictions derived from assumptions on some economic relationships among the variables in the VAR model. In the language of Eviews, the above identification scheme is implemented by imposing short-run restrictions on the innovations as follows:

@e1 = C(1)*@u1

@e2 = C(2)*@e1 + C(3)*@u2

@e3 = C(4)*@e1 + C(5)*@e2 + C(6)*@u3

@e4 = C(7)*@e1 + C(8)*@e2 + C(9)*@e3 + C(10)*@u4

@e5 = C(11)*@e1 + C(12)*@e2 + C(13)*@e3 + C(14)*@e4 + C(15)*@u5

@e6 = C(16)*@e1 + C(17)*@e2 + C(18)*@e3 + C(19)*@e4 + C(20)*@e5 + C(21)*@u6

@e7 = C(22)*@e1 + C(23)*@e2 + C(24)*@e3 + C(25)*@e4 + C(26)*@e5 + C(27)*@e6 + C(28)*@u7

@e8 = C(29)*@e1 + C(30)*@e2 + C(31)*@e3 + C(32)*@e4 + C(33)*@e5 + C(34)*@e6 + C(35)*@e7 + C(36)*@u8

Where:

@e1 for DLCOMMODITY residuals

@e2 for DLRGDP_US residuals

@e3 for FFR residuals

@e4 for DLBGRANTS residuals

@e5 for INFL residuals

@e6 for DLM3 residuals

@e7 for DLNEER residuals

@e8 for DLRGDP_RDA residuals

5. EMPIRICAL RESULTS

Using the augmented Dickey-Fuller test, we find that all variables, except the Federal Funds Rate (FFR), Inflation, and the interbank rate, are stationary in first differences. To avoid having spurious regressions, we would proceed to test for the existence of a long run relationship among the variables in the system. The SVAR literature guarantees that the variables in the system trend together in the long run. For example, monetary policy tightening corresponds to lower inflationary pressures but this happens between the medium to long term as the short term is characterized by inflation inertia.

Table 1: Stationarity test

Variable	**Level of integration**
Commodities' price index	1
RGDP_US	1
FFR	0
BGRANTS	1
RGDP_Rda	1
INFLATION	0
M3	1
NEER	1

Source: Author's estimations

However, when the non-stationary variables in table 1 above are expressed in QoQ growth rates, they become stationary and can thus be used in the SVAR

estimation. This makes sense due to the fact that it is for example the response of inflation, rather than of CPI, to an external shock that matters since monetary policy is more concerned with the smoothing of business cycles and short-term price changes (Zulkefly Abdul Karim et al., 2016).

5.1. IMPACT OF EXTERNAL SHOCKS ON DOMESTIC MACROECONOMIC STABILITY

To answer the objective of assessing the impact of external shocks on domestic macroeconomic stability (i.e. stability in output growth and maintenance of low and stable inflation), we estimate a SVAR model and use it to assess how shocks to the external variables affect domestic inflation and output growth. After estimating a simple VAR (3) model, the lag selection test indicates that the optimal lag length is 1. We thus estimate the SVAR (1) model.

Table 2: Lag selection test

VAR Lag Order Selection Criteria
Endogenous variables: D4LCOMMODITY D4LRGDP_US FFR D4LBGRANTS D4LRGDP_RDA INFL D4LM3 D4LNEER
Exogenous variables: C
Date: 01/31/17 Time: 09:27
Sample: 2006Q1 2016Q1
Included observations: 35

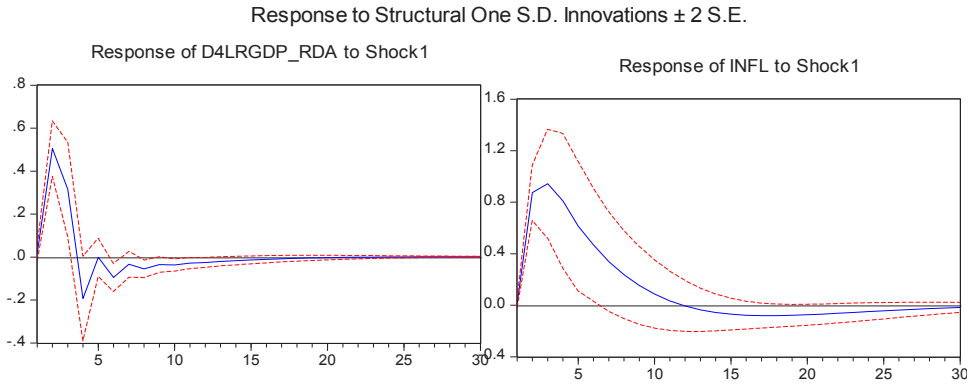
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-554.1000	NA	12296.97	32.12000	32.47551	32.24272
1	-427.7506	187.7191*	383.2239	28.55718	31.75675*	29.66167*
2	-348.1736	81.85059	292.8309*	27.66706*	33.71070	29.75333

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

As expected, a positive shock to international commodity prices leads to an increase in GDP (due to the increase in export receipts) and to an increase in

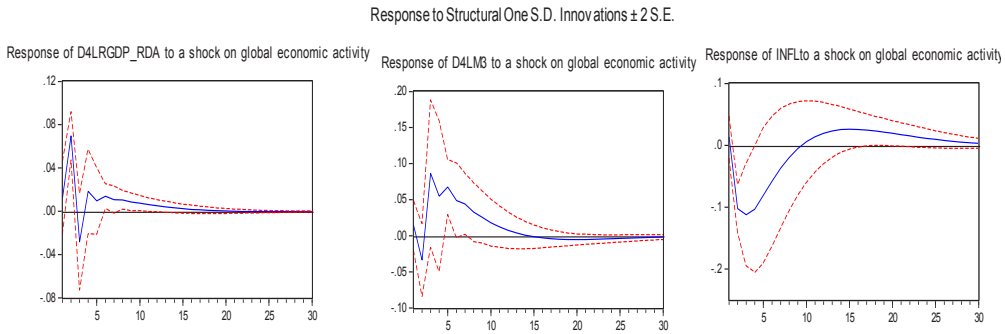
inflation (due to rising imported inflation & pressures from increasing demand for domestically produced goods). Inflation peaks at the 3rd quarter and declines thereafter whereas GDP peaks at the 2nd quarter before declining afterwards.

Figure 4: Impact of a positive shock to international commodity prices



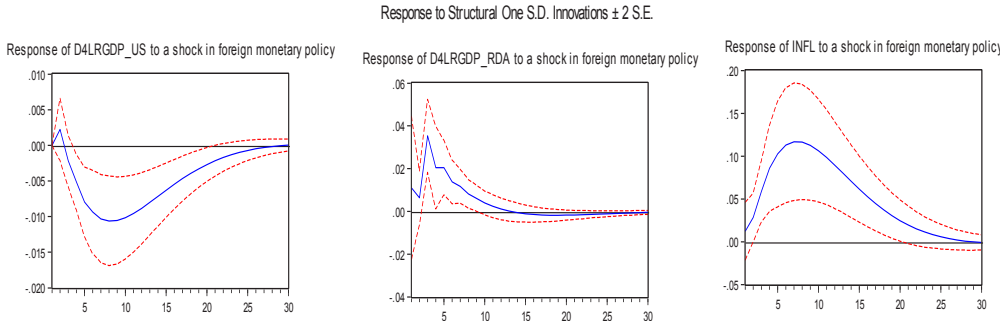
Baseline impulse responses also show that the Rwandan economy responds positively to a shock in the global economic activity as domestic GDP peaks at the 2nd quarter before declining thereafter. Domestic inflation also increases in the first quarter but this increase is short-lived as economic agents expect for monetary policy tightening, which actually happens in the 2nd and 3rd quarters.

Figure 5: Impact of a positive shock to the global economic activity



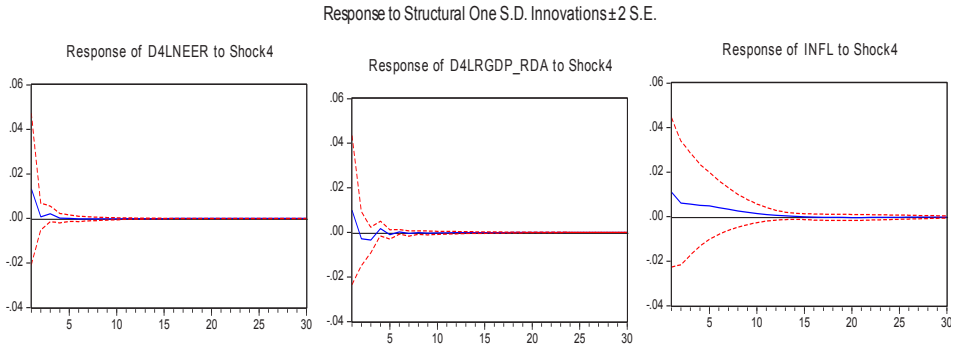
A positive shock on the global monetary policy conditions impacts global economic activity after some time lag, that is, after about 3 quarters, the global economy contracts. The domestic economy, which views the tight global monetary policy stance, expects a drop in the global economic activities. Thus, the domestic economic performance drops (in quarter 2) even before the global economy does, but recovers quickly (in quarter 3). However the drop in the domestic economy (in quarter 2) is not significant, while the recovery in quarter 3 is significant, thus inflation rises quite significantly from quarter 3 to quarter 8 before declining thereafter.

Figure 6: Impact of a positive shock to foreign monetary policy



A shock to budget grants has expected but statistically insignificant effect on the domestic economy. A sudden increase in grants has: appreciating effects on the FRW after some time lag; initially a positive effect on economic growth but later turns to negative as a growing import bill weighs on the economy; a positive effect on inflation but later declines due to FRW appreciation and economic slowdown (declining aggregate demand).

Figure 7: Impact of a positive shock to budget grants



5.2. IMPACT OF EXTERNAL SHOCKS ON THE EFFECTIVENESS OF MONETARY POLICY

Under the SVAR formulation, we can examine the effectiveness of monetary policy in mitigating the effect of foreign shocks on domestic macroeconomic variables (output and inflation) by comparing the baseline impulse responses with the constrained model's impulse responses. In the constrained model, we mute the impact of domestic monetary policy on domestic output and inflation. Thus, we change the SVAR matrix as follows:

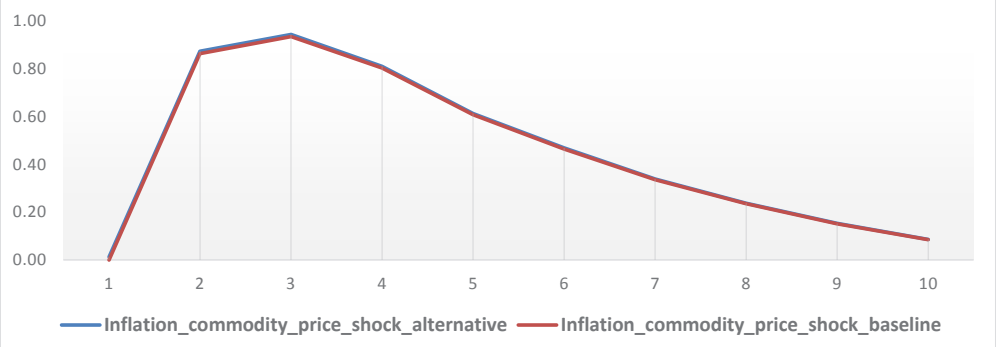
$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31}^0 & a_{32}^0 & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{41}^0 & a_{42}^0 & a_{43}^0 & 1 & 0 & 0 & 0 & 0 \\ 0a_{51}^0 & a_{52}^0 & a_{53}^0 & a_{54}^0 & 1 & 0 & 0 & 0 \\ a_{61}^0 & a_{62}^0 & a_{63}^0 & a_{64}^0 & a_{65}^0 & 1 & 0 & 0 \\ a_{71}^0 & a_{72}^0 & a_{73}^0 & a_{74}^0 & a_{75}^0 & a_{76}^0 & 1 & 0 \\ a_{81}^0 & a_{82}^0 & a_{83}^0 & a_{84}^0 & a_{85}^0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{\Delta LCOMMODITY} \\ \mu_t^{\Delta LRGDP^{us}} \\ \mu_t^{FFR} \\ \mu_t^{\Delta LBGRANTS} \\ \mu_t^{INFL} \\ \mu_t^{\Delta LM3} \\ \mu_t^{\Delta LNEER} \\ \mu_t^{\Delta LRGDP} \end{bmatrix} = \begin{bmatrix} \varepsilon_t^{\Delta LCOMMODITY} \\ \varepsilon_t^{\Delta LRGDP^{us}} \\ \varepsilon_t^{FFR} \\ \varepsilon_t^{\Delta LBGRANTS} \\ \varepsilon_t^{INFL} \\ \varepsilon_t^{\Delta LM3} \\ \varepsilon_t^{\Delta LNEER} \\ \mu_t^{\Delta LRGDP} \end{bmatrix}$$

This removes the direct effect of shocks to foreign variables on domestic monetary policy variables. We then assess the magnitude of the reaction of monetary policy variables in the baseline and alternative scenarios. We will only

consider the shocks that are found to have a significant impact on domestic macroeconomic stability as reported in section 5.1.

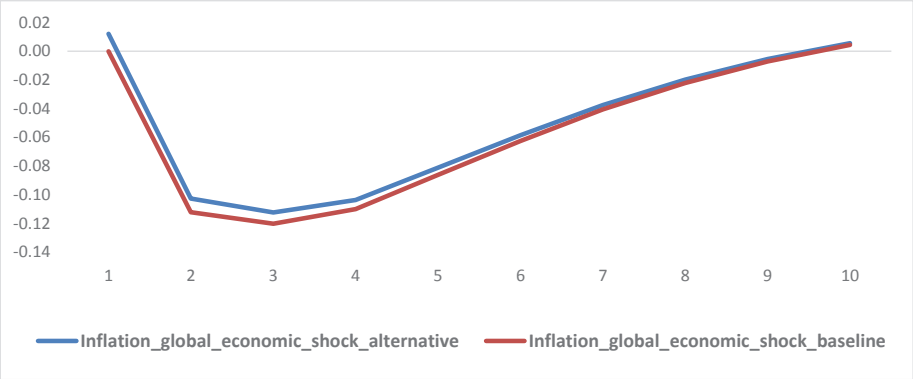
As highlighted in the baseline scenario, a positive shock on international commodity prices leads to an increase in inflation. The expectation is that the impulse response function (IRF) should be of the same direction but with a different magnitude, once domestic monetary policy does not react to the international commodity prices shock. Indeed, as a positive shock to international commodity prices hits, inflation is slightly higher in the alternative scenario when domestic monetary policy does not react. However, the difference between the baseline and alternative scenario is quite minimal suggesting that commodity prices have had less influence on inflation developments in Rwanda over the past.

Figure 8: Baseline and alternative IRFs for a positive shock on international commodity prices



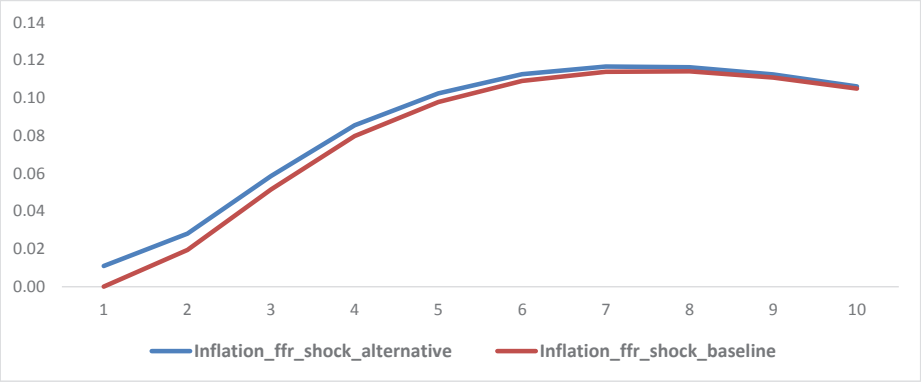
Similarly, with a positive shock to global economic activity, inflation is slightly higher in the alternative scenario than in the baseline. This again points to the fact that domestic monetary policy is quite effective in mitigating the effects of an external shock. In other words, if domestic monetary policy does not react to an external shock, inflation is higher than if there was monetary policy reaction.

Figure 9: Baseline and alternative IRFs for a positive shock on global economic activity



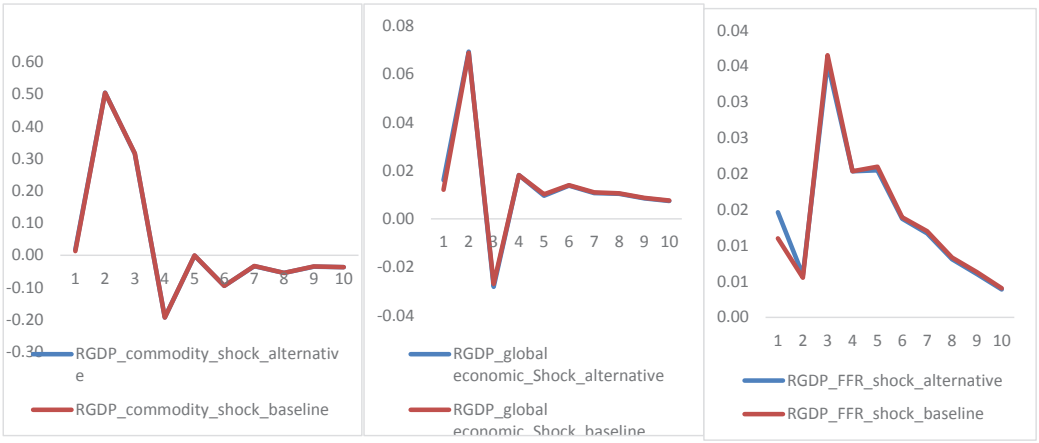
As mentioned earlier, global monetary policy is proxied by the federal funds rate. From section 5.1, it is shown that a tight monetary policy on a global scale leads to contraction of the global economy but the impact on the domestic economy is insignificant given the fact that the Rwandan economy is not so much financially integrated. Since domestic demand remains robust, inflation tends to rise from quarter 3 to quarter 8 before declining thereafter. Again, the effect is slightly higher when domestic monetary policy remains passive to a global monetary policy shock.

Figure 10: Baseline and alternative IRFs for a positive shock on global monetary policy



The response of domestic economic growth to external shocks seems to be the same, with or without domestic monetary policy reaction. Monetary policy affects real GDP after a considerable time lag given the fact that the primary mandate of the central bank is maintaining low and stable inflation, rather than stimulating economic growth. However, there is some difference for the case of foreign monetary policy tightening as real GDP initially declines faster when domestic monetary policy reacts than when it remains passive.

Figure 11: IRFs for real GDP to selected external shocks



Source: Author's estimations

6. SUMMARY OF THE MAIN FINDINGS

The focus of this paper was to examine the impact of external shocks on the effectiveness of monetary policy in Rwanda. To do this, the paper starts by investigating how external shocks induce fluctuations in domestic macroeconomic variables. Thereafter, the paper proceeds to investigate whether monetary policy reaction can help to mitigate the adverse effects of external shocks. Using the SVAR model, this study employs the shutdown methodology, which enables the analysis of the impact of external shocks before and after the reaction of domestic monetary policy variables.

Results show that external shocks, except a shock to budget grants, have destabilizing effects on the domestic economy. Comparing the baseline and alternative scenarios, it is clear that monetary policy is more effective in mitigating the effects of external shocks on domestic inflation. The response of domestic economic growth to external shocks seems to be the same, with or

without domestic monetary policy reaction. This is quite plausible given the fact that the central bank is more focused on price stability than output growth. However, there is some difference for the case of foreign monetary policy tightening as real GDP initially declines faster when domestic monetary policy reacts than when it remains passive.

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Assessing the preparedness towards inflation targeting framework: the case of Rwanda

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ABSTRACT

This paper has assessed whether BNR satisfies major preconditions for adopting inflation targeting framework, using both qualitative and quantitative approach. Using qualitative analysis, the study reveals that BNR fulfils some preconditions to inflation targeting framework as long as it has: (1) price stability as the primary objective; (2) a well-developed information inclusive forecasting and policy analysis systems; (3) independence to choose monetary policy instruments and; (4) a fairly developed communication strategy. Absence of fiscal dominance and external dominance has been tested using Standard Forecast Error Variance Decomposition (FEVD) on two different VAR models. Empirical findings reveal that BNR also fulfils the precondition of not operating under fiscal dominance, while structural shocks from the external sector are found to have negative impact to the conduct of monetary policy.

Key words : Monetary policy framework, Inflation targeting, Rwanda

JEL Classification: E51, E58

1. Introduction

Rwanda and a large number of sub-Saharan African (SSA) countries have been and are operating monetary policy framework centered around targets on monetary aggregates. Historically, monetary targeting was adopted in the mid-1990s to: (i) move away from fiscal dominance; (ii) bring down inflation; and (iii) anchor inflation expectations. In a context of low credibility, monetary targeting was used to signal that fiscal stabilization was on track. Large and sustained deviations were then considered to be an indication of fiscal pressures and increases in inflation often followed (Mohsin *et al.*, 2002).

Among many other central banks, the National Bank of Rwanda (BNR) still conducts monetary policy based on a monetary targeting framework. In this framework, broad money (M3) is the intermediate target for regulating the money supply and reserve money is the operating target with an assumption of a stable demand for money and stable money multiplier. However, findings by Kigabo and Mutuyimana (2016) have shown that money demand function and money multiplier are unstable for the case of Rwanda. Indeed, over the past decades, economic debates beyond the Rwandan case have increasingly proved weak relationships between the base money and broader monetary aggregates and between the monetary aggregates and monetary policy goals. It has become apparent that, over time horizons that mattered importantly for monetary policy, different monetary aggregates exhibit widely disparate growth rates.

As a result, most central banks have either downgraded or abandoned altogether their targets for money growth, and turned to setting interest rates as a way of making monetary policy without any specific intermediate target. For instance, Klaus and Matias (2001) pointed out that since its introduction in the 1990s inflation targeting became increasingly a popular monetary policy regime among Central Banks.

Mindful of the issues of unpredictable monetary aggregates, central banks of the East African Community (EAC) and BNR in particular have committed to adopt an inflation targeting frameworks by end 2018. But a research question emerges from this commitment; does BNR fulfill necessary preconditions for adopting an inflation targeting framework? According to Freedman and Otker-Robe (2009), international experience has shown that some preconditions for the IT were in place when countries introduced IT while others were still missing. Based on these international experiences, the objective of this study is to assess BNR's preparedness with regard to preconditions for adopting inflation targeting framework. This paper draws from the approach by Ankita and Vinod (2009) who extended the methodology by Fraga *et al.* (2003) and comprehensively tested different IT preconditions.

The rest of the paper is organized as follows. Section 2 is articulated around theoretical and empirical literature while data and methodology are presented in section 3. Section 4 presents empirical findings and section 5 discusses the conclusion and policy implications.

2. Literature review

Following the breakdown of the relationship between monetary aggregates and goal variables, many countries that want to maintain an independent monetary policy have adopted inflation targeting as their monetary policy regime (Mishkin, 2007). Inflation targeting is therefore an increasingly popular monetary policy regime among industrialized and developing countries (Klaus and Matias, 2001). There is a considerable body of theoretical studies on implementing monetary policy in an inflation targeting regime, and here we reviewed some of the existing studies mainly from central banks reports and research papers.

2.1 The conceptual framework of inflation targeting

Inflation targeting can be defined as a monetary policy framework within which policy actions are guided by the expected path of future inflation relative to announced inflation target (Addison, 2008). The inflation targeting framework was initially adopted to resolve conflicts between monetary policy objectives and so intended to enhance the performance of monetary policy (Mohsin *et al.*, 2002).

In fact, many countries adopted this framework to address problems experienced with previous monetary policy regimes such as exchange rate pegs or monetary aggregates as the intermediate target. In a few countries, inflation targeting was used where earlier inflation-stabilization efforts consisting of heterodox programs and crawling exchange rate bands had conflicted with efforts to maintain the official exchange rate regime and to control inflation. The inflation targeting framework avoids these conflicts by serving as a clear statement that inflation fighting is the primary goal of monetary policy. The central bank is given the freedom to conduct monetary policy independently of the influence of political cycles, thus making it accountable for its success in achieving monetary policy goals.

According to Kamal (2011), Inflation targeting countries have been classified into three regimes, namely full-fledged inflation targeting (FFIT), implicit price stability anchor (IPSA), and Inflation targeting lite (ITL). The regimes were defined by the clarity and credibility of the central bank's commitment to inflation target. Clarity was gauged by public announcement of inflation target and by the institutional arrangements in support of accountability to the target. Credibility was proxied by the actual inflation outturn and by market ratings of long-term local currency government debt.

Kamal goes further to explain the three classifications of IT and stipulated that FFIT is where countries had a medium to high level of credibility. In this context, the central bank clearly commits to the

achievement of an inflation target, and this commitment is institutionalized in form of transparent monetary policy.

IPSA is observed in central banks that have no full transparency and accountability for an inflation target, but gain credibility that results from low and stable inflation, as well as a high degree of financial stability. Such central banks can pursue the objective of price stability and output stabilization.

ITL is where countries announced a broad inflation objective and were not able to maintain inflation as the foremost policy objective due to low credibility. Their relatively low credibility reflected their vulnerability to large economic shocks, financial instability and weak institutional frameworks.

2.2 Lessons from international experience

When examining how well inflation targeting has worked in countries that adopted it, Mishkin and Posen (1997) analyze the experience in the first three countries that have adopted inflation targeting (IT) – New Zealand, Canada and the United Kingdom. New Zealand was the first country to implement inflation targeting formally starting in 1990 and it has been highly successful: This country which was prone to high and volatile inflation before IT regime was adopted, has emerged from this experience as a low-inflation country with high rates of economic growth. As Murrey (2006) pointed out, when inflation targeting was implemented in New Zealand, it was viewed as a special case, because New Zealand was a small open economy that had just announced a number of audacious reforms.

In Canada, inflation targeting has also worked to keep inflation low and stable even though accountability is to the general public rather than specifically to the government through specified contracts. As in New Zealand, a key component of Canada's success with inflation targeting

has been a strong and increasing commitment to transparency and the communication of monetary policy strategy to the public. As part of this strategy, the Bank of Canada has emphasized that inflation targeting can help dampen business cycle fluctuations because the floor of the target range is taken as seriously as the ceiling.

The United Kingdom adopted inflation targeting in 1992 in the aftermath of a foreign exchange crisis in order to restore a nominal anchor and to lock in past disinflationary gains. Until May 1997, inflation targeting was conducted under severe political constraints, that is, under a system in which the government, not the central bank, set the monetary policy instruments. Despite this handicap, British inflation targeting helped produce lower and more stable inflation rates. The success of IT in the United Kingdom can be attributed to the Bank of England's focus on transparency. The Bank of England led the way in producing innovative ways of communicating with the public, especially through its *Inflation Report*.

However, according to Debelle *et al.* (1998), it was probably too early to declare that the IT approach has succeeded in delivering lower inflation, given that inflation has also generally declined in many industrial countries that have not adopted IT. During 1988-92, however, IT countries reduced their inflation rates more than the major industrial countries and since then have remained at levels of inflation comparable to those of major industrial economies.

By end 1990's, a group of emerging-market economies started to adopt the framework. It is important to note that, in many of these emerging-market economies, several economic reforms had been implemented in the years previous to the adoption of inflation-targeting.

South Africa and Ghana are the two African economies which have formally announced a full-fledged inflation targeting framework in the 1st decade of the 2000's and they have been successful (Addison, 2008).

According to Kamal (2011), the first inflation target in South Africa was announced by the government after consultation with the South African Reserve Bank and the framework initially included an escape clause for major unforeseen events that could be outside the Reserve bank's control, and the target was an annual average inflation of the CPI excluding mortgage costs. The South African experience was remarked by a transition period from informal to formal inflation targeting, and this could guide any emerging market to investigate the ability of inflation targeting framework in curbing inflation through practicing the same approach. South Africa's fiscal and external positions have improved since the adoption of inflation targeting, but like many emerging market countries, the implementation of the IT strategy in South Africa was challenged by external shocks.

According to Addison (2008), at the time of adoption of an inflation targeting regime in Ghana in 2002, not all preconditions for an IT framework such as the central bank independence, sound and well developed financial sector and absence of fiscal dominance had been fulfilled, but Ghana has achieved remarkable progress in price stability with IT framework and this supports the emerging view that low income countries with the necessary capacity can benefit immensely from IT framework. Kyereboah (2012), further argue that following the introduction of IT framework, the Ghanaian economy has experienced relative stability, improved macroeconomic performance and resilience, and thus IT has had a significant impact on the reduction of inflation.

According to Mugume (2012), Bank of Uganda moved away from the monetary target to short term interest rates in July 2012, adopting inflation targeting lite (ITL) since the stability and predictability of both money demand and velocity were no longer certain. With Uganda's experience, it is believed that once the policy rate is set correctly, other interest rates should follow, and the evidence shows that the Bank of Uganda's policy rate has influenced other interest rates apart from lending rate. Inflation targeting lite in Uganda has however had some

challenges, among which include: weak fiscal position that in some instance affected the stance of monetary policy; exogenous shocks such as weather, terms of trades shocks, increased demand for foreign exchange and thus the need to build reserves; inadequate instruments to deal with structural liquidity as well as weak transmission mechanism due to structural rigidities that have caused asymmetric response to lending interest rate.

Overall, the literature has shown that inflation targeting is an effective monetary policy framework in ensuring macroeconomic stability in a transparent manner. It is however important to note that the art and science of prudent monetary policy is continuously tested by price shocks that require central banks to carefully assess optimal policy responses (Addison, 2008).

2.2.1 Preconditions for inflation targeting framework

According to Mishkin (2000), inflation targeting entails five main elements:

> *"1) the public announcement of medium-term numerical targets for inflation; 2) an institutional commitment to price-stability as the primary goal of monetary policy, to which other goals are subordinate; 3) an information-inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments; 4) increased transparency of monetary policy strategy through communication with the public and markets about the plans, objectives and decisions of the monetary authorities; and 5) increased accountability of the central bank for attaining its inflation objectives."*

Alongside these elements that come with an inflation targeting regime, researchers that include Debelle *et al.* (1998), Ankinta and Vinod (2009),

Mohamadi (2010) and Jahan (2012) have indicated central bank independence from fiscal dominance is one of the major preconditions for adopting IT. According to Debelle *et al.* (1998), to comply with this requirement, a country cannot exhibit symptoms of fiscal dominance, which implies that: (1) government borrowing from the central bank is low or nil; (2) domestic financial markets have enough depth to absorb placements of public debt, such as treasury bills; government does not have to rely on seigniorage. Otherwise, inflation pressures from the fiscal side may undermine the effectiveness of monetary policy.

According to Ankita and Vinod (2009), absence of external dominance can also be considered as an important precondition to the adoption of IT. The authors define external dominance as the presence of large external vulnerabilities that may jeopardize the fulfillment of the inflation target.

3. Methodology and data discussion

3.1 Methodology

This paper uses both qualitative and quantitative approaches to assess BNR readiness towards inflation targeting framework vis-à-vis the preconditions listed in literature review. The qualitative analysis concerns preconditions pointing to the review of BNR legal framework and practices, while other prerequisites have been tested using empirical data.

The empirical approach is used to test BNR independence from fiscal dominance and external concerns. Authors that have empirically tested fiscal dominance include Fraga *et al.* (2003), Awad (2008) and Ankita and Vinod (2009). Ankita and Vinod (2009) follow Fraga *et al.* (2003), but extends the methodology by testing other preconditions to IT, such as monetary policy independence from external dominance.

In this paper, we depart from Ankita and Vinod (2009) who have developed a methodology which is compressive enough to answer the question of whether the Central Bank meets the main preconditions for adopting IT. Their methodology was applied for the case of India and it consisted of using Generalized Forecast Error Variance Decomposition (GFEVD) on sector specific VAR models. Ankita and Vinod (2009) chose to use GFEVD which is ordering invariant because they were not sure of the order of variables in their respective VAR models. In this paper we propose an ordering for each of the VAR models and therefore we use standard Forecast Error Variance Decomposition (FEVD) and Cholesky impulse responses in lieu of the GFEVD.

The mathematical representation of the VAR (QMS, 2010) models is:

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + Bx_t + \varepsilon_t$$

Where y_t is a vector of endogenous variables; x_t is a vector of exogenous variables and ε_t is vector of innovations.

Given that innovations are usually correlated, the interpretation of variance decomposition will require a transformation P to make them uncorrelated:

$$u_t = P\varepsilon_t \sim (0, D)$$

Where D is a diagonal covariance matrix.

3.2 Data discussion

The two VAR models use quarterly data with a sample spanning from 2005Q1 to 2016Q2. All variables have been collected from the National bank of Rwanda and log transformation has been applied to variables that are not in percent or ratio.

Table 1: Variables in the sector specific VAR models

Sector specific	Variables and ordering
Fiscal dominance	Gross fiscal deficit as a ratio of GDP (GFD_RATIO)
	Reserve money growth (RMG)
	Headline inflation (INF)
External dominance	Log of imported goods index (IMP-INDEX)
	Log of broad money (M3)
	Log of nominal exchange rate (NER)
	Log of consumer price index (CPI)

4. Analytical and empirical findings

4.1 Qualitative findings

A number of preconditions are necessary for a successful implementation of inflation targeting but, the absence of some of these conditions should not discourage countries from embarking towards an IT framework. It is in this connection that the assessment of Rwandan experience suggests that well-established policy credibility has been essential to coping with unfavourable supply shocks. Rwandan experience also shows that when expectations are well anchored the increase in inflation from unfavourable supply shocks has relatively less effect on inflation expectations and hence minor second round effects and the National Bank of Rwanda (BNR) needs to continue to be well prepared and proactive.

It is essential to highlight that, in line with this recent monetary policy strategy, Rwanda and BNR in particular made remarkable efforts to fulfil some of the aforementioned preconditions to inflation targeting.

1. ***An institutional commitment to price stability as the primary goal of monetary policy to which other goals are subordinated:***

   The law n° 55/2007 of 30/11/2007 governing the Central Bank of Rwanda clearly stipulates that the main missions of BNR are: (1) to ensure and maintain price stability and; (2) to enhance and maintain a stable and competitive financial system without any exclusion.

2. ***An information inclusive price strategy in which many variables and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments:***

Since 2012, BNR embarked on the project of "Forecasting and Policy Analysis Systems (FPAS)", which involves the construction of a macroeconomic model for Rwanda and reforming the technical and decision making processes. The FPAS project has exposed BNR staff to hands-on training in building and using a macroeconomic model encompassing different sectors, which is in line with the pre-requisites for the transition to a modern forward looking monetary policy framework.

3. **Increased transparency of the monetary policy strategy through communication with the public and the markets about the plans, objectives and decisions of the monetary authorities:**

BNR underwent substantial transformation and reforms in the way monetary policy decisions are taken and communicated to the public, progressively moving from single decision maker to the Monetary Policy Committee (MPC) composed of internal and external members. This development in BNR decision making process is in line with the effort of the central bank to increase its transparency and credibility as well as making the monetary policy more forward looking and predictable by improving the quality of policy decisions. The Central Bank also considers domestic, regional and international economic developments as well as market surveys.

The central bank uses currently a variety of tools to communicate its monetary policy such as: (i) semi-annual monetary policy and financial stability statement (in February and August), (ii) MPC press releases and press conferences by Governor, (iii) central bank publications (annual reports, inflation reports, BNR economic review, Magazine, etc.), (iv) The use of social media such as tweeter as well

as (v) regular meetings with stakeholders in the financial sector to discuss key issues in achieving price stability and sustaining the stability of the financial sector.

4.2 Empirical findings

4.2.1 Fiscal dominance test

The model for testing the fiscal dominance is composed of inflation, fiscal deficit as a ratio of GDP and reserve money growth. Findings reveal that a one-time shock to fiscal deficit does not explain the current and future path of inflation for short and long forecasting horizon confirming BNR's independence in choosing the monetary policy instruments within a framework of price stability as the primary and overriding objective. For instance, the response of inflation to a shock on budget deficit is numerically 12.5% for a forecasting horizon of four quarters, but is not statistically significant. Therefore, empirical evidence shows that the National Bank of Rwanda does not exhibit symptoms of fiscal dominance. These results are confirmed by the impulse responses depicted in Figure 1 (see Appendixes).

Table 2: Variance decomposition of inflation (Fiscal dominance test)

Horizon	S.E.	GFD_RATIO	RMG	INF
Q1	**3.942459**	**4.614926**	**1.007026**	**94.37805**
		(6.22522)	(4.57510)	(7.42355)
Q2	5.811889	7.823156	10.05340	82.12344
		(8.74782)	(10.7926)	(13.9150)
Q3	6.810863	9.956368	16.12889	73.91474
		(10.7518)	(13.3428)	(16.5488)
Q4 (One year)	**7.625346**	**12.52861**	**18.66413**	**68.80725**
		(12.7535)	(14.5892)	(17.5458)
Q5	8.223739	15.26561	19.46952	65.26488
		(14.4419)	(14.8570)	(17.8955)
Q6	8.611857	17.20962	19.15209	63.63830
		(15.4540)	(14.4103)	(18.0462)
Q7	8.879250	18.05278	18.73574	63.21148
		(16.0006)	(13.9316)	(18.3028)
Q8 (Two years)	**9.061738**	**18.22619**	**18.71905**	**63.05477**
		(16.5298)	(13.8308)	(18.6630)

Cholesky Ordering: GFD_RATIO RMG INF
Standard Errors: Monte Carlo (100 repetitions)

Similarly, historical shocks to reserve money growth do not significantly explain the variance of inflation for all forecasting horizon that have been tested. Indeed, having reserve money as an operational target, BNR has successfully kept reserve money at levels that ensure the ultimate goal of price stability is achieved.

4.2.2 External dominance test

The model on the test of external dominance is composed of imported goods index, broad money, nominal exchange rate and price level. Findings reveal that a shock to imported goods index explains forecast error variance of price level to a magnitude of up to 46.6% for a forecasting horizon of four quarters, pointing to the structural Rwandan

trade deficit. Findings also show that the forecast error variance of price is 25.2% explained by a shock to lagged broad money for a forecasting horizon of four quarters. By contrast, it is found that nominal exchange rate do not explain the current and future inflation, which is in line with the stability of the FRW exchange rate recorded during the sample period.

As far as external shocks are concerned, the National Bank of Rwanda exhibits symptoms of external dominance as evidenced by the reaction of inflation on the shock from imports. However, it is worth mentioning that the shock can be eased by central bank actions of setting appropriate level of broad money which significantly explains the future path of price level. These results are confirmed by the impulse responses reported in Figures 2 of the Appendixes.

Table 3: Variance decomposition of inflation (External dominance test)

Horizon	S.E.	LIMP_INDEX	LOG(M3(-1))	LOG(NER)	LOG(CPI)
Q1	**0.014660**	**30.00090**	**6.378342**	**3.046204**	**60.57456**
		(13.0439)	(7.27891)	(4.84013)	(12.7193)
Q2	0.023820	44.33184	12.75022	4.128072	38.78987
		(14.3169)	(9.87247)	(6.90673)	(11.2882)
Q3	0.029975	49.52971	18.86990	7.148154	24.45223
		(15.5168)	(12.2875)	(7.74728)	(8.89683)
Q4 (One year)	**0.033811**	**46.61773**	**25.21974**	**11.07524**	**17.08729**
		(16.4627)	(14.4737)	(9.11583)	(8.42119)
Q5	0.036817	39.47891	32.40961	14.98520	13.12628
		(16.6721)	(16.3074)	(10.7697)	(9.04226)
Q6	0.040213	31.44486	38.83892	17.94057	11.77565
		(15.8677)	(17.5223)	(12.0861)	(10.1393)
Q7	0.044326	25.05717	42.74299	19.38854	12.81130
		(14.4325)	(18.0009)	(12.9332)	(11.2229)
Q8 (Two years)	**0.048514**	**20.98586**	**44.11426**	**19.62257**	**15.27732**
		(13.2992)	(18.0638)	(13.6777)	(12.2762)

Cholesky Ordering: LIMP_INDEX LOG(M3(-1)) LOG(NER) LOG(CPI)
Standard Errors: Monte Carlo (100 repetitions)

5. Conclusion and Policy implication

Many Central banks around the globe still operate monetary policy framework involving monetary aggregates as operational targets, with the ultimate goal to attain price stability. However, since some decades, monetary policy makers and researchers have questioned the assumed stable relationships between the base money and broader monetary aggregates and between the monetary aggregates and monetary policy goals. Indeed, empirical evidences have shown that the stability of money demand function and money multiplier no longer hold for most of cases and therefore calling for more flexible monetary policy frameworks.

On this regard, the Central Banks of the East African Community and BNR in particular, have committed to adopt an inflation targeting frameworks before the end of 2018. This being the case, this study aimed to assess whether BNR fulfills necessary preconditions for the adoption of an Inflation targeting framework.

This paper uses Variance decomposition and impulse responses of VAR models for different sectors to test necessary preconditions for IT; namely monetary policy independence from fiscal and external concerns. Empirical findings have revealed that BNR does not operate under fiscal dominance but it is highly exposed to structural shocks precisely from the external sector. Indeed, the results show that innovations on fiscal do not explain the current and future path of inflation, confirming BNR's independence in choosing the monetary policy instruments and the fiscal discipline that has characterised Rwanda for the sample period under review. By contrast, the forecast error variance of inflation is 46.6% explained by a shock to imported goods for a forecasting horizon of four quarters, pointing to the structural Rwandan trade deficit.

All in all, results indicate that BNR fulfils many of the analysed preconditions to inflation targeting framework, notably it has: (1) price stability as the primary objective; (2) a well-developed information inclusive *forecasting and policy analysis systems;* (3) independence to choose monetary policy instruments and; (4) a fairly developed communication strategy; (5) no symptoms of fiscal dominance over the conduct of monetary policy. However, BNR should continue its advisory role with a focus on sustainable solutions to the external sector deficit, which is reported to be the main challenge to the IT framework. Moreover, BNR has to be mindful that although not classified among major preconditions to IT, international experience has shown that well developed financial markets as well as a sound and stable financial system are also imperative for a successful inflation targeting regime.

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Appendixes

Figure 1: Impulse responses of the fiscal dominance test

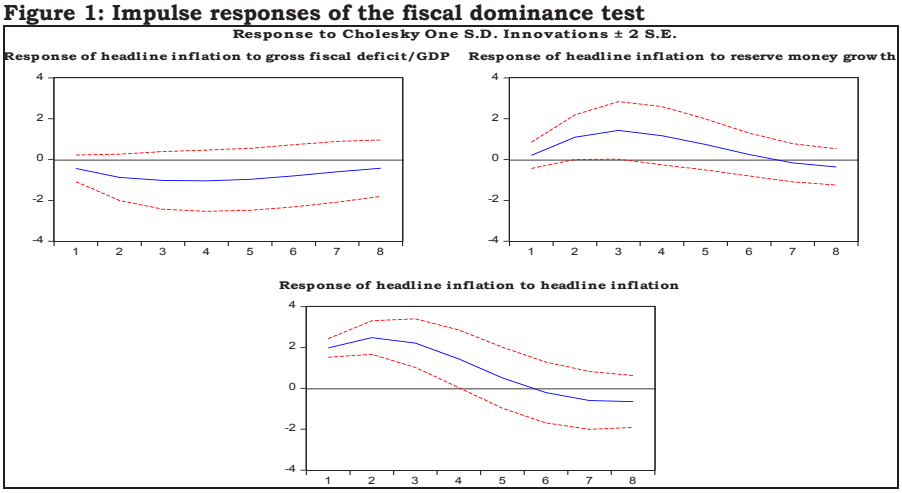
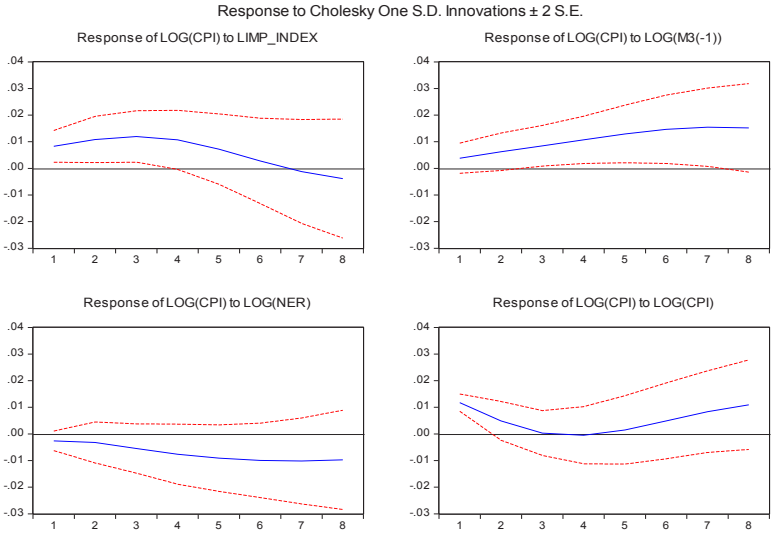


Figure 2: Impulse responses of the external dominance test



The Determinants of Non-Monetary Poverty in Rwanda

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Abstract

This paper's motivation is to contribute to the growing literature on the determinants of Poverty in African countries using Rwanda as an example. Rwanda has made important progress over the last twenty years after the 1994 genocide against the Tutsi. Rwandans have benefited from a rapid economic growth of 8 percent on average since 2000, as well as reduced income poverty. This paper focuses on non-monetary poverty using Alkire and Foster method of the Oxford Poverty and Human Development Initiative (OPHI). The idea is to compute a Multidimensional Poverty index (MPI) by identifying ten indicators grouped into three dimensions: education, health and living standards, which can be used to classify household as poor or not. Another indicator can be derived: the deprivation score of households also called intensity of poverty.Using Rwanda's latest Census data, we use a probit model to model the probability of being poor and OlS estimation for the intensity of poverty. We find that the age, gender, education level of the head of household, and other household characteristics like roofing quality, number of children among others help explain that a particular household is deprived or not as well as the intensity of this poverty.

Keywords: Multidimensional Poverty, Non-monetary poverty, Household Data.

JEL Classification: I3, 01

1 Introduction

This paper's motivation is to contribute to the growing literature on the determinants of poverty in African countries using Rwanda as an example and to give some policy recommendations. Rwanda has made important progress over the last twenty years, after the 1994 genocide against the Tutsi. GDP growth averaged 8 percent since 2000 as published by the National Institute of Statistics of Rwanda (NISR, 2015b). To continue on this path, the country developed its second Economic Development and Poverty Reduction Strategy, in short EDPRS 2 (Rwanda, 2013) in line with the country's Vision 2020 (Rwanda, 2000). Rwandans have seen the overall level of poverty in the country reduce tremendously from 56.7 percent of the population below the national poverty line in 2005/2006 to 44.9 percent in 2010/2011 and 39.1 percent in 2013/2014 (NISR, 2015c).

In Rwanda like in most countries, the most common measure of poverty used by economists is still based on income, consumption, expenditure, or a combination of these three. This can lead to two issues. First, the measurement of these indicators is often accompanied with inaccuracy of data and/or reluctance from the respondents to give information. Second, having an income slightly above or below a poverty line is not substantially different, the same low income can affect different people in different ways (asymmetry). Income poverty does not show health, education or social deprivations, and reducing income poverty does not necessarily reduce non-income-related deprivations or increase the overall well-being of people. For these reasons, this paper focuses on an alternative concept: non-monetary poverty measured by a multidimensional poverty index.

The method used here was previously applied by the NISR in a preliminary descriptive analysis (NISR, 2012) and has been originally derived from the Oxford Poverty and Human Development Initiative

(OPHI) method (Alkire and Foster, 2011). The idea is to identify poor households by considering the range of deprivations they suffer and compute the Multidimensional Poverty Index (MPI). The MPI methodology adapted to the Rwanda context identifies nine indicators grouped into three dimensions: education, health and living standard, each having the same weight. Then a "dual cutoff" approach is applied first to categorize if a particular household is deprived in a particular indicator, and second to classify the household as poor or not. A household that is deprived in more than one third of the weighted indicators is considered as 'MPI poor'. Along with the so-called "incidence" of poverty (the proportion of poor people), we can also identify the "intensity" of poverty using the overall deprivation score of every household. For example, a household deprived in 90 percent of the weighted indicators has a greater intensity of deprivation than another one deprived in only 20 percent of the weighted indicators.

Due to differences in data sources and limitations in data collection, the NISR adapted the definition of some indicators in comparison with the original OPHI methodology to better reflect the particularities of the Rwandan context (NISR, 2012). Therefore, this paper will follow these minor adaptations and use census data instead of the Demographic and Health Survey (DHS) as suggested by the original OPHI computations since we believe this approach gives a more complete picture and allows for a more in-depth analysis of household characteristics.

Although more and more papers about the MPI are being published by the OPHI, most of them discuss merely descriptive results of MPI figures in different countries including Rwanda (OPHI, 2015). In the aforementioned report, the NISR finds that 37 percent of the Rwandan population can be considered as poor and that this is correlated with characteristics like age and gender of the head of household, and other household characteristics like roofing quality or number of children among others.

Using the same MPI definition as the NISR, this paper seeks to validate and explore the links between these determinants and poverty in the Rwandan context by means of further econometric analysis in order to make inferences about possible causes of non-monetary poverty using the latest Census data. First, a probit model is used to analyse the probability of being MPI poor in general as well as the probability to be deprived in each indicator at the household level. Further, an OLS estimation tries to explain the determinants of the intensity of poverty*.

We find that household characteristics like the household head's age, gender, literacy in different languages, employment status and religion as well as household-related variables like roofing quality, number of rooms, access to internet, geographical location, disability status and others are significantly related to both the incidence and intensity of being considered poor in this context. Most of these factors are also significant when looking at the individual indicators, whereas their low significance level in some probit models additionally yield interesting findings.

2 MPI: Method and Literature Review

Alkire and Foster (2011) methodology is based on a multidimensional index. There are ten indicators grouped in three dimensions. Identifying MPI poor households is done in a two-step procedure: first within each dimension by evaluating whether a household is deprived in each indicator according to the respective definition (first cutoff) and second, by identifying across dimensions those households that are deprived in more than one third of the weighted indicators. The MPI has two components: the poverty headcount *H* or proportion of the population who is poor, and the intensity of poverty *A*, which corresponds to the

* The variable used for the intensity takes into account all households poor or not, are classified as poor only the households having an intensity higher than one third

average number of deprivations suffered by the poor. The MPI is then computed as:

$$MPI = H * A \qquad (1)$$

Where

$$H = \frac{q}{n} \qquad (2)$$

H is the proportion of poor people, the total number of poor, q, divided by the total population, n.

Just for comparison purposes, Table 1 summarizes MPI results found by OPHI (Alkire and Robles, 2015) for selected countries including Rwanda. This shows that Rwanda is performing better than countries in the region like Democratic Republic of Congo, Uganda, Ethiopia, South Sudan and Burundi but worse than Kenya and Tanzania.

Table 1. OPHI MPI results for selected countries

Country	Multi Poverty Index	Headcount ratio (% population poor)	Year of the survey
South Africa	0.044	11.1	2012
Iraq	0.045	11.6	2011
Gabon	0.070	16.5	2012
Zimbabwe	0.127	29.7	2014
Ghana	0.139	30.4	2014
Nepal	0.217	44.2	2014
Kenya	0.229	47.8	2014
Pakistan	0.230	44.2	2012/13
Cameroon	0.248	46.0	2011
Haiti	0.248	49.4	2012
Bangladesh	0.253	51.3	2014
India	0.283	53.7	2005/06
Nigeria	0.303	53.2	2013
Senegal	0.309	56.9	2014
Cote d'Ivoire	0.310	58.7	2011/12
Tanzania, United Rep of	0.332	65.6	2010
Malawi	0.334	66.7	2013/14
Rwanda	**0.350**	**69.0**	**2010**
Afghanistan	0.353	66.2	2010/11
Madagascar	0.357	66.9	2008/09
Uganda	0.367	69.9	2011
Congo, Democratic Rep of	0.401	75.1	2011/12
Central African Republic	0.430	77.6	2010
Burundi	0.454	80.8	2010
Mali	0.457	77.7	2012/13
Chad	0.554	87.2	2010
South Sudan	0.557	91.1	2010
Ethiopia	0.564	87.3	2011

In their analysis, NISR (2012) presented some MPI related descriptive results for Rwanda. Their computation is based on a slightly modified version of the MPI to better capture the particularities of the country. They find H = 0.37 meaning 37 percent of the population is multidimensionally poor and the MPI of 0.167.

This revised MPI gives substantially different results from the original methodology as published by OPHI. Using Demographic and Health Survey (DHS) data from 2012, OPHI found that 69 percent of people in Rwanda could be classified as poor and MPI for Rwanda is 0.35 (OPHI, 2015). However, in this paper we adopt the modifications of NISR for two main reasons: first, in our views, it better captures the specific context of Rwanda and second of all, it uses

Census data, which we deem to be more complete than the DHS containing some additional information on household characteristics.

Table 2 summarizes the different indicators and their respective weights, comparing the original MPI and the revised approach that this paper follows based on NISR (2012). The main difference can be found in the definition of child mortality, where the indicator has been redefined considering a household as deprived in this aspect if any child of a woman aged between 15-35 years has died in the family. Taking the original definition (women aged between 15 and 49 years old) in the case of Rwanda would lead deprivation in this indicator to be overestimated because of the 1994 genocide against the Tutsi. Furthermore, we do not consider charcoal as unimproved cooking fuel because the large majority of households in Rwanda uses either firewood or charcoal, the latter actually being even more commonly used by the upper income quintile (NISR, 2015c). Hence, it hardly represents a deprivation in this sense and should not further contribute to the poverty measure in question here. Another main difference to the OPHI approach is that we had to drop the nutrition indicator in the health dimension because there is no data available in the Census related to this field, leading child mortality to be the only indicator for the health dimension with a full weight of one third. Similarly, lack of information led to further adaptions of indicators, for example regarding improved types of latrines and the distance to the water source.

In general, there are some recent accounts dealing with an adapted version of the MPI for a few countries in East Africa matching the specific data availabilities and country context. Levine, Muwonge, and Batana (2014) for example used household survey data to compute a slightly modified MPI for Uganda. They found a MPI of 0.369 (compared to OPHI's 0.367), where deprivation mainly stems from generally low living standards even though the MPI has decreased since a previous 2000/2001 survey.

Table 2. MPI Methodology

Indicator	MPI original methodology (OPHI)	Weights MPI original	MPI Revised (NISR)	Weights MPI Revised
Years of schooling	No household member has completed 5 years of schooling.	1/6	MPI original used	1/6
Child School Attendance	Any school-aged child is not attending school up to class 8.	1/6	MPI original used	1/6
Child Mortality	Any child of women aged between 15-49 years has died.	1/6	Women age group changed: 15-35 years.	1/3
Nutrition	Any adult or child for whom there is nutritional information Is malnourished.	1/6	Indicator dropped, not available in the Census	0
Electricity	The household has no electricity.	1/18	MPI original used	1/18
Sanitation	The household's sanitation facility is not improved (according to MDG guidelines), or improved but shared.	1/18	MPI original used but impossible to identify the improved types of latrines.	1/18
Drinking Water	The household does not have access to improved drinking water (according to MDG guidelines) or safe drinking water is more than a 30 minute walk from home, roundtrip.	1/18	MPI original used but data on distance to water source not available in the Census	1/18
Flooring	The household has a dirt, sand or dung floor.	1/18	MPI original used	1/18
Cooking fuel	The household cooks with dung, wood or charcoal.	1/18	Charcoal was removed from the list	1/18
Assets ownership	The household does not own more than one radio, TV, motorbike or refrigerator and does not own a telephone, bike, car or truck.	1/18	MPI original used	1/18

Brück and Kebede (2013) were interested in the determinants of poverty using both the MPI methodology and the notion of consumption poverty for the case of Ethiopia. They also used a slightly modified MPI and found similar proportion of poor people for both definitions, namely around 52 percent. However, they found disparities regarding the determinants of either kinds of poverty. For example, household size is an important determinant of consumption poverty but there is no significant effect on

multidimensional poverty. Hence, they also insist on the complementarity between the two approaches.

Achia, Wangombe, and Khadioli (2010) analysed the determinants of poverty in Kenya using Demographic and Health Surveys. They constructed an asset index showing the social economic status of each household. The main determinants affecting the probability of being poor based on this asset index were found to be mainly education, living in a rural area, age of the household head and religion.

3 Data

The data used is the Rwanda Population and Housing Census 4 (RPHC4) from 2012, data available with full documentation at NISR (2015a). A thematic report was published by NISR (2014). Four Census surveys have been conducted so far in Rwanda: in 1978, 1991, 2002 and 2012. Census 2002 counted 8,128,553 people as opposed to 10,515,973 people from 2012 census.

Using this data, we first computed our index based on the definition of indicators as described in Table 2 focusing on the household level for all the 242,461 households in the sample. Table 3 shows the proportion of deprived households for each indicator* representing nine dichotomous variables.

* Results are very similar to table 4 of NISR (2012), except that they present results at the household level as opposed to individual level as shown in the NISR report.

Table 3. MPI indicators

Indicators	% Deprived Households	Standard Deviation
Years of schooling	36.19	0.481
Child School Attendance	7.52	0.264
Child Mortality	6.18	0.241
Electricity	82.14	0.383
Sanitation	13.26	0.339
Drinking Water	26.51	0.441
Flooring	77.74	0.416
Cooking fuel	84.92	0.358
Assets ownership	49.76	0.500

We can observe that Rwandan households appear to be most deprived in electricity, cooking fuel and flooring: 85% cook with dung and wood*, 82% of households have no electricity, and 78% have a dirt, sand or dung floor. To be complete, we also observe a MPI of 0.166 and a share of 37.09% of poor households.

Table 4 describes potential explanatory variables available in the Census that we will use for this analysis. The selection of this list of possible determinants of non-monetary poverty is mainly based on theoretical reasoning and past empirical evidence. Further, we eliminated those variables from the analysis that measure similar aspects than the individual MPI indicators, which otherwise would render the analysis impossible.

* Only wood, almost no one uses dung to cook in Rwanda.

Table 4. Household characteristics used as explanatory variables

Variable	Description	Mean	Standard Dev
Age	Age of the household's head	43.29	15.818
Gender	Gender of household's head, 1 if male	0.71	0.452
Onlykinya	1 if Can read and write with understanding in Kinyarwanda only, 0: illiterate	0.48	0.500
French	Can read and write with understanding in French and Kinyarwanda, 0: illiterate	0.05	0.220
Engl	Can read and write with understanding in English and Kinyarwanda, 0: illiterate	0.02	0.135
Frenchengl	Can read and write with understanding in English, French and Kinyarwanda, 0: illiterate	0.05	0.215
Otherlg	Can read and write with understanding in English, French, Kinyarwanda, and some other languages, 0: illiterate	0.01	0.118
Nowork	1 if unemployed	0.17	0.374
Roofql	1 if improved quality material (iron sheets, industrial tiles), 0 if unimproved (local tiles, concrete, cartons, grass,...)	0.60	0.49
Roomno	Number of rooms	4.06	1.692
Nointernet	1 if no internet connection	0.93	0.249
Childno	Number of children who are less than 18	2.148	1.762
Rural	1 if living in a rural area	0.74	0.438
Kigali	1 if living in Kigali	0.12	0.323
Owner	1 if owner of the property the household is living in	0.80	0.400
Cow	Household owns at least one cow	0.32	0.465
Agr	1 if any Household member worked in agriculture during the last 12 months	0.62	0.485
Cath	1 if household's head is catholic, 0 for no religion	0.46	0.498
Christ	1 if household's head is christian but non-catholic, 0 for no religion	0.47	0.499
Muslim	1 if household's head is muslim, 0 for no religion	0.02	0.147
Relother	1 if household's head has another religion, 0 for no religion	0.003	0.053
Disabled	1 if any household member is disabled	0.16	0.36
Insured	1 if at least 1 household member has medical insurance	0.91	0.290

4 Results: Probit and OLS regressions

Hereafter, we present results for 10 probit equations: model (1) for the probability of being poor at a household level based on our revised MPI definition, and the 9 following models explaining the probability of being deprived separately for each indicator used. Models (2), (3), and (4) are respectively for the probability to be deprived in the indicators years of schooling, child school attendance, and child mortality. Models (5), (6), (7), (8), (9) and (10) are respectively for electricity, sanitation, drinking water, flooring, cooking fuel, and assets ownership. Table 5 summarizes the results for models (1) to (4) and Table 6 illustrates living standard models (5) to (10).

In general, we find that all household characteristics considered help explain whether a particular household is deprived. Taking a look at the general treatment of the MPI in model (1), the increasing age of the household's head (HH) has a negative impact on the probability of being poor up to a certain level where the HH might be too old to take care of his family, hence increasing poverty*. Having a female HH is also increasing the probability of being poor. This could be explained by the fact that after the genocide against the Tutsi and until now, a high proportion of families are led by widows, who are facing difficulties in all of the 9 indicators.

Being unemployed, having no access to internet, or more children also increases the probability of being poor. The living area, may it be rural or outside Kigali, affects poverty. This is in line with some correlations found on income poverty using Rwandan household surveys (NISR, 2015c). Being disabled is another determinant of poverty, this may due to the difficult access of disabled people to education, employment, health services and assets in general. Not having any medical insurance tends to increase the probability of being multidimensionally poor.

* We added the square of the variable age to test for this

However, already 90% of households have at least one member with insurance coverage, which means that Rwandans in principle have good access to health care.

On the contrary, the household's head being literate especially in both English and French decreases the probability of being poor as literacy could be a good indicator of employability especially in a country like Rwanda, where both Kinyarwanda as well as English and French are official languages. Being literate in all three certainly is an advantage and provides more opportunities to respective households.

Having a religion, especially Islam, good roof quality and possessing at least one cow especially in rural areas* [5] are other determinants of non-deprived households.

* We added the the interaction term cow*rural to test for this

Table 5. Probit models (1) to (4)

Variable	(1)	(2)	(3)	(4)
	MPI	Schooling	Child school	Child mortality
Age	-0.0459***	-0.0526***	0.000583	-0.0119***
Agesq	0.000398***	0.000455***	0.0000133	-0.0000891***
Gender	-0.0607***	-0.0710***	-0.170***	0.146***
Onlykinya	-0.822***	-0.987***	-0.181***	-0.0869***
French	-1.255***	-1.806***	-0.265***	-0.122***
Engl	-1.407***	-1.809***	-0.291***	-0.331***
Frenchengl	-1.512***	-2.496***	-0.121***	-0.295***
Otherlg	-1.115***	-1.364***	-0.288***	-0.116**
Nowork	0.0289***	0.0240**	-0.0039	0.0310*
Roofql	-0.0307***	-0.00355	0.0284**	0.0749***
Roomno	-0.121***	-0.126***	-0.0521***	-0.0222***
Nointernet	0.691***	1.166***	0.0631**	0.190***
Childno	0.0276***	-0.0712***	0.274***	0.0941***
Rural	0.364***	0.236***	0.125***	0.114***
Kigali	-0.346***	-0.292***	0.00761	-0.0884***
Owner	0.132***	0.0615***	-0.0544***	0.0824***
Cow	-0.0836***	-0.157***	-0.028	-0.0186
Cow x rural	-0.249***	-0.153***	-0.130***	-0.0727**
Agr	0.0398***	-0.00463	0.00154	0.0449***
Cath	-0.314***	-0.344***	-0.190***	-0.104***
Christ	-0.227***	-0.223***	-0.183***	-0.0782***
Muslim	-0.387***	-0.332***	-0.255***	-0.0547
Relother	-0.122*	-0.194**	0.036	-0.139
Disabled	0.0429***	-0.0126	0.187***	0.0359**
Insured	-0.224***	-0.195***	-0.180***	-0.00928
cons	1.425***	1.452***	-1.571***	-1.364***

More or less the same conclusions about the links between the household characteristics and deprivation in different indicators hold for almost all the single probit estimations (2) to (10) even if some variables like age, literacy or religion might not be significant in some cases. Looking more closely at these results can give us more information and explanation about these links.

For the education dimension of the MPI for example, the roofing quality and disability of one household member does not affect the years of

schooling. However, disability does affect the child school attendance indicating that either disability of one of the parents leads children to skip school to take care of him or her, or the disability of the child makes it difficult for him or her to attend school. It should also be noted that age and employment status of the HH or cow possession does not explain child school attendance.

About the health dimension here only represented by child mortality, it is interesting to note that insurance coverage has no apparent effect. That can be explained by what we mentioned earlier about the very high insurance coverage in Rwanda. However, insurance coverage is significant in almost all other estimations. The explanation could be found in the fact that despite being very cheap, about 4 $ per year per person including children, it is possible that a part of the population (the 10 % that have no members with insurance coverage) have such a low income that they cannot afford it and hence cannot meet most of all other MPI criteria.

On the living standard side, age of the HH has no impact on access to water or on flooring quality. Literacy in different languages have a weak or no effect on sanitation. HH being unemployed have no effect on access to water, cooking fuel and flooring. Finally, owning the living property has no impact on being deprived in the assets indicator.

Table 6. Probit models (5) to (10)

Variable	(5) Electricity	(6) Sanitation	(7) Water	(8) Flooring	(9) Cooking	(10) Assets
Age	-0.000251	-0.0129***	0.000488	-0.000441	0.0145***	-0.0136***
Agesq	0.0000166	0.000106***	-0.0000144	-0.0000336*	-0.0000806***	0.000184***
Gender	-0.0725***	-0.103***	0.0484***	0.0626***	-0.0701***	-0.342***
Onlykinya	-0.326***	-0.0138	-0.0766***	-0.415***	-0.322***	-0.466***
French	-0.700***	0.0403*	-0.222***	-0.836***	-0.795***	-0.779***
Engl	-0.850***	-0.0241	-0.302***	-0.961***	-0.879***	-0.758***
Frenchengl	-1.009***	-0.0638**	-0.374***	-1.289***	-0.985***	-1.152***
Otherlg	-0.740***	0.165***	-0.259***	-0.842***	-0.823***	-0.858***
Nowork	0.00528	0.0660***	0.00434	-0.00459	0.0183	0.101***
Roofql	-0.532***	-0.105***	0.221***	-0.166***	-0.398***	-0.313***
Roomno	-0.112***	-0.171***	-0.0451***	-0.179***	-0.00459	-0.199***
Nointernet	0.867***	-0.0125	0.460***	0.887***	0.827***	1.073***
Childno	-0.00646**	-0.0195***	0.0140***	0.0102***	0.0689***	-0.00800***
Rural	0.879***	-0.211***	0.531***	0.676***	1.008***	0.393***
Kigali	-0.533***	0.544***	-0.183***	-0.507***	-0.832***	-0.427***
Owner	0.461***	-0.656***	0.168***	0.746***	0.633***	0.0131
Cow	0.195***	-0.190***	0.225***	-0.0482**	0.368***	-0.314***
Cow x rural	-0.183***	0.0463*	-0.243***	-0.235***	-0.324***	-0.157***
Agr	0.187***	-0.154***	0.0837***	0.151***	0.443***	-0.00926
Cath	-0.135***	-0.117***	-0.0858***	-0.127***	-0.0453	-0.226***
Christ	-0.218***	-0.0640***	-0.00805	-0.110***	-0.141***	-0.280***
Muslim	-0.469***	0.0488	-0.134***	-0.320***	-0.557***	-0.486***
Relother	-0.209**	0.00648	-0.00665	-0.0603	-0.234**	-0.178**
Disabled	0.0615***	0.0387***	0.0594***	0.0197*	0.0565***	0.0617***
Insured	-0.363***	-0.0643***	-0.017	-0.291***	-0.265***	-0.333***
cons	0.950***	0.786***	-1.551***	0.647***	-0.296***	1.167***

Finally, Table 7 shows the results of an ordinary least squares regression for the intensity of poverty *A*. The dependent variable takes into account all households poor or not (remember that are classified as poor only those with a deprivation intensity higher than one third). The OLS analysis can allow us to check if we can draw the same conclusions about what determines an increase in intensity as the probability of being MPI poor. We find that all these characteristics help explain the intensity of this poverty. The results are similar to those in model (1) emphasizing that the determinants explaining the probability of being multi-dimensionally poor

also explain the intensity of poverty.

Table 7. The intensity of poverty

Variable	Coefficient	Variable	Coefficient
Age	-0.00391***	Rural	0.0657***
Agesq	0.0000305***	Kigali	-0.0459***
Gender	-0.00768***	Owner	0.0204***
Onlykinya	-0.0854***	Cow	-0.00156
French	-0.135***	Cow x rural	-0.0372***
Engl	-0.154***	Agr	0.00865***
Frenchengl	-0.160***	Cath	-0.0381***
Otherlg	-0.133***	Christ	-0.0316***
Nowork	0.00388***	Muslim	-0.0530***
Roofql	-0.00650***	Relother	-0.0225***
Roomno	-0.0141***	Disabled	0.00827***
Nointernet	0.0664***	Insured	-0.0307***
Childno	0.00746***	cons	0.438***

Conclusion and Policy Recommendations

This paper's main objective is to identify the main determinants of non-monetary poverty in Rwanda using an econometric approach as opposed to most papers on the topic using mainly descriptive statistics. The method used is the Multidimensional Poverty approach by NISR (2012), originally derived from Alkire and Foster (2011).

We present results for 10 probit equations. All the household characteristics used help explain that a particular household is deprived or not in general. The same characteristics give somehow similar conclusions for almost all the single probit estimations using the indicators as dependent variables. We also present the results of an ordinary least squares regression for the intensity of poverty and find similar results.

Given these results, we can make the following policy recommendations. The Rwandan authorities could use MPI results by household or location in targeting the poorest, the beneficiaries of their different poverty reduction policies like the Vision 2020 Umurenge Program (VUP) which give technical and financial assistance to the poorest people. In this case, being MPI poor could be a criteria to access or not such programs.

Since as we showed, households led by female face more difficulties than others, targeting them through implementing better or improving current policies aiming at helping them access to finance could produce significant results. The number of children is also a key determinant: improving knowledge, sensitization and access to contraception especially in rural areas is important. Improving living situation of disabled people especially their access to a normal education and the labour market is key as their condition is strongly linked to poverty.

Policies aiming at providing decent housing materials at a lower cost for

basic infrastructure, as well as ensuring internet access for everyone are also recommended. Since being a member of a religious community seems to reduce non-monetary poverty, support such groups in their initiatives for education or health for example could be a good way to help reduce multi-dimensional poverty. Further enforce health insurance coverage to reach universal coverage would also further reduce non-monetary poverty.

Despite the fact that Rwanda's literacy rate has been improving from 64.4% in 2002 to 68% in 2012 (NISR, 2014), table 4 shows that the majority of literate household heads (48%) can read or write with understanding only Kinyarwanda. Results of this paper show that literacy in both English and French is an advantage, a recommendation could be to focus on improving language skills of children even at primary school level. Finally, Possessing a cow is another determinant of not being poor, confirming that the current Girinka program providing a cow to the poorest families should continue. As the VUP, the beneficiaries of the Girinka program could also be targeted through the MPI.

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