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## Foreword

The bi-annual publication of BNR Economic Review intends to avail information to the public on various economic topics, focusing on features and challenges of the Rwandan economy. This 16th volume of BNR Economic Review consists of four research articles touching on topical issues related to the role of financial sector for effective transmission of monetary policy and the nuanced response of exchange rate to changes in capital and financial account structure. The papers aim to provide concrete evidence-based analyses and policy recommendations in order to continue improving economic policymaking in Rwanda.

The first two articles focus on the interest rate channel of monetary policy transmission in Rwanda, an important topic for monetary policy-makers in the wake of the adoption of a price-based monetary policy framework in 2019. Cognizant of the role played by the banking sector soundness for the transmission of monetary policy impulse in Rwanda, the first article examines how asset quality in the banking system affects the degree and speed of reaction of retail market interest rates to changes in the central bank rate (CBR). The study uses panel data from a sample of 10 commercial banks. The empirical findings confirm insights from recent studies on the ongoing improvements in the transmission of monetary policy in Rwanda and suggest that deterioration in bank asset quality lowers the immediate pass-through, thereby impeding monetary policy transmission in Rwanda. The findings reiterate the importance of addressing credit risk as a critical measure for ensuring an effective transmission of monetary policy impulse in Rwanda. The authors call for more efforts in laying supportive legal and institutional environments for banks by streamlining the insolvency law and the collateral foreclosure process that will facilitate banks to recover funds from collateralized written-off loans. The authors also recommend banks to enhance their credit recovery function.

The second article looks at the upstream of monetary policy transmission in Rwanda where National Bank of Rwanda (NBR) interacts with domestic banks on money markets. The aim is to understand the implications of money market dynamics for the implementation of monetary policy in Rwanda. Unlike previous empirical studies

on the interest rate channel in Rwanda, this paper takes a different perspective by looking at the effect of banks' decisions with respect to some money market features such as allotment and bank reactions to central bank communication. The findings suggest that bank decisions reinforce central bank policy objectives on the interbank market but less on the repo market. Another key evidence is that efficient communication can be a useful tool to achieve policy goals. Overall, these findings underscore a positive impact from recent reforms in monetary policy implementation and the importance of ongoing efforts to strengthen monetary policy operational framework, which is critical for effectiveness of monetary policy transmission.

The next article builds from recent empirical evidence from emerging and advanced economies to investigate macroeconomic implications of household debt versus corporate debt in Rwanda. Using time series data spanning from 2007 to 2019 in Vector Error Correction Models (VECMs), the paper mainly finds that both household and corporate debts have a positive effect on economic growth in the long run, though the positive effect from corporate debt is relatively stronger compared to household debt. The unveiled growth benefits of both household and corporate debt in Rwanda could be explained by the fact that private sector debt level is still relatively low. Therefore, the findings support ongoing initiatives to expand financial inclusion and development. However, economic policymakers and NBR in particular should continue to closely monitor the dynamic structure of private debt and ensure an appropriate institutional and regulatory framework, which would mitigate any downside risks going forward.

As the Rwandan economy has been rapidly growing and strengthening its ties with the rest of world, the structure of balance of payment evolved and macro-economic effects of such a dynamism were substantial. In that context, the fourth article sheds light on the linkages between different types of capital flows and real exchange rate in Rwanda. This article uses vector autoregressive framework with data from 2000 to 2018. In addition to other key variables namely terms of trade, productivity differential and trade openness, the results revealed that the response of exchange rate to capital flows depends on capital types, explaining the relative orientation towards tradable versus the non-tradable sector. This study shows that inflows of

Foreign Direct Investment and other private borrowings have positive (depreciative) effect on real exchange rate, suggesting a bias towards tradable sectors. By contrast, inflows of public sector and remittances increase the demand for and the price of non-tradable goods, thereby causing an appreciation of the real exchange rate. The findings echoes the rationale of taking into account the evolution and structure of capital flows during monetary policy formulation.

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RWANGOMBWA John
Governor

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# Effect of bank asset quality on monetary policy transmission in Rwanda

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## Abstract

A well-functioning monetary transmission mechanism is critical for monetary policy. In 2019, National Bank of Rwanda (NBR) shifted from a monetary targeting to a price-based monetary policy regime, which considers that changes in the central bank rate (CBR) are transmitted to retail interest rates to influence aggregate demand and ultimately inflation. Although monetary policy transmission improved in Rwanda over the last two years, it remains weak, and efforts to improve it further are necessary. Extensive theoretical and empirical literature globally indicate that in bank-dominated financial system, monetary policy actions are transmitted largely through banks and therefore, banks' financial health can affect the effectiveness of monetary policy by passing on interest rate changes from central banks to market rates. The objective of this paper is to assess how changes in asset quality of banks in Rwanda influence their loan pricing behavior and responsiveness to monetary policy.

These effects were estimated in a dynamic panel data framework using a generalized method of moment (GMM). We find evidence that the deterioration in asset quality of banks lowers the immediate pass-through, hence impeding monetary policy transmission in Rwanda. Efforts should be put in laying a supportive environment for banks to increase recovery of written-off loans and this will reduce credit risk premium that banks have to factor in while pricing new loans. Specifically, the insolvency law and the collateral foreclosure process need to be streamlined to facilitate banks to recover funds from collateralized written-off loans. As for banks, they need to enhance their credit recovery function.


**Key words:** Asset quality, Banks, Monetary policy transmission, Rwanda

**JEL Classification:** E52, E58, G21

## 1. Introduction

The economic transformation and financial development over the World have brought changes in the thinking of monetary policy formulation and implementation overtime. Financial sector reforms and payment systems modernization have made the monetary targeting framework challenging, and pushed many central banks including the National Bank of Rwanda (NBR), to adopt interest rate-based monetary policy framework. The foundation of the latter framework is the existence of an effective market mechanism that is able to transmit monetary policy actions into real prices in the market (Aguirre, et al., 2016), which in turn needs a sound and stable financial system among other prerequisites (Vredin, 2015).

Primarily, the monetary authorities assume that policy actions are transmitted to market interest rates instantaneously, symmetrically, and in a linear fashion (Rocha, 2012). However, evidences show that banks' pricing behavior and structure of financial system have an important bearing to transmission of monetary policy actions (Gregor & Melecky, 2018). In a bank-dominated financial system, monetary policy actions are transmitted largely through banks and therefore, banks' financial health can affect the effectiveness of monetary policy by passing on interest rate changes from central banks to market rates (Gigineishvili, 2011). Banks' assets are more influential channels, given that the largest asset category of most banks is loans. Banks with less risky loan portfolios, on the one hand, are expected to adjust their lending and pricing of loans in response to monetary policy impulses. On the other hand, banks with high level of non-performing assets strive to build up provisions and may (less) disproportionately change their lending rates, thereby impeding monetary transmission (Byrne & Kelly, 2017). Indeed, under default risk distress, new loan pricing must reflect the higher risk weighting caused by distressed loan books and potentially be increased to offset loans which are not bearing interest. Under such circumstances, banks' ability to supply credit and lower loan pricing in response to reductions in the policy rate could be hampered (Makambi, et al., 2013).

This assertion is more compelling for the case of Rwanda, where the response of bank lending rate to successive policy rate cuts has been weak. For the past six years, the policy rate was cut several times (from 7.5 percent in March 2013 to 5.0 percent in June 2019), in an effort to stimulate bank lending and further support the economy through domestic demand and private sector investment. However, the pass-through

of policy rates to market rates remained weak (Kigabo, 2018; Kigabo & Kamanzi, 2018), with weighted average lending rates decreasing disproportionately from 17.17 percent in March 2013 to 16.54 percent in June 2019. Normally, the stickiness of bank lending rates with respect to central bank rates is generally viewed as an obstacle to the effective implementation of monetary policy.

Moreover, although the Non-Performing Loans (NPLs) ratio dropped in the last 10 years (from 12.8 percent in September 2009 to 4.9 percent in September 2019), it has been in some instances driven by write-offs that required banks to increase provisions. This trend in NPLs has contributed to the setting of the lending rates (Kigabo & Nyalihama, 2016; Karangwa & Nyalihama, 2018).

With the above situation in the backdrop, this study is an attempt to analyze whether and to what extent the asset quality of banks interferes with policy rate pass-through to commercial lending rates in Rwanda. The novelty of this paper lies in presenting new piece of evidence on monetary transmission mechanism in Rwanda. Most of the studies on interest rates pass-through in Rwanda were done at aggregated level (Kigabo, 2018; Kigabo & Kamanzi, 2018). The advantage of using bank level data in this study is that, it delivers more accurate estimates of parameters due to larger number of observations, and more variability (Hsiao, 2006). Others studies (Kigabo et al, 2016; Karangwa and Nyalihama, 2018) focused on the determinants of the interest rate spread. A more recent study that tested the interest rate pass-through to deposit and lending rates in Rwanda, Kigabo (2019) recommended further research that uses econometric models with more variables including bank specific characteristics to give results that are more robust. The present study emphasizes on the role of the banking system in monetary transmission, especially on the role of asset quality of banks. In addition, other factors that affect individual bank in setting lending prices and likely impact of each factor on pass-through of policy actions are discussed. This knowledge could provide important input for the identification of measures that are needed to improve the transmission of monetary policy in Rwanda.

The rest of this paper is structured as follows: Section 2 highlights some aspects of asset quality of banks and monetary policy transmission in Rwanda. Section 3 outlines theoretical and empirical literature. Section 4 presents the methodology. Section 5 provides results and discusses the findings. Section 6 concludes with policy recommendations.

## 2. Some facts on monetary policy transmission and assets quality of banks in Rwanda

This section discusses the monetary policy framework and its transmission in Rwanda, as well as some features of the banking sector.

### 2.1. Monetary policy framework and transmission mechanism in Rwanda

The NBR has adopted the price based monetary policy framework effective from January 2019, due to the ongoing economic transformation and financial sector developments that posed some challenges to monetary targeting framework adopted since 1997.

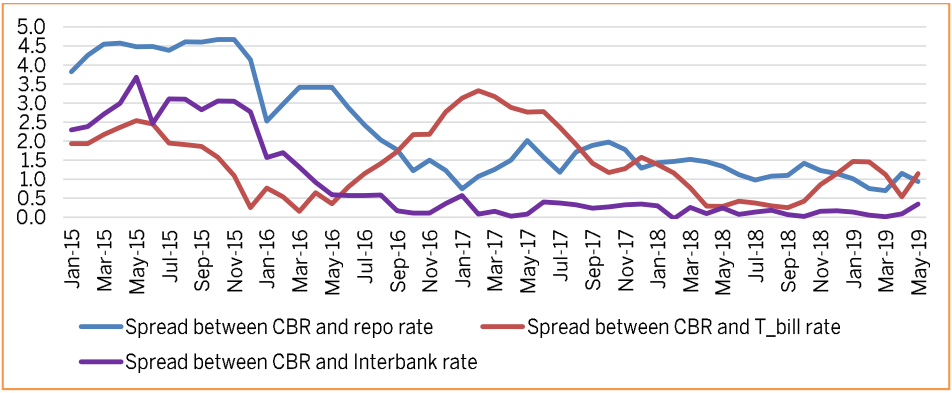
In the new framework, the central bank uses the interest rate as an operating target, and align money market rates with the central bank rate (CBR). Ideally, a change in CBR would lead to change in money market rates (interbank rates, repo rates and treasury bill rates) from short maturities to longer maturities. In the next phase, the change in money market rates would lead to change in deposit and lending rates, which in the final phase of monetary transmission affect savings, investments and consumption, and therefore aggregate demand and ultimately prices. Therefore, the foundation of a price based monetary policy framework is the existence of an effective market mechanism that is able to transmit monetary policy actions into real prices in the market.

The effectiveness of this framework depends on a set of pre-requisites including a sound and stable financial sector among others. In an efficient financial sector, banks will follow the cue set by monetary policy authority to increase or decrease interest rates hence transmitting the actions of monetary authority into real prices in the market. Banks are therefore important players for effective transmission of monetary policy, especially in economies like Rwanda, where banks accounts the largest share of the financial system assets.

In an effort to stimulate bank lending and further support the economy through domestic demand and private sector investment, the NBR's Monetary Policy Committee revised down the CBR six times since 2013, from 7.5 percent in March

2013 to 5.0 percent in June 2019. The money market rates (interbank rates and T-bills rates) generally responded to the central bank rate (CBR). The spread between the money market rates and CBR has significantly reduced in recent period. This demonstrates the working of the first phase of interest rate channel in transmitting monetary policy impulses in Rwanda.

Figure 1: Spread between central bank rate and money market rates

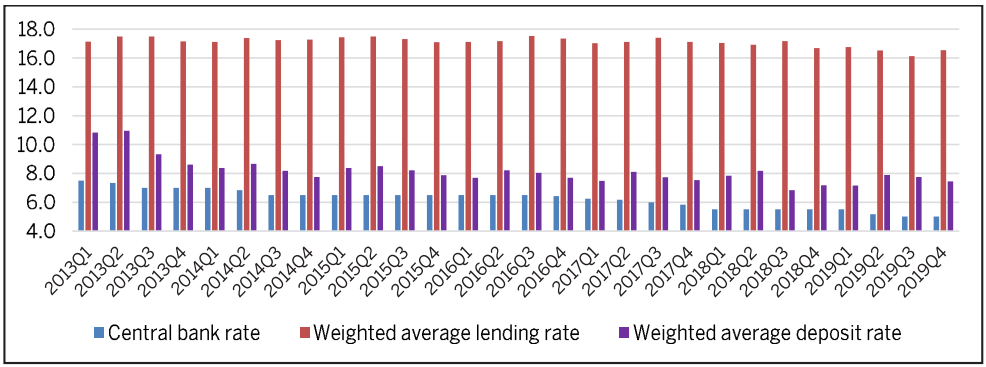



Source: National Bank of Rwanda, 2019

However, the pass-through of policy rates to market rates remained weak. The weighted average deposit rates reduced from 10.94 percent in March 2013 to 8.13 percent in June 2019, while the weighted average lending rates decreasing marginally from 17.17 percent in to 16.54 percent in the same period. This poses a problem to a second phase of transmission of policy actions of monetary authority to the real economy.

The deposit rate has been more volatile than the lending rate mainly due to the fact that the deposit market is driven by large depositors who have negotiating power, and emergence of other investment opportunities such as the treasury bills. According to Karangwa and Nyalihama (2018), the rigidity in the lending rate was driven by the cost of funds, operating costs, loans' market concentration and credit risk (loan loss provisions).

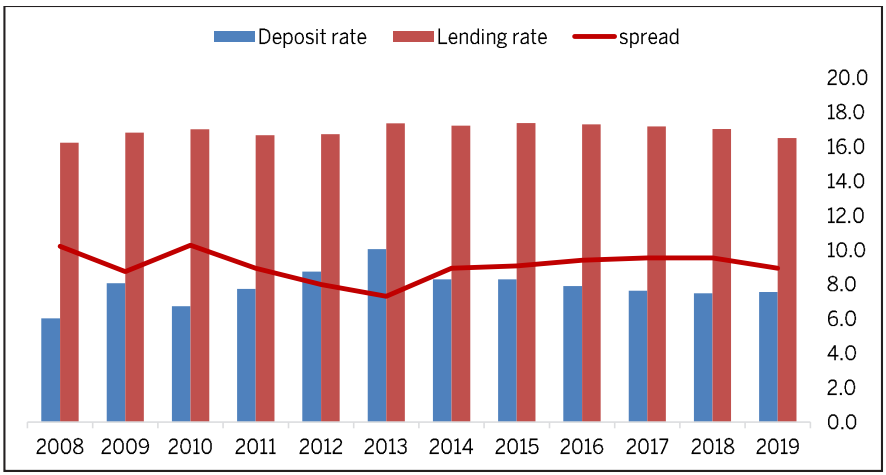
Figure 2: Central bank rate versus average market rates in Rwanda




Source: National Bank of Rwanda, 2019

Data indicate that the wedge between the average lending and deposit rate, which generally indicates the efficiency of banks, has consistently remained sticky. The main reason attributed to lending rates that have been rigid and quite high over the past compared to the fluctuating and less elevated deposit rates.

Figure 3: Annual average interest rate spread in Rwanda (2008-2019)




Source: National Bank of Rwanda, 2019

## 2.2. Overview of financial sector and the quality of bank assets in Rwanda.

Rwanda's financial sector has continued to grow, and became diversified albeit still dominated by banks. The financial sector developments are linked with the increased financial sector liberalization and ongoing efforts to increase financial inclusion and access to finance. In terms of assets, the ratio of total assets of the financial sector relative to GDP increased to 56.9 percent in June 2019 from 5.2 percent in 2007. The establishment of capital market in 2011 has started to yield results, but more efforts are needed for more vibrant and diversified financial sector.

By June 2019, the financial sector consisted of 500 institutions: 16 Banks, 457 Microfinance institutions, 14 Insurers and 13 Pension Schemes (these include 1 mandatory Pension scheme and 12 Voluntary Pension Schemes). Banks continue to hold the largest combined share of financial sector assets at 66.1 percent. Before 2008, the banks' combined share was over 80 percent, implying diversification in financial sector in recent years. This is a positive development especially in terms of financial breadth.

Financial intermediation remains the main business of banks and source of income for the banking sector. On average, the share of loans to total assets accounted for 55.4 percent between the first quarter of 2012 and the second quarter of 2019. Bank with the largest share of loans to total assets accounted for 65.6 percent compared to the bank with the smallest share of 35 percent of total assets, entailing the standard deviation of 7.8. Cognizant that the size of banks is measured by the logarithm of total assets, the same analysis indicates that there is strong positive correlation between the total assets and gross loans, implying that big banks lend more than small banks.

Moreover, the average share of bank deposits to total banking system liabilities accounted for 83.7 percent of over the same period. Bank deposits are positively correlated with bank gross loans, showing the necessity of more deposits, especially the long-term deposits to enable banks continuing finance the economy. This may also indicates the likely influence of cost of deposits, when banks set their lending rates.

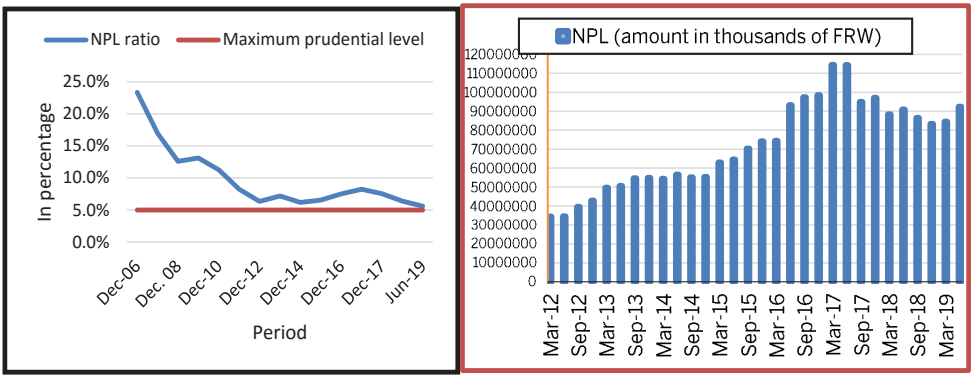
The banking sector loans are mainly to the private sector and are largely in local currency. Loans to government agencies accounted for only 6.7 percent of total loans

in June 2019, and the rest going to private households and corporates. Local currency loans accounted for 87.7 percent of total banking sector loans, with only 12.3 percent being denominated in foreign currency, hence minimal exchange rate exposure and risks in lending activities.

The banking sector in Rwanda remains sound and stable. The sector maintains capital buffer above the minimum prudential requirements, and are expected to increase their capital base in the next five years in line with the new licensing requirements by the NBR in December 2018. It also remains adequately liquid, with liquidity coverage ratio that indicates the proportion of banks' liquid assets to their short-term obligations standing at 180.5 percent as at end June 2019, against 100 percent minimum prudential requirement. Banks' profits were largely driven by Net Interest Income (NII), and 85 percent of total interest income is generated from loans. Over the sample of our study, the average share of loan interest income to total income among banks stood at 56.3 percent, with maximum share standing at 81.2 percent compared to the minimum share of 37.5 percent, reflecting disparities among banks. It is worth noting that, non-interest income represents only 25 percent of banks' total income, indicating overreliance on lending for revenue generation.

With regard to asset quality, the Non-performing Loans (NPLs) have dropped over the last 10 years, although this has been in some instances driven by write-offs. The BNR regulation loan classification and provisioning requires banks to write-offs loans classified in" loss category" for more than 360 days. Although banks recovery of written off loans have been increasing in the recent past, when banks write-off, they first incur provisional expenses that affects their incomes. Therefore, where NPLs dropped due to write-offs, banks incurred provisional expenses. In fact, the share of provisional expenses to total NPLs increased from 49 percent in June 2011 to 93 percent in June 2019.

Figure 4: Trend of Non-performing loans in banking sector.




Source: National Bank of Rwanda, 2019

The regulation of the NBR on credit classification and provisioning ensures that banks promptly identify and monitor their nonperforming credit facilities and undertake adequate measures to manage credit risk in their portfolios. It classifies credit facilities into five categories namely: normal, watch, substandard, doubtful and loss; and loans that fall in the last three classes are considered as non-performing loans. A credit facility with a pre-established repayment schedule is considered as non-performing if the principal or interest is due and unpaid for at least ninety days; or the principal or interest payments equal to at least ninety days interest have been capitalized, refinanced, renegotiated or restructured.

A bank is required to provide general provisions for credit facilities classified as "Normal" and "Watch" Risk, and maintained at not less than 1% and 3 % of the outstanding balance of the credit facility respectively. It must also maintain specific provisions for all non- performing credit facilities. All credit facilities classified as "Substandard", "Doubtful" and "Loss" are subject to specific provisions, regardless of whether the subjective or objective criteria were used in determining classification.

Specific provisions for substandard, doubtful and loss assets are maintained at not less than 20%, 50 % and 100% of the outstanding balance of the credit facility respectively. The outstanding balance consists of principal, interest which has been capitalized and all other charges, fees and other amounts, which have been capitalized to the outstanding balance, interest in suspense. In addition, a bank must write off loans that have been classified "Loss" for more than 360 days. However, a

bank may continue the recovery process after writing off the loan in line with other applicable laws.

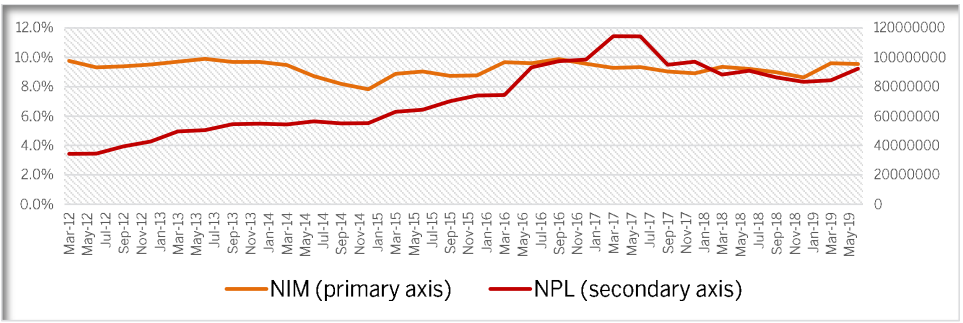
Ideally, the level of loan loss provisioning should be able to reflect the beliefs of bank management on the quality of the loan portfolio that they have, indicating that provisions should be able to cover the whole spectrum of expected credit losses if they are to think of provisions as a measure of true credit risk. In this regard, provisions in banking system in Rwanda have increased recently, and are expected to increase further in next 5 years after the implementation of Internal Financial Reporting Standards 9 (IFRS9) that started in December 2018. In this standardized reporting system, banks are required to recognize the provision for the expected credit loss at all the times and its implementation may pose more burden to the banks' balance sheet.

Recalling that healthy banks are expected to pass the actions of the central banks to the market, the presence of NPLs and increased provisions could have affected the loan price behavior of banks by passing the risks to borrowers, hence limiting the expected reduction in lending rates in response to central bank rate cuts. A common indicator of efficiency of financial intermediation is the Net Interest Margin (NIM) of a bank, which is the difference between interest income and interest expenses (as percent of total assets). The NIM is an important measure of how efficiently banks transmit monetary impulses in fulfilling the ultimate monetary policy objectives of price stability with growth. As banks mainly rely on unremunerated demand deposits, the only way to maintain their NIM when credit losses increase is by raising the lending rate. In countries where remunerated term deposits dominate liabilities of banks, banks respond to CBR rate by first lowering the deposit rate and lending rate in the same proportion and here stability of NIM does not mean that transmission is ineffective. In Rwanda, the stability of NIM has been achieved through rising or holding stable the lending rate.

When banks face higher default risks, the direct impact would be observed on reduction in NIM. However, the figure below for the case of the banking sector in Rwanda indicates that, the NIM remained stable for many years in the range between 8% and 10 percent, regardless the changing trend of non-performing loans in the sector. This may indicate that banks have priced the risks prudently by keeping high

lending rates and maintain their level of NIM and profitability. This can also be an indicator of limited competition in the banking sector in Rwanda.

Figure 5: Non-performing loans and Net interest margins of the banking system in Rwanda




Source: National Bank of Rwanda, 2019

## 3. Literature Review

In consideration of the main objective of this paper, this section reviews theoretical and empirical literature on effect of bank asset quality on monetary policy transmission mechanism, and factors that influence the interest rate pass-through.

### 3.1. Theoretical Literature

One of the pillars of contemporary monetary economics is the good understanding of monetary transmission channels, their strength and speed, which determine the effectiveness of monetary policy. Among various channels of monetary transmission, the interest rate channel is the most documented mechanism, and has been subjected to intense scrutiny (Gigineishvili, 2011). It started to attract more attention with the growing popularity of forward-looking monetary policy framework, for which the interest rate channel is indispensable.

Over the years, basic assumptions of the interest rate channel were scrutinized. Initially, Rousseas (1985) proposed a simple theoretical model for interest rate pass-

through based on the marginal cost theory. Assuming perfect competitive markets, the author demonstrated that bank lending rates would change one-to-one with the monetary policy rate (the cost of funding), i.e. a complete pass-through. When a central bank changes the official rate, it affects short-term money market rates, longer-term rates, banks' cost of funds, and, ultimately, bank lending rates (Borio & Fritz, 1995). However, this assumption is often violated in practice because the timing and extent of this transmission depends on additional factors, which are often outside the direct control of monetary policy. Therefore, a complete pass-through may not always be expected.

Generally, economic theories group factors that influence the pass-through of monetary policy actions to market rates and banks' lending interest rate setting into three categories: (i) individual bank-specific factors such as operating or administrative costs, credit risks (non-performing loans), interest rate margin, bank capital, among others; (ii) factors specific to the banking sector/industry such as the degree of competition or market concentration, regulatory requirements such as statutory reserve requirements or regulated minimum deposit rates and, (iii) macroeconomic indicators which include real gross domestic product (GDP) growth rate, and inflation rate (Rebei, 2014).

When banks lend money to customers, an interest rate is charged for a number of reasons, including value preservation, compensation for risk, and profits among others (Sheriff & Amoako, 2014). In bank-dominated financial systems, theoretical and empirical literature acknowledged that bank-specific characteristics play an important role in loan pricing decisions, hence may influence the responses of bank lending rates to central bank policy actions. From this point of view, Bernanke & Blinder (1988), Bernanke & Gertler (1995), Jimborean (2009) and Ehrmann, et al. (2011), stressed that banks are not neutral conveyors of monetary policy impulses. Among the banks' characteristics component, the quality of assets is given a special emphasis, due to the fact that, loan portfolio is likely to be the main asset for banks, and any risk that affect the returns from this asset influences the decision of banks in their loan pricing.

The asset quality of a bank's balance sheet is commonly interpreted in terms of credit risk inherent in the loan portfolio. Credit risk in a bank's asset portfolio, i.e., the probability of a bank asset turning into Non-Performing Assets (NPA) is proxied by

variables such as (i) NPA to total assets/interest income earning assets; and (ii) loan loss provisions to total assets/total loans (Almarzoqi, et al., 2015). In case of accommodative monetary policy, profit-maximizing banks might be less responsive to central bank rate when credit quality is poor, and contribute to the sluggishness of pass-through mostly in non-competitive banking/financial systems. In perfectly competitive markets, individual banks are price- takers.

The role of bank credit risks in influencing the level of pass-through of central bank rate to market rates is based on the fact that, banks are able to cope with the credit risk inherent in their loan portfolio by appropriately pricing the lending rates, and successfully absorbing the loan losses arising out of risky exposures (Marinkovic & Radovic, 2014). They thus charge additional credit risk premia from their borrowers to compensate themselves for higher credit risk in order to protect their margins, meet their targeted return on assets as well as build up loan loss provisions. Therefore, the bank asset quality, lower/higher non-performing loans, may improve/hamper the pass-through from central bank policy rate to market rates (Sander & Kleimeier, 2004).

However, some theories suggest that banks may not always respond to risky assets by raising their lending rates. Stiglitz and Weiss (1981) advanced the hypothesis of credit rationing, which may occur because of asymmetric information in credit markets. When banks perceive the default risk to be high, they are inclined to maintain a large spread between lending and deposit rates. However, given that borrowers that accept higher rates are likely to be of poor quality and borrowers with less risky investments are likely not to borrow if rates increase (i.e., adverse selection), and given that any increase of lending rates will give incentives for borrowers to choose riskier projects (i.e., moral hazard), any monetary policy rate increase would raise the probability of loan default. Thus, banks may decide not to raise their rates albeit their cost for getting funds increases, and reach the equilibrium in the loan market by rationing credit. As a result, lending rates may be rigid and adjustment may turn out to be asymmetric (Grigoli & Mota, 2017).

### 3.2. Empirical Literature

Some empirical studies examined interest rate pass-through using just a monetary policy rate as an explanatory variable of lending rate (Jobst & Kwapil, 2008; Holmes, et al., 2015; Bernhofer & Treeck, 2013). In contrast, other papers acknowledge that the lending rate markup and interest rate pass-through depend on various market conditions and not just on the monetary policy stance, hence including more control variables ( Gigineishvili, 2011 ; Gambacorta, et al., 2015; Eller & Reininger, 2016).

The empirical literature indicates that the analysis of factors that influence lending interest rate setting by commercial banks, and the pass-through of policy rates to market rates largely focused on banking system related factors as well as macroeconomic indicators. A wide range of different variables has been identified as important within each of these categories (Georgievska, et al., 2011; Bhattarai, 2015). At the level of individual banks, some bank characteristics such as credit risks, bank size, operating costs, leverage ratio, capital buffer, and the liquidity ratio; were found to be the determinants of loan pricing and pass-through of monetary actions ( Horvath & Podpiera, 2012; Holton & d'Acri, 2015; Havranek, et al., 2016; Kapuściński & Stanisławska, 2018).

Studies on pass-through have emphasized on the role of the quality of bank assets through credit risk following episodes of global financial crisis. Paries, et al. (2014) and Holton and d'Acri (2015) analyzing the case of European countries found the growing influence of borrower's credit risk on corporate loan rates, and report a significant effect of credit risk on the interest rate pass-through. In other words, they found that banks tend to, at least in part; pass on costs associated with higher non-performing loans to borrowers in form of higher interest rates.

Gigineishvili (2011) used cross-sectional data that cover 70 countries from all regions, including low income, emerging and developed countries, with a wide range of macroeconomic and financial market structure variables to uncover structural determinants of pass-through. The findings reveal that credit quality, overhead costs, exchange rate flexibility, and banking competition strengthen the pass-through, whereas excess banking liquidity impede it. Among macroeconomic variables, per capita GDP and inflation have positive effects on pass-through, while market volatility has a negative effect. In the same scope, Saborowski and Weber (2013) brought new

insight on the exact impact of reduction in credit risks to pass-through of policy rates. Their findings suggest that non-performing loans (NPL) ratios, liquidity ratios as well as exchange rate flexibility along with banking sector concentration and financial dollarization are particular determinants of pass-through. More importantly, they advocated that a fall in the share of NPLs in total loans from the 80th to the 20th percentile is associated with an increase in pass-through of between 10 and 20 percentage points.

Studies on African countries support the some findings (Ahokpossi, 2013; Were & Wambua, 2014). The results from their analysis indicate that bank-specific factors such as credit risk, liquidity risk, and bank equity have an impact on transmission of monetary policy.

In spite of agreement of the direction and effect of each variables on loan pricing and pass-through of monetary policy actions, there are some controversial findings depending on the various economic structures, variables used as proxies and methodology employed. Sorensen and Werner (2006) and Horváth and Podpiera (2012) found that credit risk (loan provisioning) improve pass-through in Euro area and Czech Republic respectively.

## 4. Methodology

In this section, we present how the econometric model is specified and describe the methods used to analyze data. In the last sub-section, we discuss the dataset used with detailed description of the variables used in the model.

### 4.1. Empirical framework

Following Gambacorta (2008) and Holton and d'Acri (2015), we use bank level data to examine the price setting behaviour of individual bank, and estimate the effect of bank asset quality on the pass-through of changes in monetary policy actions to banks' lending rates. This approach allows us to capture the possibility of heterogeneity between banks' response to monetary policy actions depending on their characteristics.

The study employs the generalized method of moments (GMM) dynamic panel estimator proposed by Arellano and Bond (1991) and Arellano and Bover (1995), and further extended by (Blundell & Bond, 1998). Application of GMM in panel data contexts is advisable when a model contains a lagged dependent variable along with an unobserved effect. The advantage of the GMM is that it helps control for potential biases induced by endogeneity (the correlation between the lagged dependent variable and the error term), because of the inclusion of lagged dependent variables as regressors. The presence of the lagged values of the dependent variable could imply that the error term is correlated with the independent variables thereby violating one key assumption of the Ordinary Least Squares approach (OLS). In other words, estimating both a dynamic panel data model using fixed or random effects could produce biased and inconsistent results. In addition, the endogeneity problem could arise in the model because monetary policy decisions maybe affected by the conditions in the financial sector.

GMM estimator has been proven to perform much better that is less bias and more precision, especially when the series are persistent or the autoregressive process is persistence, which is the first differences, might be weakly correlated with its lagged levels. Because the original time-varying errors are assumed serially uncorrelated, the differenced errors must contain serial correlation. GMM is well suited for obtaining efficient estimators that account for the serial correlation (Arellano and Bond, 1991).

Compared to other estimation methods, GMM is much more flexible since it only requires some assumptions about moment conditions. It allows estimating a structural model equation by equation and becomes appropriate in case most data are characterized by heavy-tailed and skewed distributions. As it does not impose any restriction on the distribution of the data, GMM represents a good alternative in this area as well.

In our analysis, regressions were performed in different equations. The reason was to avoid multi-collinearity problems owing to the presence of strong correlations between macro and some financial sector indicators. In most cases, macroeconomic variables became insignificant when used jointly with financial sector variables in the same regression, possibly implying that the latter were capturing the impact of the former.

## 4.2. Model specification

We use a model specification that permits to assess the effect of assets quality of banks in monetary transmission. The applied model specification was inspired by that of Kashyap and Stein (1995), and adopted by other authors (Mbowe, 2016; Apergis & Alevizopoulou, 2011), and more recent studies that analyzed the transmission mechanism using the bank level data. The model captures different factors that are likely to influence banks in setting their lending rates, and more importantly, it helps to analyze the effects banks assets quality in pass-through of monetary policy actions to market rates.

Two equations were used to well capture the effect of bank asset quality. In the equation 1, we used the ratio of non-performing loans to gross loans in capturing the credit risk as a measure of bank asset quality and its likely effect on monetary policy transmission.

The first equation is specified as follows:

$$\mathrm{Lr}_{i,t} = \mu_i + \sum_{i=1}^{p} \delta_i \left(\mathbf{lr}_{i,t-1}\right) + \sum_{i=0}^{p} \lambda_i \left(\mathbf{mpr}_{t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{NPL\_ratio}_{i,t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{Cost\_str}_{i,t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{bank\_size}_{i,t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{Capital\_str}_{i,t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{Market\_power}_{i,t-p}\right) \sum_{i=1}^{p} \tau_i \left(\mathbf{NPL\_ratio}_{i,t-1} * \mathrm{mpr}_{t-p}\right) + \sum_{i=0}^{p} \alpha_i \left(\mathbf{GDP}_{t-p}\right) + \varepsilon_{it}$$

Where

$\mathrm{Lr}_{i,t}$ is the quarterly bank lending rate for individual bank ***i*** at time ***t;*** $\boldsymbol{\mu_i}$ is included in our model to capture unobservable heterogeneity between banks in the setting of lending interest rates; $\mathbf{lr}_{i,t-1}$ is the lagged bank's own lending rate to capture the level of persistence of dependent variable**,** while $\mathbf{mpr}$ stands for the central bank rate. We address the possibility of heterogeneity between banks in pass-through to their lending rates by introducing bank-specific variables to the model, with special attention to variables capturing the quality of banks' assets, and variables are lagged to mitigate endogeneity concerns. Variables representing asset quality of banks are interacted with the central bank rate, $\mathbf{mpr}_t$ to investigate how they affect immediate pass-through and GDP stands for macroeconomic variables. $\varepsilon_{it}$ is the white noise error term. Individual banks are denoted by i (i =1,....,N) , t indicates the time observation for each variable, and p is the number of lags.

In the second equation, the credit risk is captured by the ratio of provisions to gross loans as alternative measure to judge the consistency of findings.

Equation 2 is specified as follows:

$$\mathrm{Lr}_{i,t} = \mu_i + \sum_{i=1}^{p} \delta_i \left(\mathbf{lr}_{i,t-1}\right) + \sum_{i=0}^{p} \lambda_i \left(\mathbf{mpr}_{t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{Provision\_ratio}_{i,t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{Cost\_str}_{i,t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{bank\_size}_{i,t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{Capital\_str}_{i,t-p}\right) + \sum_{i=1}^{p} \beta_i \left(\mathbf{Market\_power}_{i,t-p}\right) \sum_{i=1}^{p} \tau_i \left(\mathbf{Provision\_ratio}_{i,t-1} * \mathrm{mpr}_{t-p}\right) + \sum_{i=0}^{p} \alpha_i \left(\mathbf{GDP}_{t-p}\right) + \varepsilon_{it}$$

### 4.3. Data sources and variables description

Data are obtained from different sources. Data on bank specific variables are obtained from the quarterly balance sheets of 10 out of 11 licensed commercial banks operating in Rwanda over the period 2012Q1 to 2019Q2. One bank is not considered due to the insufficient data coverage with the sample period. The period was chosen to enrich the sample by including a large number of banks including some new and big banks on the market. Data on monetary and financial variables such as interest rates are from the National Bank of Rwanda database while Gross Domestic Product is obtained from the National Institute of Statistics of Rwanda.

The choice of variables in this study was mostly influenced by the approach in other empirical studies, as well as factors suggested by the literature.

As mentioned earlier, the dependent variable in this study is the **lending interest rate (Lr)**.It is the quarterly average interest rate on lending of individual commercial bank. We want to capture some factors that affect the loan pricing by banks, and analyze the extent to which the quality of banks' assets might have influenced the pass-through of monetary policy actions to retail market rates, specifically the lending rates that have reduced marginally despite the frequent central bank policy rate cuts.

The variable **mpr** denotes the appropriate interest rate measuring the monetary policy stance, here captured by the **repo rate**. Higher values of **mpr** correspond to a tighter monetary policy stance. It is assumed that, tighter monetary policy stance

should result in higher lending rate and its coefficient is therefore expected to be positive.

The variable of interest in this study is the asset quality of banks. Banks with weak balance sheets may react to an expansionary monetary policy stance by shoring up liquidity rather than extending credit at lower rates. A change in the policy rate may thus have only a limited impact on market rates. In essence, potential new loans are crowded out by the presence of bad loans on balance sheets. The quality of assets was captured by two different variables. We use the share of non-performing loans to total loans commonly known as "Non performing ratio". As the lending interest rates of bank may be affected by the likelihood a borrower may fail to repay some or even all of a loan's principal and interest, an increase in the NPL ratio is expected to lead to higher lending rates and/or reduces the pass-through of monetary policy action. We also considered a variable called "ratio of provisions" of a bank measured by provisions for loans to gross loans. An increase in the provision for loan losses implies a higher cost of bad debts. Given the risk-averse behaviour, banks that face higher credit risk are likely to pass the risk premium to the borrowers, leading to higher borrowing rate. This is also expected to have a positive relationship with lending rate and negatively affecting the pass-through of monetary policy actions to market rates.

As commonly applied in other similar studies, for the bank size, logarithm of total assets was used. Some authors suggest a positive relationship between the size of a bank and lending rates; however, the literature presents contrasting results. Fungáčová and Poghosyan (2009) argue that due to increased economies to scale, banks that provide more credit should benefit from their size and charge lower rates to borrowers. However, the larger the average size of the operations, the larger the risks concentrated in single customers and the higher the lending rates (Liebeg & Schwaiger, 2006).

Capital structure is included in our model and measured by the ratio of core capital to total risk weighted Assets. As a proxy for the creditworthiness of a bank, a bank having higher capital adequacy is likely to be more solvent, which would reduce its funding costs, thereby reducing the lending rates, and vice versa (Almarzoqi & Naceur, 2015).

We use the share of loans by bank in total loans of the banking system to represent the market power of each bank. Banks with high market power are expected to charge higher lending rates to borrowers due to the limited competition in the loan market.

The cost structure of banks is a proxy for servicing and monitoring transactions (Almarzoqi & Naceur, 2015). Operating costs include salaries, pensions, and other expenses such as depreciation, administrative expenses, occupancy costs, software costs, and lease rental. There is a consensus in the literature that banks pass on the operating costs to customers; therefore, the higher the operating costs, the higher the lending rate (Dumicic & Ridzak, 2013).

Macroeconomic variable here captured by Gross domestic product is also included in the model to represent the demand for loans in an economy. It is expected that when the economy is booming, people demand more loans and may push the borrowing cost higher if banks do not have enough money to lend. Contrariwise, higher demand for loans may result into lower lending rate in economies with lower default risks (Kaymaz & Kaymaz, 2011).

Lastly, the interaction term of variables representing the quality of bank asset with central bank rate are computed as the product of a variable with central bank rate, and used to assess the effect of each variable on interest rate pass-through. Both terms are expected to reduce the pass-through.

## 5. Results

In this section, estimation results of the model are presented. Equation 1 and equation 2 considers two alternative measures of bank assets quality. The first equation includes the non-performing loans ratio while the second includes provisions for loans to gross loans as a proxy of credit risk.

Table 1: Estimation results

| | Equation 1 | Equation 2 |
|---|---|---|
| LR (-1) | 0.384*** | 0.394*** |
| MPR (-1) | 0.047* | 0.043* |
| NPL_RATIO | 0.03** | - |
| INTERACTION_NPL | -0.099*** | - |
| PROVISIONS_RATIO(-1) | - | 0.03* |
| INTERACTION_ PROVISION | - | 0.009** |
| Log (COST_STRUCTURE(-1)) | 0.014*** | 0.015** |
| Log (BANK_SIZE (-1)) | -0.821*** | -0.843*** |
| CAPITAL_STRUCTURE(-1) | -0.007** | -0.009** |
| MARKET_POWER (-1) | 0.017*** | 0.017*** |
| Log (GDP(-1)) | -0.258 | -0.337 |
| C | 10.3*** | 10.3*** |
| Dependent variable: LR<br>Method: Panel Generalized Methods of moments<br>Number of banks: 10<br><br>*, **, *** on coefficients indicate the level of significance at 1 % , 5% and 10 % respectively | | |

Source: Authors' estimation using Stata 14.

The lagged lending rate is statistically significant, implying that the lending interest rate of the banks in Rwanda is persistent, largely determined by the rates in the previous quarters.

The lagged monetary policy variable (MPR) is positive and statistically significant, although the effect is moderate, reflecting the stickiness of the banking sector lending rate. This confirms the ongoing improvement in the transmission of monetary policy in Rwanda compared to the previous studies assessing transmission to lending rates. Specifically, one percentage point increase in the central bank rate, leads to an increase in the bank lending interest rate by around 0.045 percentage point ceteris paribus.

The variables of interest in our study are those related to assets quality of banks. The results in equation 1 indicate a positive and significant coefficient of default risk (non-performing loans ratio). An increase in the share of bad loans in the total loan portfolio by one percent increases the lending rates of banks by around 0.026 percent ceteris paribus. We used credit risk in equation 2 as an alternative indicator of assets quality. The results reveal almost similar effect, whereby a one percent increase in the ratio of provisions to total loans results in an increase of bank lending rates by 0.03 percent

ceteris paribus. These findings suggest that banks pass the risk premium inherent in their loan portfolio to the borrowers, and successfully compensate themselves for higher credit risk in order to protect their margins, meet their targeted return on assets, hence keeping high lending rates.

The effect of bank asset quality to monetary policy transmission was assessed by including the interaction term between non-performing loans ratio with the central bank rate. Alternatively, we considered the same interaction term with the credit risk. The coefficient of the interaction term (INTERACTION_NPL) is negative, implying that improvement in asset quality of commercial banks would reinforce interest rate pass-through, and subsequently, deterioration of banks assets quality would be a drag to policy transmission. The findings indicate that the quality of banks' assets is important for monetary policy transmission, as banks pass on the burden of bad loans to borrowers in the form of higher lending rates, hence limiting the effectiveness of accommodative monetary policy stance.

Looking at other bank specific variables, the coefficients of bank size and capital structure are negative and statistically significant, indicating that expansion of banks assets and improvement in bank solvency would lead to a lower lending rates charged to customers. This implies that large banks enjoy economies of scale, and their per unit cost of underwriting a loan is small compared to small banks. This is true because data shows that small banks and microfinance banks charge interest rate in the range of 20-25 percent while large commercial banks charge interest rate in the range of 16-18 percent. As suggested by theory, the coefficients of bank market power and bank cost structure are positive and significant, implying that competitive market would lead to lower lending rates. Specifically, a one percent increase in share of loans of a bank to total loans of the banking system and/or overhead costs, results in an increase in the lending rates by 0.014 percent and 0.017 percent respectively, ceteris paribus.

In summary, empirical evidences confirmed the ongoing improvement of monetary policy transmission in Rwanda as change in policy rate has an effect on lending rate though still moderate. Secondly, the changes in asset quality of banks influence monetary policy transmission. (1)Deterioration of asset quality causes banks to increase lending rate to new borrowers, even if monetary policy is accommodative. The relationship would indicate that when asset quality of banks improve, they would

lower the lending rates to new borrowers even if the monetary policy were tightened. However, experience from other countries demonstrates that banks are less responsive to improved asset quality. (2) Growth in size and improvement in capital adequacy lead to lower lending rates. Hence, expected improvement in capital adequacy and balance sheets expansion are likely to reduce the high cost of credit in Rwanda and improve financing conditions in the economy. Results also suggest that more competition on banking market would also contribute to reducing lending rates.

## 6. Conclusion and policy implications

The key focus of study was to assess how asset quality of banks affects monetary policy transmission in Rwanda. This was assessed using dynamic panel General Methods of Moments with quarterly data from 10 commercial banks for the period ranging from 2012Q1 to 2019Q2. Specifically, the study examines factors that affect the lending interest rates among banks as well as the effect of bank assets quality on the pass-through of changes in monetary policy actions to changes in loan pricing at the retail markets.

The results indicate that the lagged lending rates as well as the repo rates have positive and statistically significant impact on banks' lending rates. Consistent with our hypothesis, the coefficient of default risk (non-performing loans ratio) and loan provisions are positive and statistically significant, implying that an increase in the share of bad loans in the total loan portfolio and increased provisions result into higher lending rates among commercial banks in Rwanda. These findings on variables representing the quality of banks' assets suggest that banks pass on the risk premium inherent in their loan portfolio to new borrowers in-form of higher lending rates. This means accommodative monetary policy through reduced CBR is not a sufficient condition for banks to reduce lending rates. Banks tend to adjust their lending rates to compensate for provisional expenses incurred for higher NPLs. This relationship is supported by the structure of the banking sector that is still less competitive and loans as a dominant earning asset.

The same analysis reveals that others bank specific factors like size, market power, capital and cost structure of banks have influence on lending interest rate.

Our analysis purposefully assessed the effect of banks' asset quality on the pass-through of monetary policy actions. The results indicate that the ratio of non-performing loans to gross loans has a statistically significant and negative impact on pass-through. This suggests that the quality of banks' assets is important for monetary policy transmission, as banks pass on the burden of bad loans to borrowers in the form of higher lending rates, hence limiting the effectiveness of accommodative monetary policy stance.

Based on the above findings, the National Bank of Rwanda should ensure effective coordination of monetary policy and financial stability.

Efforts should be put in laying a supportive environment for banks to increase recovery of written-off loans and this will reduce credit risk premium that banks have to factor in while pricing new loans. Specifically, the insolvency law and the collateral foreclosure process need to be streamlined to facilitate banks to recover funds from collateralized written-off loans. As for banks, they need to enhance their credit recovery function.

The findings of this paper emphasize the importance of developing a diversified financial system that is not only dependent on the banking sector. The capital market offers alternative financing mechanism and competitive mechanism for banks. For enhancing monetary policy transmission mechanism, the capital market needs to be developed.

The findings of this study also indicate the need to introduce dynamic provisioning rather than flat provisioning. Dynamic provisioning enables banks to increase provisions during good economic and financial condition and to reduce provisioning during economic downturn. In other words dynamic provision approach would support the monetary policy orientation during different economic conditions.

Efforts to contain growth of non-performing loans and credit risk in general need to be expedited for financial stability purposes and monetary policy effectiveness. Issues causing non-performing loans relate to loan concentration to sectors like mortgage, trade and hotels (NBR, 2019). It is important that banks diversify their loan portfolio by lending to other sectors like agriculture and manufacturing. It is therefore important that efforts to de-risk these sectors be expedited.

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# Appendices

## Equation 1

System dynamic panel-data estimation — Number of obs = 280
Group variable: C_id — Number of groups = 10
Time variable: t

Obs per group:
min = 28
avg = 28
max = 28

Number of instruments = 550 — Wald chi2(10) = 1170.85
Prob > chi2 = 0.0000

One-step results

| lr | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| lr | | | | | | |
| L1. | .384514 | .0404258 | 9.51 | 0.000 | .3052808 | .4637472 |
| L2. | .3806707 | .0399091 | 9.54 | 0.000 | .3024502 | .4588912 |
| mpr | .0477512 | .0199352 | 2.40 | 0.017 | .008679 | .0868234 |
| NPL_ratio1 | | | | | | |
| D1. | .0267217 | .0107642 | 2.48 | 0.013 | .0056244 | .0478191 |
| interaction_npl | | | | | | |
| D1. | -.099169 | .0343324 | -2.89 | 0.004 | -.1664591 | -.0318788 |
| cost_structure1 | | | | | | |
| L1. | .014292 | .0049282 | 2.90 | 0.004 | .0046328 | .0239511 |
| Bank_size | | | | | | |
| L1. | -.8214841 | .1569211 | -5.24 | 0.000 | -1.129044 | -.5139243 |
| capital_structure1 | | | | | | |
| L1. | -.00785 | .0025957 | -3.02 | 0.002 | -.0129375 | -.0027625 |
| market_power1 | | | | | | |
| L1. | .0177927 | .0041829 | 4.25 | 0.000 | .0095943 | .0259912 |
| gdp_growth | | | | | | |
| LD. | -.2587669 | 1.050114 | -0.25 | 0.805 | -2.316954 | 1.79942 |
| _cons | 10.34165 | 1.663063 | 6.22 | 0.000 | 7.082102 | 13.60119 |

## Equation 2

System dynamic panel-data estimation — Number of obs = 280
Group variable: C_id — Number of groups = 10
Time variable: t

Obs per group:
min = 28
avg = 28
max = 28

Number of instruments = 550 — Wald chi2(10) = 1154.95
Prob > chi2 = 0.0000

One-step results

| lr | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| lr | | | | | | |
| L1. | .3948847 | .040939 | 9.65 | 0.000 | .3146459 | .4751236 |
| L2. | .3852425 | .0403551 | 9.55 | 0.000 | .306148 | .4643371 |
| mpr | | | | | | |
| L1. | .0436015 | .0188386 | 2.31 | 0.021 | .0066784 | .0805246 |
| credit_risk1 | | | | | | |
| LD. | .0297378 | .0185302 | 1.60 | 0.109 | -.0065808 | .0660564 |
| interaction_credit | | | | | | |
| D1. | .0094407 | .0038078 | 2.48 | 0.013 | .0019776 | .0169037 |
| cost_structure1 | | | | | | |
| L1. | .0154912 | .004919 | 3.15 | 0.002 | .0058501 | .0251324 |
| Bank_size | | | | | | |
| L1. | -.8438784 | .1593265 | -5.30 | 0.000 | -1.156153 | -.5316042 |
| capital_structure1 | | | | | | |
| L1. | -.009333 | .0025677 | -3.63 | 0.000 | -.0143656 | -.0043004 |
| market_power1 | | | | | | |
| L1. | .0178756 | .0042207 | 4.24 | 0.000 | .0096032 | .0261479 |
| gdp_growth | | | | | | |
| LD. | -.3379305 | 1.052931 | -0.32 | 0.748 | -2.401637 | 1.725776 |
| _cons | 10.31951 | 1.68264 | 6.13 | 0.000 | 7.0216 | 13.61743 |

# Money market dynamics and the implementation of monetary policy in Rwanda

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## Abstract

The study examines money market dynamics and the implementation of monetary policy. Understanding these dynamics is key for effective monetary transmission mechanism especially the interest rate channel, and in guiding policy. It completes earlier studies on interest rate channel in Rwanda. The main contribution of the study is to explore the effect of bank decisions focusing on unexplored money market features such as allotment and communication, and by applying a different technique of panel VAR. The study uses daily data at individual bank level. Empirical findings suggest differences in bank's behaviour for each market. They indicate that banks' decisions counter-act policy objective on repo market while they back it on interbank market. On both markets, effects of policy intervention on narrowing interest rate spread have not been evident. A noteworthy finding is that efficient communication can be an important tool to achieve policy goals. Revisiting how policy intervention on both market is decided is critical for effectiveness of the transmission.

**Keywords:** Money market, Policy rate, Monetary Policy

**JEL classification:** E440, E430, E52

## 1. Introduction

Money market is the starting point of the monetary transmission process, and it is pivotal for monetary policy implementation. De facto, money market is a platform that allow central banks to achieve their objectives. To that end, central banks apply either an interest rate policy approach or a liquidity management approach. An interest rate policy approach implies that a central bank sets short-term money market rates as operational targets and uses its instruments to attain the targets. Liquidity management approach suggests that a central bank defines liquidity targets, which independently contain information about the monetary policy stance.

In the recent past, the National Bank of Rwanda (NBR) has tried to follow the two tactical approaches on the money market. On one hand, given that NBR operates in the excess liquidity context, it defined an optimal level of excess reserves that support smooth transmission of monetary policy decisions. The optimal level guides the daily liquidity injection or mop up. On another hand, NBR sets a central bank rate (CBR) and expects that during implementation open market operations (OMO) should lead short-term interest rates close to CBR. Since the application of the two approaches takes place on the same market using the same instruments, a practical question is to know whether NBR can attain the two goals simultaneously and effectively.

The literature documents the effectiveness of monetary policy in steering the money market targets. It establishes that the actions of both the central bank and commercial banks are key to success. While central banks have the ability to conduct effective monetary policy on money market, the effectiveness can get weaker and even disappear (Abbassi & Linzert, 2012; Jardet & Le Fol, 2007). Empirical evidence indicates that the decision, choice and preferences of commercial banks to participate in money market and in which instrument influence the effectiveness. Knowledge on these aspects of the money market remains scant in Rwanda (Affinito, 2013; Jordan & Kugler, 2004).

Knowing how the daily banks' decisions on money market affect policy implementation and vice versa, is key in understanding monetary transmission mechanism (MTM), and subsequently in guiding policy. The policy issue the paper addresses is to know how the intentions of the central bank are moderated by the

commercial banks' reactions. The objective of this paper is to contribute in refining this understanding at NBR. In this perspective, the question the paper responds to is two-fold: how NBR interventions affect banks' investments in money market and how do those interventions adjust to banks' reactions.

This study completes earlier studies on strengthening the understanding of monetary transmission mechanism in Rwanda. These earlier studies mainly looked at the interest rate channel such as Kigabo et al. (2016) and at the bank-lending channel namely Kamanzi et al. (2019). The main contribution of this paper is to provide empirical evidence of the speed of adjustment in policy objective and the feedback effect from individual bank-level decisions.

The reference close to this study is Jordan and Kugler (2004). However, unlike Jordan and Kugler (2004), this study opted to use individual bank-level data to capture more information. Moreover, this study uses new techniques of Panel VAR to analyse speed of adjustment contrary to earlier works that employed error-correction models.

The remainder of the paper is as follows: the section 2 briefly reviews the literature. Section 3 provides historical developments on institutional framework for monetary policy implementation across different economies, and describes daily process of policy implementation at NBR and the instruments used. Section 4 details the methodology. Section 5 discusses the results and section 6 concludes with policy recommendations.

## 2. Literature review

Money market is a market where financial institutions borrow and sell balances that they hold at the central bank. It is a market that enables market players to get liquidity on short time and invest excess funds in relatively liquid short-term assets called money market instruments.

Money market instruments are like other financial assets. This paper relates two strands of literature on MTM and on assets demand and supply. According to the interest rate channel of MTM, the effectiveness of monetary policy begins with the impact of policy rate on money market rates. After a change in policy rate, financial

institutions respond by altering their spending and investment patterns that result in a change of other money market rates (Kobayashi, 2008; Davoodi et al., 2013). On one hand, several empirical research on the effectiveness of monetary policy in steering money market rates close to the target concluded on the degree of the pass-through. This type of studies often established the importance of the financial sector development on the degree of the pass-through as a signal of effectiveness of monetary policy (Carare et al., 2002; Holton & Rodriguez d'Acri, 2015).

On the other hand, other studies focused on how policy implementation affects the structure of the money market and on how this structure may impede on the effectiveness itself. Mishkin (2004) relates these studies to the theory of asset demand and supply. Several other concepts underlie this line of research. The expectations hypothesis assumes perfect substitutability among financial assets of different maturities because long-term rate is the average of short-term rates. Other scholars such as Mishkin (2004), Abbassi and Linzert (2012) and Abbassi et al. (2010) put forward the segmented market theory claiming that financial assets of different maturity are not perfect substitutes and investors may prefer one type of asset to another. The preferred habitat theory combines the first two theories by postulating that investors prefer assets of one maturity to another, a particular asset maturity (preferred habitat) in which they prefer to invest. Therefore, investors will be willing to buy bonds that do not have the preferred maturity only if they earn a somewhat higher expected return or term premium.

An empirical aspect that has not received much consideration in the literature is the influence of market participants' decisions in terms maturity, frequency and allotment in implementing monetary policy decisions. Few studies include Jordan and Kugler (2004) and Linzert et al. (2007) analyzed the effects of the aforementioned decisions on the "adjustment process" of the policy implementation looking at the volatility in the operating interest rate target and auction outcomes respectively.

This section provides the theoretical underpinnings of the interactions between a central bank and commercial banks on the money market. The next section brings in the role of the environment and structure that underlie those interactions looking at some countries' experiences.

## 3. Monetary policy implementation

### 3.1. Overview of countries' experiences

According to Brink and Kock (2009), central banks implement monetary policy by applying either an interest rate policy or a liquidity management policy or both. In the conduct of monetary policy implementation, central banks in developed and most emerging economies operate in a "liquidity deficit" context, though the situation of excess reserves emerged after the burst of the 2007 financial crisis. The money market acts as a source of liquidity for financial institutions. Central bank refinancing is the primary liquidity market through repo operations, and these consist of liquidity injection. The interbank market is the secondary liquidity market, which reallocates the liquidity obtained in the primary market among banks.

In policy implementation through running open market operations (OMO), central banks apply fixed rate or variable rate tenders depending on the prevailing liquidity circumstances. For fixed rate (volume) tenders, the central bank specifies some interest rate in advance. The participating counterparties then bid the amount of money they want to transact at this interest rate. On the other hand, in variable rate tenders counterparties bid the amounts of money and the interest rates at which they want to enter into transactions with the central bank. For example, before the 2007 global financial crisis the Swiss National Bank used the fixed-rate while the South African Reserve Bank used the fixed-volume, though it could switch to fixed-rate to stabilize interest rate movements (Jordan & Kugler, 2004). Other differences among economies depend on contextual framework and the objective of each central bank. For instance, the European Central Bank (ECB) mostly used open market operations are the main refinancing operations on weekly basis, and conducted in order to steer the overnight rate. At the contrast, other central banks such as the Fed, the Swiss National Bank (SNB) or the Bank of England carry out daily operations. They also target different instruments where for example, the SNB target a range of the 3-month LIBOR.

The situation just described changed when economies hit the zero lower bound following the 2007 global financial crisis. Central banks stopped using some instruments that became ineffective, while they introduced unconventional tools with an aim to ease monetary and liquidity conditions. For example, the Czech National

Bank introduced a 2-week and 3-week maturity repo operations and the Poland Central Bank introduced for the first time a central bank bill (Plescau, 2017). As the crisis dissipated, some central banks abandoned the unconventional instruments. This suggests that monetary policy implementation is in continuous evolution consistent with economic growth and the state of the financial system (Cukierman, 2013).

The literature provides other aspects that play a role on the money market and impact on the effectiveness of monetary policy. One of the considerations pertains to the reserves requirements, Reserve requirements can be used as either a banking regulation or a monetary policy tool. A Central bank runs open market operations in a way that allow banks to fulfil reserves requirements. Bindseil et al. (2009) argue that during the last days of reserves requirement maintenance period, liquidity shortage occurs. In the same line of thinking, Jardet and Le Fol (2007) claim that the lack of harmonizing the dates of maintenance period and repo auctions can create the episodes of underbidding and overbidding. Therefore, the timing can reduce the volatility in the money market. This was case of the ECB before it changed the maintenance period to coincide with the governing council meetings.

Similar to reserves requirement, Monnet and Vari (2019) demonstrate how other macro-prudential policies, especially liquidity ratios, influence the money market dynamics in Sweden and USA. In fact, prudential regulation and monetary policy consider liquidity ratios as instruments they can apply to influence the money market. In cases of considerable excess reserves, liquidity ratios have no effect. This is the case in South Africa, where liquidity ratio or money market shortage is an explicit monetary policy instrument. However, its effect reduces as banks' balance sheets grow (Brink & Kock (2009).

Other considerations are with respect to fiscal policy. Despite that, there was no consensus on the effects of fiscal policy on interest rates in preceding empirical literature, Dai & Philippon (2005) established that fiscal deficits in the USA affect the money market structure by increasing interest rates while fiscal shocks raise the longer-term interest rates through the risk premium. Fiscal policy shock is an exogenous shock to interest rates not linked with changes in real output. For Kurmann and Otrok (2013) fiscal shocks affect the slope of the term structure of interest rates in USA as well.

Fiscal policy concerns get strong in developing countries. In some countries such as Ukraine and the Gambia, fiscal concerns came out as fiscal dominance, and usually jeopardized the effectiveness of monetary policy. They involved fiscal deficit financing related to the inexistent market for treasury securities or fiscal indiscipline. For other developing economies (Tunisia and Egypt), even when treasury securities market exists, commercial banks predominates the market, while the interbank market remains shallow, leading to a weaker interest rate channel (Laurens, 2005).

While most developed economies operate in liquidity deficit context, developing economies face the liquidity surplus challenge in running OMO. In such instances, in the fixed-volume tender, the power of a central bank in steering money market interest rate reduces, because banks have multiple choices of assets allocation (Laurens, 2005).

## 3.2. The Rwandan case

This section brings the previous discussion to the Rwanda case. It first discusses how the money market instruments at NBR evolved over time and their current use, and then describes daily practice in the up-to-date context of implementing monetary policy.

### 3.2.1. Brief on monetary policy framework in Rwanda

Since 1997 to 2018, NBR implemented a monetary targeting framework with reserve money as the operating target. After some time, the principles that underlie an effective framework such as the stability and predictability of money multiplier and velocity were no longer holding. Subsequently, in January 2019 the National Bank of Rwanda adopted the Price-based Monetary Policy Framework to strengthen the effect of monetary policy on real economy. The 7-days interbank rate is the operating target.

In the Price-based Monetary Policy Framework, effective money market operations are critical in order to steer short-term interest rate around the operating target. To achieve that goal, in March 2017 NBR created a Financial Market Operations

Committee (FMOC) in charge of implementing monetary policy decisions. It focuses on liquidity management, through liquidity forecasting and enhanced communication with market participants. Currently, the available instruments remain.

### 3.2.2. Monetary policy instruments

As far as monetary policy implementation is concerned, NBR have been using a variety of tools such as Open Market Operations (OMO) that consist of Repos, Reverse repos, central bank bills (CBB), standing facilities (Deposit & Lending) and refinancing facility. Some other instruments serve monetary purposes such as Reserve requirement and Foreign exchange market operations.

#### 1. Open Market Operations (OMO)

OMO refer to an action of a central bank to provide (or drain) liquidity to (or from) the banking system in line with central bank adequate liquidity management. OMO have been serving as the primary means of monetary policy implementation. They normally include Repos, Reverse repos, central bank bills standing facilities (Deposit & Lending), and Refinancing window.

#### a. Repurchase Agreements (Repos) and Reverse Repurchase agreements (Reverse repos)

Before August 2008, NBR had used an instrument called 7-day mop up. Repo/reverse repo instruments replaced it from August 2008 up to date. In Rwandan, a repo takes place when NBR sells a security to a commercial bank with agreement of buying it back at maturity date. It is used for mopping up liquidity from the banking system. Conversely, Reverse repo occurs when a central bank buys a security from commercial with an agreement of selling it back at maturity date. Reverse repos are used for injecting liquidity into the banking system. For the two instruments, the maturity period goes from 1 day to 7 days.

### b. Central Bank Bills (previously known as Monetary Treasury Bills)

For the NBR to sterilize the liquidity for a bit longer period, the central bank bills (CBB) have been in use since long time in accordance with provisions of the instruction no 05/98 of September 24, 1998, for period of 28, 91, 182, 364-day maturity. CBB used to be called T-bills for monetary purposes before 2017 to be distinguished from T-bills for fiscal purposes. To that end, CBB have been key in the implementation of monetary policy, as they helped the central bank to deal with high excess reserves, and thus reducing the cost of monetary policy by limiting multiple interventions using repos of 7 days maximum.

### c. The Overnight Facilities (ODF and SLF)

NBR uses standing facilities in order to enhance liquidity management of the banking system. On one hand, the Standing Deposit Facility (SDF), now renamed Overnight Deposit Facility (ODF) occurs when a depository bank wants to invest its excess money for one night, the remuneration is the Central Bank rate (CBR) minus 2%. On the other hand, the Standing Lending Facility (SLF) takes place when any bank falls short, and it allows banks to borrow from the Central Bank for overnight to fill any liquidity gap that may unexpectedly arise from the daily settlements on money market or other payment operations. To access this facility, banks provide collaterals for overnight loan at a predetermined interest rate; a rate decided by the monetary policy committee, the latest being CBR plus 1%.

### d. Refinancing facility (previously known as Discount window)

Previously called Discount window, the refinancing facility is the other central bank's instrument of last resort that allows depository banks to borrow money from the central bank, usually on a short-term basis, to meet temporary shortages of liquidity. The refinancing facility rate is set at the central bank rate plus 4 %. This high rate aims at discouraging banks to come at the central bank any time they run short unless they have exhausted all other alternatives at their disposal including interbank trading. In other words, the refinancing facility rate is currently set at 9% since the

CBR is at 5%. For more than 10 years, banks rarely used the refinancing facility due to relatively sufficient liquidity into the banking system. Its maximum maturity is 7 days.

2. Reserve requirements (RR)

Commercial banks are obliged to hold minimum amount of reserves against their deposit liabilities at the central bank. Previously, prudential measures and liquidity management normally explained the imposition of reserve requirements. However, NBR no longer applies the prudential wing following the recent introduction of Depository Guarantee Fund for the Rwandan banking system. Nowadays, reserve requirements solely serve as the monetary policy tool in order to influence banking system liquidity and its capacity to create loans. The current reserve requirement ratio is 5%. The increase of this ratio would cause immediate liquidity reduction for banks with low excess reserves, and the reverse action would expand banking system liquidity.

3. Foreign exchange market operations

NBR intervenes in the foreign exchange market in order to limit the exchange rate volatility. At the same time, those interventions serve for monetary policy purpose since any intervention would affect banks' reserves either positively or negatively depending on whether the central bank intervenes by selling or buying foreign currency. When a central bank proceeds by selling foreign currency, it receives local currency in exchange. For that case, it is a mop-up, while the purchase of foreign currency leads to injection of liquidity as the central bank gives local currency in exchange for foreign currency. This instrument has been facilitating NBR to sterilize some excess liquidity, especially during the period of structural high liquidity.

### 3.2.3. Implementation of monetary policy in Rwanda

NBR implements monetary policy in accordance with its mandate of ensuring price stability. During every quarterly Monetary Policy Committee (MPC) meeting, policy rate is set consistently with the medium term inflation objective. The Monetary Policy

Implementation Committee (MPIC) is in charge of follow-up, and has the responsibility of monitoring all maneuvers to get MPC's decisions successfully implemented.

On daily basis, using a variety of tools as outlined before, FMOC conducts liquidity forecasting to guide daily monetary operations. Every day morning, FMOC collects all information expected to influence commercial banks' balances held at the central bank, in order to forecast daily transactions necessary for the committee decision of injecting/mopping liquidity into/from the banking system. The collected information include, among others, domestic government outlays expected to increase banks' reserves, domestic government revenues with a negative effect on banks' reserves, and foreign exchange operations that involve local currency as counterpart; those are sales or purchases of foreign currency and foreign currency swaps among others. Additionally, FMOC collects information about expected changes in currency in circulation (CIC) since an increase in CIC induces a decline in banks' reserves while the reverse would increase them, and commercial banks net borrowing vis-à-vis the central bank. These commercial banks net borrowing take into account the maturing money market debts between commercial banks and central bank as they definitely affect banks' balances.

With all that information, FMOC is able to estimate closing balances of banks, having their opening situation. Table (1) is the illustration of the collected information during the monetary policy implementation process for a particular day.

However, this information is not sufficient for FMOC to take the final decision of injecting or mopping. Therefore, FMOC resorts to further information gathered by Market Intelligence Team (MIT). Every morning, MIT has to talk to every money market participant (commercial banks and non-financial institutions) through phone calls and e-mails in order to know their positions in terms of both inflows and outflows, and investment plans for the day and the near future. For instance, FMOC knows that bank X is going to pay a given amount of reverse repo at maturity date, bank Y is willing to invest in central bank bill with a given amount and price or bank Z is intending to borrow a given amount on interbank market. Through this exercise, the committee is able to judge if the supply of liquidity is matching (or not) the demand of liquidity into the banking system. This information has been of paramount importance to fine-tune FMOC decisions.

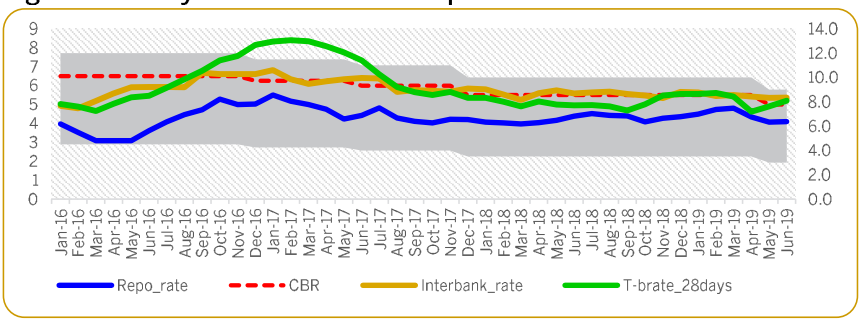
As result, FMOC's approach has already yielded significant results since money market interest rates have been converging towards the CBR and their spread reducing significantly, thus becoming more predictable to help market participants (see figure 1). Consequently, this emerged to be very important to strengthen the transmission of monetary policy to the real economy. Besides, interbank market recorded significant improvement. For example, from January 2019 to September 2019, both the volume and number of transactions summed to 444 and FRW 991 FRW billion from 208 and 422 FRW billion during the same period of 2018 respectively (see figure 2).

Table 1: Daily liquidity forecasting

| Liquidity Projections (in billion FRW) | Wednesday 9/25/2019 | Thursday 9/26/2019 | Friday 9/27/2019 | Monday 9/30/2019 | Tuesday 10/1/2019 | Wednesday 10/2/2019 | Thursday 10/3/2019 |
|---|---|---|---|---|---|---|---|
| Forex operations | | | | | | | |
| Sales of FX to banks (-) | 0.0 | 0.0 | 0.0 | 0.0 | 4.5 | 0.0 | 0.0 |
| Swaps (+) | | | | | 1.7 | | |
| Swaps - reverse (-) | | | | | | | |
| Government operations (OTR) | | | | | | | |
| Revenues (-) | 0.0 | 0.0 | 25.8 | 0.0 | 18.0 | 0.0 | 0.0 |
| of Which: Taxes | 0.0 | 0.0 | 10.8 | 0.0 | 18.0 | 0.0 | 0.0 |
| *T-bond reopening | | | 15.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *T-bond new issuance | | | | | | | |
| *T-bill new issuance | | | | | | | |
| Expenditures (+) | 4.0 | 3.3 | 2.0 | 4.0 | 3.0 | 3.0 | 3.0 |
| *Retirement of T-bills/Bonds/Coupon | | | | | | | |
| *Other expenses/Invoices | 4.0 | 3.3 | 2.0 | 4.0 | 3.0 | 3.0 | 3.0 |
| Line ministries | | | | | | | |
| Expenditures (+) | 3.3 | 3.3 | 3.7 | 2.6 | 3.0 | 3.0 | 3.0 |
| Commercial banks net (OMO) | | | | | | | |
| Repo repayments (+) | | | | | | | |
| Central bank bill issuances (-) | | | | | | | |
| Central bank bill repayments (+) | | | | | | | |
| Reverse repo repayment (-) | 19.6 | 0.0 | 0.0 | 0.0 | 0.0 | 15.0 | 0.0 |
| Standing Lending facility repayment (-) | | | | | | | |
| Currency in Circulation | | | | | | | |
| Withdrawals (-) | 1.5 | 0.5 | 2.6 | 2.6 | 3.5 | 1.2 | 1.2 |
| Deposits (+) | 2.5 | 2.0 | 1.5 | 1.3 | 3.2 | 1.5 | 1.0 |
| Net Impact on liquidity | 11.3 | 8.1 | 21.2 | 5.3 | 18.5 | 8.7 | 5.8 |
| Opening balance (excess + /shortage -) | 23.2 | 27.7 | 41.6 | 19.6 | 24.2 | 13.1 | 29.2 |
| Projected closing balance of excess reserves | 11.9 | 35.3 | 20.4 | 24.9 | 5.7 | 4.4 | 25.0 |
| Commercial banks | | | | | | | |
| Repo operations | | | | | | | |
| Reverse repo operations | 15.0 | | | | 30.0 | 20.0 | |
| Repo outstanding | | | | | | | |
| Reverse repo outstanding | 15.0 | 15.0 | 15.0 | 15.0 | 25.0 | 30.0 | 30.0 |
| Central bank bill | | | | | | | |

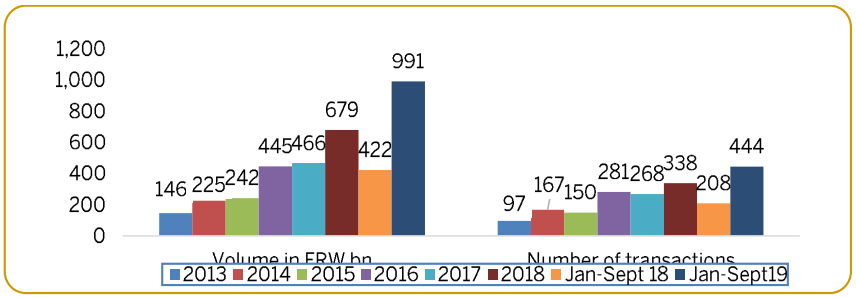
Source: NBR, Monetary Policy Department

Figure 1: Money market rates developments in Rwanda




Source: NBR, Financial Markets Department

Figure 2: Example of interbank activity in Rwanda




Source: NBR, Financial Markets Department

## 4. Methodology

### 4.1. Model specification

Empirically, the paper assesses how NBR and commercial banks react with regard to market changes and how these reactions feed into policy. To consider these relationships, the paper specifies a panel vector-autoregressive model (panel VAR). The analysis combines the approach of Hung and Tai (2017) that uses impulse response function, and that of Linzert et al. (2007) that employs panel models to analyze effects of exogenous variables.

To examine the speed of adjustment, the study analyses impulse responses from the panel VAR akin to Hung and Tai (2017) with time-varying variables for $i = 1, \dots, K$ banks observed for time $t = 1, \dots, T$

$$\begin{bmatrix} Y_{11} \\ \vdots \\ Y_{1T} \\ \vdots \\ y_{KT} \end{bmatrix}_{K\times T} = \begin{bmatrix} \alpha_{1,1} \\ \vdots \\ \alpha_{1,T} \\ \vdots \\ \alpha_{K,T} \end{bmatrix}_{K\times KT} \times \begin{bmatrix} Y_{1,t-1} \\ \vdots \\ Y_{1,t-n} \\ \vdots \\ Y_{K,t-T} \end{bmatrix}_{KT\times K} + \begin{bmatrix} X_{1,1} \\ \vdots \\ X_{1,T} \\ \vdots \\ X_{K,T} \end{bmatrix}_{KT\times K} \times \begin{bmatrix} \beta_{1,1} \\ \vdots \\ \beta_{1,T} \\ \vdots \\ \beta_{K,T} \end{bmatrix}_{K\times KT} + \begin{bmatrix} \varepsilon_{1,1} \\ \vdots \\ \varepsilon_{1,T} \\ \vdots \\ \varepsilon_{K,T} \end{bmatrix}_{K\times T}$$

Where Y is vector of VAR variables defined as explained before. $\alpha$ and $\beta$ are vectors of coefficients.

$$Y = \begin{bmatrix} spread_{it} \\ allotment\ ratio_{it} \\ intervention_{it} \end{bmatrix},\ allotment\ ratio = \begin{bmatrix} repo\ allotment\ ratio_{it} \\ interbank\ allotment\ ratio_{it} \end{bmatrix}$$

X is a K-dimension row vector of time-varying exogenous variables,

$$X = \begin{bmatrix} RMP_t \\ Communication_{it} \\ bank\ size_{it} \end{bmatrix}$$

$\varepsilon$ is a vector of the random error term.

The study also investigate random effects models a la Linzert, et al. (2007) focusing on the effects of the dummy variables. For consistency, the random effects models are exactly specified and variables defined as in the Panel VAR model:

$$Y_{it} = \alpha_i Y_{i,t-1} + \beta_i X_{i,t-1} + \varepsilon_{it}$$

The study estimate two different equations: repo equation and interbank equation. In the estimated repo equation variables are defined as follows:

$$Y_{it} = repo\ spread_{i,t}, \text{ and } X_{i,t-1} = \begin{bmatrix} repo\ spread \\ intervention \\ interaction \\ RMP \\ communication \\ bank\ size \end{bmatrix}$$

In the interbank equation, the study uses the same variables except the variable interaction and communication. The study could not identify a plausible proxy of interbank communication.

$$Y_{it} = interbank\ spread_{i,t}, \text{ and } X_{i,t-1} = \begin{bmatrix} interbank\ spread \\ intervention \\ RMP \\ bank\ size \end{bmatrix}$$

## 4.2. Data

The analysis covers the period from January 2017 to 3 July 2019, a period marked with liquidity mopping by NBR. Data are in daily frequency, and count only working days; they exclude weekends and holidays. In case a bank did not participate on the

market on any day, zero is recorded. The analysis does not exclude these zero observations because they constitute a set of information. Data are expressed either in percent or in ratio.

### 4.3. Description on variables

Using the relationships described in section (3.2.2) the study selected variables outlined hereafter. NBR uses the fixed-volume auctions in liquidity surplus environment; that is it mops excess liquidity held by banks. Therefore, to represent this policy action, the study defines a variable called intervention that equals to the ratio of mopped amount to total bank reserves at the start of the day.

The empirical literature includes other variables that influence the change in interbank and repo rates. Some studies focused on the spread between the policy rate and other money market rates. They use the evolution in spread as an indicator of stability and connectedness of policy and implementation. On one hand, banks would not want to deviate from the policy rate by fear of losing the auction. On the other hand, banks apply the spread as an indicator of premium for transaction costs (Abbassi & Linzert, 2012; Abbassi et al., 2010). For central banks, the spread can be an indicator of loose or tight money market conditions ( (Nyborg & Ostberg, 2014). This study defines two spread variables: the repo-spread and the interbank-spread. They are the dependent variables that represent both the policy and the individual banks objectives.

Some key events are pivotal in both NBR and banks liquidity management and come into play in daily liquidity forecasting. These are the reserve maintenance period (RMP), maturing assets (MAT) in a week, government spending and taxes to be collected in the week. The study expects banks investments in money market to reduce towards the last days of RMP. RMP covers 15 days, and banks build up their reserves to meet the required reserves ratio and avoid penalties. To represent this variable, the study calculates a dummy variable that equals zero in the first 10 days of the maintenance period and one in the last 5 days of the period. This choice is in line with anecdotal evidence that banks start to reconstitute reserves in the last week of maintenance period.

Similarly, in tax payment period, banks transfer their liquidity assets to government accounts at NBR, a fact that diminishes investments in money market. The study failed to get data that capture that information. In case there are maturing assets in a week, banks investments are likely to increase as they expect back their cash to fulfil other obligations. However, the study did not use MAT because it failed to identify or separate the destination of the maturing amount. It can end up in reserves, new investments or be rolled over.

The practice in NBR shows that it engages banks into daily communication to allow interbank transactions to take place by minimizing information asymmetry. Bernanke et al. (2004) represent communication as a binary variable that takes the value one when some form of communication takes place and zero otherwise. For this study, value one represents the time when all committed amount for both demand and supply materializes and zero otherwise. This is because when banks commits to sell or buy liquidity, NBR and other banks consider that in forecasting their closing balances. When banks act contrary to commitment, it leads to unwanted outcomes.

Other studies include individual bank characteristics such as size in terms of average investments in money market (Linzert et al., 2007). This study uses bank size to represent the share or importance of each bank on the market. The idea is to assess in what direction a bank that has some market power influences the interest rates. The study defines big bank if it covers 50 percent and above of the total invested amount at the industry level, medium bank if it represents between 20 and 50 percent, and small if it is below 20 percent.

Commercial bank treasurers put together the outlined factors, in consideration with other unobserved bank specific aspects, and decide on how much money and in which instrument to invest (borrow) in (from) money market. For each bank, this decision varies, and the paper refers to it as allotment ratio. It is the ratio of the amount invested in one instrument over total reserves of a bank at the start of the day.

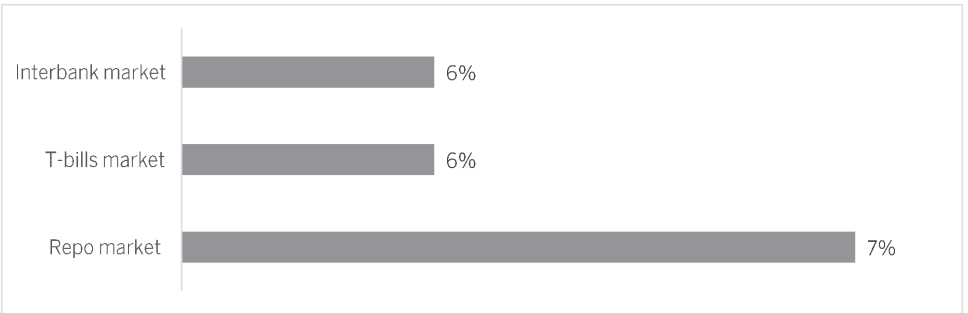
# 5. Results

## 5.1. Descriptive statistics

### a. Banks' liquidity management

To manage short-term liquidity, banks take into account all investment options available at the central bank. On the other hand, the central bank forecasts bank reserves before devising any intervention. For both money market players, bank reserves constitute the basis of any decision. Nevertheless, banks enjoy other sources of fund to invest such as clients' transfers and maturing deposits in correspondent banks. Corollary, statistics show that in some instances, the amount banks decided to invest into one of money market segments was greater than banks' reserves at NBR. That is, the allotment ratio was greater than one (see figure 3). It means that a bank invested more money in a given segment of money market regardless of the level of its reserves at the central bank. For the study sample period, that kind of situation happened 108 in 1483 transactions (7 percent) for repo market. It occurred 47 in 780 transactions for interbank market (6 percent), and 37 in 659 transactions for T-bills market (6 percent). Generally, these statistics confirm that the Rwandan banking sector heavily relies on their reserves held at the central bank to invest on money markets.

Figure 3: Allotment ratio (r) is greater than one

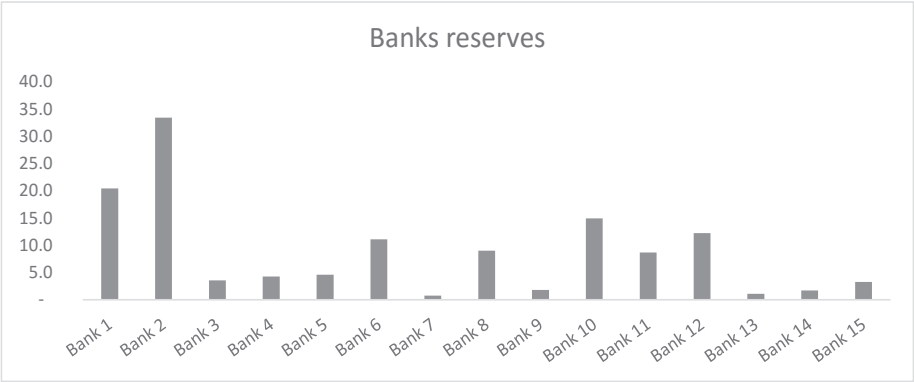



Source: Authors

b. Reserves concentration

Figure(4) demonstrates that the reserves are concentrated in four banks (62 percent of total reserves) out of 15 banks, and this can have implications on the how the liquidity is managed from the central bank's point of view. On one hand, the fact that some banks have high levels of liquidity should facilitate interactions between banks, and thus enhancing interbank market activity. On the other hand, those banks with high liquidity can hinder central bank's objective of influencing money market interest rates if those banks exercise the monopolistic behaviour.

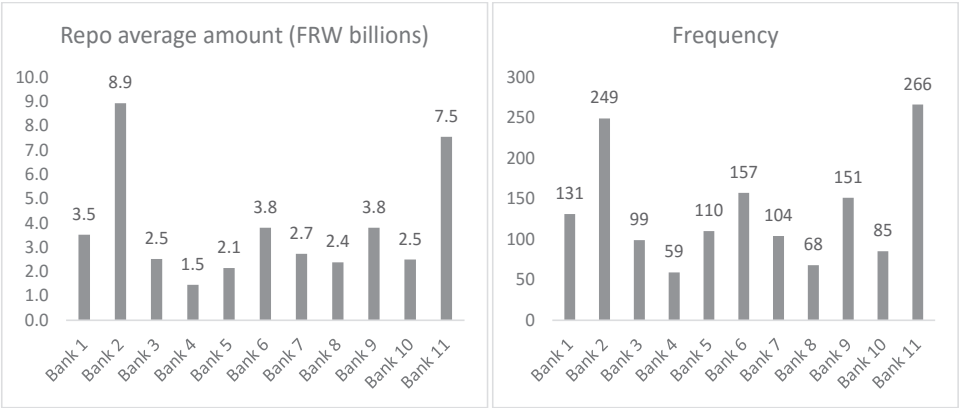
Figure 4: Banks' reserves




Source: Authors

On the repo market, two banks dominate the repo market in terms of both invested amount (around 40 percent) and frequency or number of transactions (around 35 percent). That kind of monopoly can influence money market interest rates if the two banks price in the same way; that is lower or higher the rate charged by the rest of the banks. However, the numbers indicate that on average, the two banks behaved diametrically opposite. That creates another challenge for the central bank that wants to move aggregate interest rate in one direction, which is reducing the spread.

Figure 5: Banks' concentration on repo market

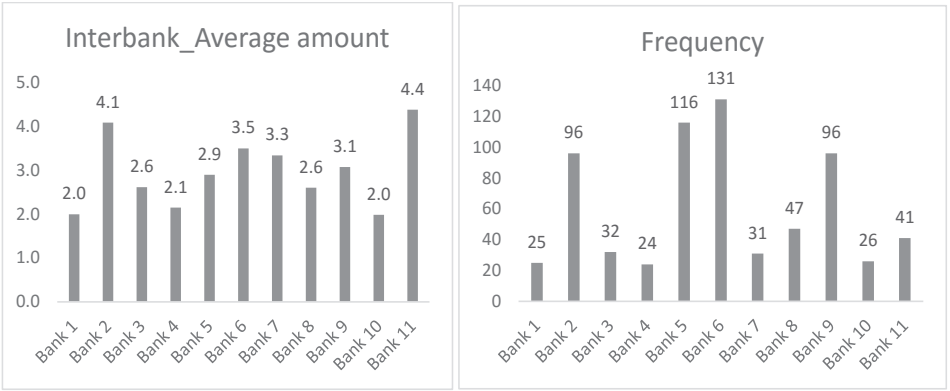



Source: Authors

On interbank market, the dominant banks in terms of the invested amount are different from those that have been more frequent on the market. It implies that this segment of money market have been paramount not only for bank borrowers but also for banks with money to invest. This has recently boosted interbank market activity as discussed in the previous sections.

For our sample period, two banks dominated the interbank market in terms of invested amount as they average FRW 4.1 billion and FRW 4.4 billion, respectively. However, that dominance seems not to be overwhelming since the standard deviation amounts to 0.8. With regard to frequency, other two different mostly participated on the interbank market although they invested less amount than the dominant ones. This can be a sign of improvement of efficiency in interbank market functioning. Alternatively, it can be a kind of competition, which can facilitate the central bank to influence the market.

Figure 6: Banks' concentration on interbank market




Source: Authors

## 5.2. Regression and impulse responses analysis

Table (2) reports the regression results of the repo equation. One expects that an increase in NBR intervention (mopped amount) leads to a reduction the repo spread. The coefficient on intervention suggests the opposite; it is significant and positive meaning that NBR intervention on repo market raises the spread on average. The impulse responses in figure (7) indicate that a sudden increase in mopped amount may actually raise the spread contemporaneously. This is consistent with the fact that a bank that increases its investments tends to charge lower interest rate to win the auction. It also implies that a one-off uptick in NBR intervention on repo market does not deliver the desired result of reducing the gap. Furthermore, looking at the regression results and impulse responses together, an instant deduction is that NBR has to mop up much amount for successive days for banks to know that they can maintain high rates for a bit longer period.

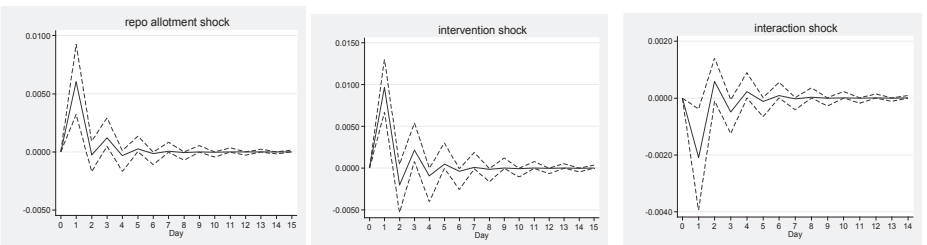
Table 2: Random effects model - Repo spread equation

| | Repo spread |
|---|---|
| L.repo spread | 0.217*** |
| | (15.23) |
| L.repo allotment | 0.00350* |
| | (2.53) |
| L.intervention | 0.000114 |
| | (0.03) |
| L.interaction | -0.00131 |
| | (-0.87) |
| rmp | 0.00226*** |
| | (4.76) |
| communication | -0.0307*** |
| | (-34.67) |
| Bank size | 0.00824*** |
| | (12.66) |
| _cons | 0.0222*** |
| | (14.45) |
| *N* | 5236 |

*t* statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors

To corroborate this deduction the study defined a variable called interaction that measures how a bank succeeds to price higher than the market and still win the auction with increased allotment. It is an interaction between the allotment and the ratio of repo rate at bank level over the aggregate repo rate. The impulse responses indicate that in this case, the spread narrows but the effect dies out quickly and account for 5 percent of the variation in repo spread. Nevertheless, according to Bindseil et al. (2009) commercial banks do not have private full information about the competitive nature of the auction, and therefore fear to bid high amount at higher price continuously. They become risk-averse.

Figure 7: Panel VAR impulse responses - repo spread equation




Source: Authors

Table 3: Random effects model - Repo spread equation with changes in dummy variables

| | Repo spread | Repo spread |
|---|---|---|
| L.repo spread | 0.217*** | 0.124*** |
| | (15.23) | (10.48) |
| L.repo allotment | 0.00350* | 0.00251* |
| | (2.53) | (2.22) |
| L.intervention | 0.000114 | -0.00351 |
| | (0.03) | (-1.19) |
| L.interaction | -0.00131 | -0.000961 |
| | (-0.87) | (-0.78) |
| rmp | 0.00226*** | |
| | (4.76) | |
| communication | -0.0307*** | |
| | (-34.67) | |
| Bank size | 0.00824*** | |
| | (12.66) | |
| 0.rmp | | 0 |
| | | (.) |
| 1.rmp | | 0.00210*** |
| | | (5.40) |
| 0.communication | | 0 |
| | | (.) |
| 1.communication | | -0.0185*** |
| | | (-24.30) |
| 1.bank size | | 0 |
| | | (.) |
| 2.bank size | | 0.0325*** |
| | | (45.36) |
| 3.size | | 0.000925 |
| | | (0.83) |
| _cons | 0.0222*** | 0.0134*** |
| | (14.45) | (14.31) |
| *N* | 5236 | 5236 |

*t* statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors

This situation improves with effective communication as suggested by the regression results. That is, when banks communicate their likely investment beforehand and honour their commitment. On average, movement from a state of lack of communication to a state of effective communication engenders a reduction in spread. Intuitively, effective communication allows NBR to improve liquidity

forecasting and announces a mop amount that tells banks that they can charge higher and still win the auction. In the same line, the results on the influence of bank size (in terms of share in the repo market), show that bigger banks tend to price lower on average. The result on the effect of the maintenance period is counter-intuitive; the coefficient is statistically significant and positive. It suggests that when banks get in the last five days of maintenance they charge lower rates. Initially, one would expect higher rates since fewer banks have money to invest.

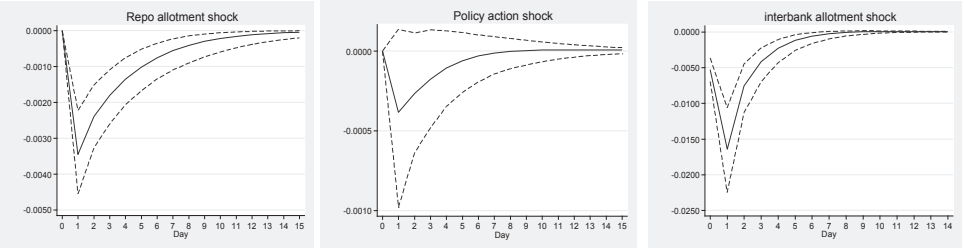
The impulse responses (figure 8) suggest a significant and negative decline in the interbank spread following a positive shock in the allotment on interbank market. It means that when a bank suddenly decides to increase its investments on interbank market, it charges lower rates in order of 35 basis points, which moves in the direction of the NBR objective of getting rates close to CBR. The impact feeds into the spread in one day and takes around 10 working days for the shock to fade away (see the left-hand panel in figure 8). However, this reaction seems not to come from policy actions of NBR since the effect of its shock to interbank spread is not statistically different from zero. The impulse of the bank allotment ratio to policy actions is significant and negative but minimal. A unit increase engenders a 0.1 unit increase. The implication is that policy actions affect bank investments at a level that may not lead to a change in spread. This is consistent with what we discussed earlier on the sources of money invested, suggesting that banks often use other sources in addition or parallel to reserves.

**Table 4: Random effects model - Interbank spread equation**

| | Interbank spread |
|---|---|
| L.interbank spread | 0.126*** |
| | (11.22) |
| L.interbank allotment | -0.00218** |
| | (-2.69) |
| L.intervention | -0.00233 |
| | (-0.90) |
| Bank size | 0.0483*** |
| | (70.68) |
| rmp | 0.000682 |
| | (1.85) |
| _cons | -0.0476*** |
| | (-72.63) |
| *N* | 5223 |

*t* statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors

Figure 8: Panel VAR impulse responses: interbank spread equation




Source: Authors

Though there is statistical evidence that market conditions created by policy actions allowed for more interbank transactions, there is no empirical evidence that those conditions were enough to narrow the spread on interbank market.

Table 5: Random effects model - Interbank spread equation with changes in dummy variables

| | Interbank spread | Interbank spread |
|---|---|---|
| L.interbank spread | 0.126*** | 0.0749*** |
| | (11.22) | (11.56) |
| L.interbank allotment | -0.00218** | -0.00146** |
| | (-2.69) | (-3.13) |
| L.intervention | -0.00233 | -0.00142 |
| | (-0.90) | (-0.95) |
| Bank size | 0.0483*** | |
| | (70.68) | |
| rmp | 0.000682 | |
| | (1.85) | |
| 1.bank size | | 0 |
| | | (.) |
| 2.bank size | | -0.0557*** |
| | | (-104.53) |
| 3.bank size | | -0.000220 |
| | | (-0.33) |
| _cons | -0.0476*** | 0.00369*** |
| | (-72.63) | (5.97) |
| *N* | 5223 | 5223 |

*t* statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors

Table (5) shows that the effect of bank size in terms of market share on the spread is positively significant. However, when the share reaches 20 percent and above it turns negative. It means that if bank investments on interbank market reaches a certain

share, it reduces the rate it charges. The regression coefficient of RMP is statistically significant and positive. It implies that in the last five days of maintenance period, a bank that is able to invest on interbank charges a high rate; 6 basis points on average. This indicates that banks' refinancing needs increase in the last days of maintenance period.

## 6. Conclusion

The broad objective of this paper has been to shed light on the implementation of monetary policy and the dynamics on the market for liquidity through studying repo auctions and trades on interbank market. It has focused on how the actions of the commercial banks and NBR contribute to achieve the policy objective of steering money market rates close to central bank rate; that is reducing the spread. The literature tells that the theories of assets demand and supply provide a framework for analyzing a bank's involvement on money market. The review of the experiences in most of developed and emerging countries establishes that money market is more of liquidity-refinancing platform for banks while it constitutes an investment-opportunity platform for banks in Rwanda. That is why the implementation of monetary policy in Rwanda has often consisted in the use of some instruments while others, though available, were rarely used.

With the developments that took place in the money market in Rwanda, the study opted to analyze the repo market and interbank market separately. It estimates a panel VAR and random effects models using daily data.

The first main finding is that banks decisions can counteract the policy objective. An increase in allotment ratio on repo market does not narrow the repo spread. However, the findings suggest a different behaviour on the interbank market where bank decisions support the policy objective by reducing the interbank spread. Another noteworthy finding is that efficient communication can be an important tool to achieve policy goals on money market.

The study also documents a number of other findings. There exists small heterogeneity among banks on both markets. Participants include big commercial banks, small banks and a type of cooperative bank with different bidding behaviour.

For instance, on the repo market the study documents that small banks do better in terms of closing the spread, whereas on the interbank market medium size banks help to close the spread.

The findings of the study also reveal that policy actions can deliver undesirable outcomes. According to Bindseil et al. (2009) this type of inefficiency may stem from less aggressive attitude on the market from both parties. These outcomes can be reversed by changing the format of the auction. NBR should be aware that, though banks reserves at NBR are an important factor in how they invest in money market, the study found that banks sometimes use money from other sources, which can soften the quality of the predictions on reserves and hence outcome. These findings complete earlier studies on the moderate level of interest rate channel in Rwanda. The fact that policy interventions do not translate into achieving the objective on the daily basis confirms it. One of the contribution of the study is to provide an empirical evidence of the impact of effective communication on attaining the policy objective. So far, the impact is small. NBR should strengthen communication mechanisms that give borrowing banks some negotiating power.

NBR has more power to attain its goal on repo market. Collorally, BNR should continue strengthening its interventions on repo markets. That may involve adopting flexible and interchangeable targets of its open market operations.

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# Assessing macro-economic effects of household debt in Rwanda

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## Abstract

Banking sector financing to the Rwandan economy consistently grew in last two decades, resulting into increase of households' debt especially prior to 2015. Since then, non-financial firms' debt has been the main driver of private debt growth in Rwanda. As recent literature pointed out differences in economic implications from household debts and non-financial firms 'debt, this study aimed to examine the macroeconomic effects of households' debt in Rwanda and contrast it to effects from non-financial firms' debt. Given that most of series had unit root, we estimated VECM models using Johansen framework and results suggested a positive effect from households' debt on output in long run although it is relatively weaker compared to the positive effect from non-financial firms' debt. Similar to recent empirical evidences, households' debt impact on real consumption is positive as for non-financial firms' debt, while its effect on investment seems to be negative in the long run. In addition, increase in households' debt lead to depreciation of real effective exchange rate. Depreciation effect from non-financial firms' debt is also evident though relatively lower. Hence, ongoing financial deepening and credit expansion especially to corporate sector would support sustaining economic growth and stability in Rwanda.

**Key words:** Households debt, Economic growth, Rwanda

**JEL Classification:** E32, E21

## 1. Introduction

Increasing households' debt level had been a policy issue in developed and emerging countries with mature financial markets (IMF, 2017). Recent studies have questioned the positive relationship between increase in private sector credit and subsequent economic growth with special attention to credit to households. While empirical evidences across countries suggested a positive impact from corporate debt to economic growth, the impact of households' debt turned out to be elusive or leading to lower economic growth (Beck et al., 2008; Mian et al., 2016).

This negative relationship between households' debts and subsequent economic growth would occur, as households are likely to borrow primarily for consumption and not for productive purposes or may experience inadequate returns on their investments when they have borrowed for productive purposes. In case of a negative shock on households' income or a credit tightening, the resulting debt overhang would lead to downward adjustment on consumption notably, and negatively affect aggregate demand and economic growth. In addition, high households' indebtedness may imply risks to financial stability due to the ensuing decline in economic growth associated with the deleveraging process as households reduce their debt by paying back and lower consumption and demand for credit or from higher debt defaults from over indebted households (IMF, 2017).

The level of financial sector development and institutional characteristics may also have implications on the effect of increasing households' debt. Adequate banks' supervision and regulatory framework, flexible exchange rate, financial sector development and good policy implementations can mitigate the negative implications from households' debt (IMF, 2017).

While in developing countries, debt of households, non-financial firms and public sector have been expanding, the level of households' indebtedness is still relatively low. However, contrary to developed countries, financial development is at early stage and most of countries are in the process of strengthening the financial sector supervision and regulatory framework. In addition, the level of average households' income is still low and subject to multiple shocks. All these factors may pose some challenges despite the low level of households' indebtedness.

In Rwanda, economic growth has been impressive for the last two decades with an average of around 8% growth on annual basis, thanks to among others, successful implementation of development plans and medium term growth strategies. Financial sector also expanded alongside, dominated by banking institutions, which have been instrumental in financing economic activities mostly via loans to both corporate sector and households.

The last financial inclusion survey (AFR, 2016) revealed that access to finance had significantly improved. However, the access to banking sector credit still remains low (4% of adult people) and largely to corporate sector, which raises risks of high private sector indebtedness.

Financial development journey in Rwanda has been characterized by an expansion in loans to private sector, mostly to corporate sector compared to households with an average of 25.5 percent against 18 percent on annual basis respectively between 2007 and 2019Q2. Nevertheless, households' debt were the main driver of growth in private debt from 2006 to 2014, following substantial build up in mortgage debt to households especially from 2006 to 2010 and from 2013 to 2018. Another main contributor to households' debt has been personal loans especially from 2011 to 2013.

In medium term development plans, financial depth and access to credit will continue to increase, to support financing investment and development initiatives. In terms of credit to households, mortgage debt to households would continue to increase in line with growing need of affordable housing. For instance, only in Kigali City, there is an estimated need of at least 310,000 houses from 2017-2032 (Bower & Murray, 2019). This would probably imply higher debt level going forward.

The outlook of credit to households brings a very important policy question regarding its anticipated role in the Rwanda development plan. The current National Strategy for Transformation (NST1) requires an average GDP growth rate of 9.1 percent and includes job creation, acceleration of sustainable urbanization and access to finance as priorities. Past studies suggested that growth in aggregate credit to economy have contributed to economic growth in Rwanda and financial sector has played a role in that journey through channeling needed funds to different economic sectors, thereby

supporting investment, consumption and economic growth (Kigabo et al., 2015; Nyalihama & Kamanzi, 2019).

Nevertheless, empirical evidences on the nature of relationship between households' debt versus corporate debt and economic growth notably the effect of households' debt in Rwanda are lacking. On one side, better financial access and inclusion are important for Rwandan households as it may help to finance small-scale projects and smooth consumption. On the other side, income level of some households is still low and volatile and more credit may worsen their indebtedness relative to their income and constrain their borrowing capacity up to a certain limit. In addition, households and firms may not necessarily borrow for the same motives; hence, the effects on the economy may differ.

This study aims to take stock of international experience and examine macroeconomic effects of households' debt vs corporate debt in Rwanda. Notably, the study investigates the effects of households and corporate debts on output and different channels through which households' debt could affect output, namely consumption, investment and external balance.

While recent studies used micro level data in panel analysis focusing mostly on developed and emerging countries, this study uses macro data in vector auto regressive framework to capture feedback effects. Building on recent studies ( Kim, 2016; Mian et al., 2016), this study contributes to existing literature by assessing macroeconomic effect of households' debt in context of a developing market with different level of financial development and broaden the analysis to contrast effect from households' debt and corporate debt on external balance in addition to output, consumption and investment.

Given that most of series had unit root, we estimated Vector error correction models (VECM) using Johansen framework and results suggested rather a positive effect from households' debt on output in long run although it is relatively weaker compared to the positive effect from non-financial firms' debt. Similar to recent empirical evidences, households' debt impact on real consumption is positive as for non-financial firms' debt. In addition, increase in households' debt and non-financial firms' debts lead to depreciation of real effective exchange rate. Depreciation effect from non-financial firms' debt is also evident though relatively lower.

The main insight from this study is that macroeconomic implications from both households and corporate debts are generally positive and current initiative to bolster financial inclusion and depth would contribute to sustaining economic growth in Rwanda. In addition, it is important for policymakers to take into account private debts dynamics and its composition (e.g. households' vs corporate) as higher debt level in the future may have new implications.

The structure of this study is as follows: the next section reviews the main developments observed in financing of households and corporate sector at Global level and in Rwanda. Section 3 reviews the literature on macroeconomic effect of households and firms' credit. Section 4 explains the methodology used. Section 5 details empirical results and section 6 concludes.

## 2. Evolution in households and corporate debt

### 2.1. Brief overview of international experience

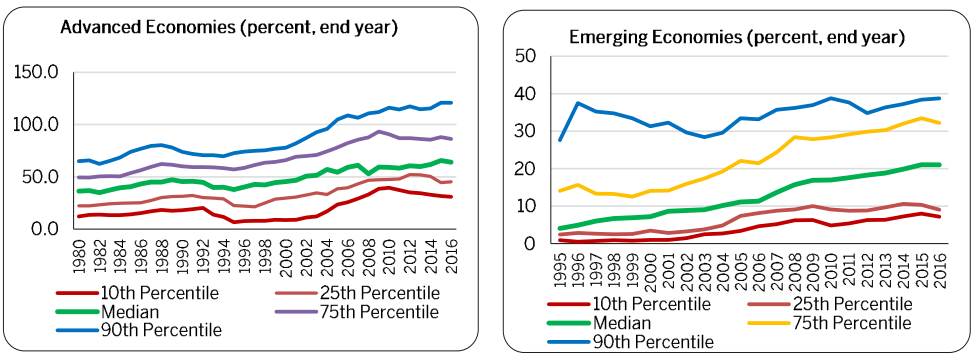
Economic history shows that global economic expansion has been accompanied by development in finance in terms of depth and breadth and financing to both corporate and household sector has never been as high as it is currently. In developed countries, growth in mortgage lending to households has been the main driver behind change in banks' balance sheets and higher leverage ratio, thereby increasing fragility of financial systems (Jorda et al., 2014). Episodes of excessive volatilities, booms, drought and crisis erupted at some frequencies, in different parts of the world and the most recent is the 2008 Global financial crisis (henceforth GFC). Reinhart and Rogoff (2009) highlighted that financial meltdowns over the history share a number of features such as loosening financial conditions and housing price booms in the build up to the crisis.

According to the IMF (2017), the upward trend in leverage across world economies has been generally sustained and growth benefits, which should usually results from better access to finance could be at risks especially due to high level of households' leverage in developed and emerging countries. Analysis of evolution in households' debts, leverage, growth performance and a number of empirical studies (e.g.

Lombardi et al., 2017; Mian et al., 2017), revealed that there could be a trade-off between the short-term benefits of rising households' debt and its medium-term costs to macroeconomic and financial stability. Nevertheless, soundness of country institutions, regulations, policies and country characteristics can help to mitigate the associated risks (IMF, 2017).

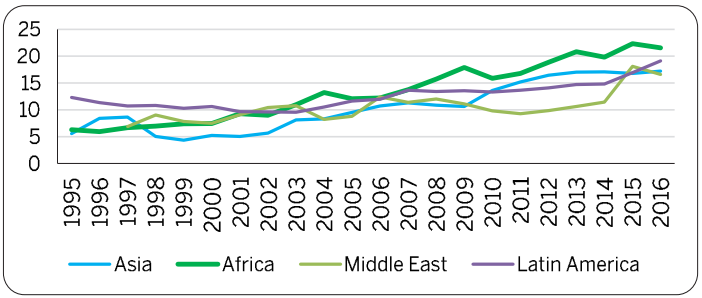
Figure 1 shows the upward trend in households' debt overtime. Although the level is clearly higher in advanced economies, the rapid increase has generally been in emerging economies where the median level has doubled in last ten years, notably in emerging Asia and Africa (see figure 2).

Figure 1. : Evolution of Household debt to GDP ratio in advanced and emerging economies




Source: IMF (GFSR, October 2017)

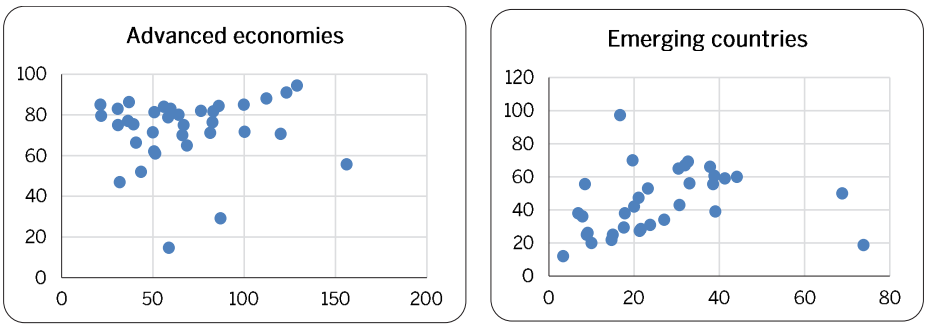
Figure 2: Evolution of median household debt to GDP ratio in emerging countries




Source: IMF (GFSR, October 2017)

Mortgage debt is the main component of households' debt, notably in advanced economies. The positive nexus in both advanced and emerging economies is evident in figure 3 and mostly resulted from easy monetary conditions and fueled increase in house prices and financial stability risks. These housing bubbles highlighted challenges faced by central banks in achieving both monetary and macro prudential policy objectives (Jorda et al., 2014).

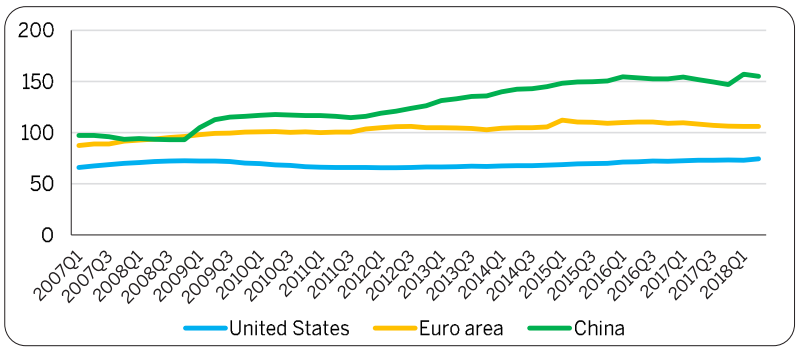
Figure 3: Household debt to GDP and share of mortgage debt in total debt




Source: IMF (GFSR, October 2017)

Non-financial firms' debt to GDP evolved rather moderately in the last decade in developed countries. However, in some emerging economies such as China, corporate debt expanded faster and has reached a historically high level.

Figure 4: Nonfinancial Firms: Debt to GDP, by region




Source: IMF (GFSR, October 2017)

Regarding emerging and developing countries in particular, it is also worth to mention that sovereign borrowing has picked up in the last decades, including international bond issuances amid relatively loose Global financial conditions and accommodative monetary policy stance in US and Europe.

## 2.2. Households and corporate debt in Rwanda

Data on loans disbursed by banking sector in Rwanda are classified in line with sector of activities and whether the borrower is a non-financial corporate company or an individual. The outstanding loans in both sub sectors are used to estimate the level of debt in non-financial firms and households respectively.

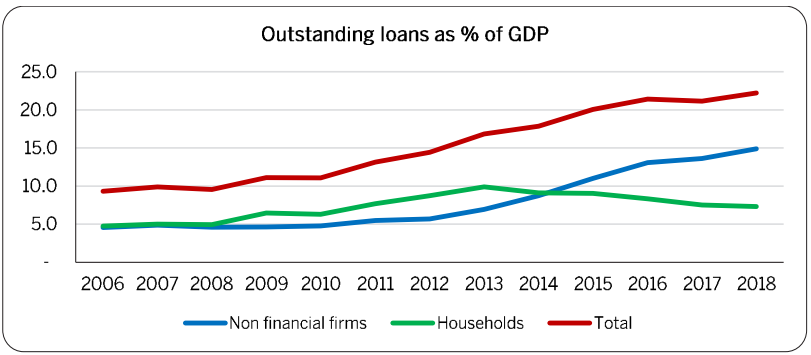
Similar to other economies over the World, debt level (measured as total outstanding loans from the banking sector) in Rwanda continue to grow as displayed in figure 5 below. While households' debt used to be the main contributor to overall private sector debt growth, non-financial firms are currently expanding at a higher pace following sizeable borrowing from some bigger companies, which had a salient impact compounded with a base effect. Nevertheless, the rate of growth in total private debt has slightly decelerated from 2017 as banks tightened lending conditions to some sectors perceived as risky following pressures from high NPLs in 2017 (BNR, 2019). This deceleration is more evident in households 'outstanding debt.

Important to note is that in percentage of GDP, households' debt level in Rwanda is still low (8.3 percent by end 2016) compared to emerging markets (median of 21 percent in 2016) and developed economies (median of 63 percent in 2016). Figure 5 shows that between 2006 and 2014, households' debt as percentage of GDP was building up and has relatively flattened since then, while debt for non-financial firms sustained its momentum. However, it is also important to note that most of households also borrow from other non-banking sectors (e.g. informal sector and microfinance notably). Hence, the level of total households' debt is not as low as suggested by outstanding loans from banking sector.

Overtime, growth in households' debt has been more volatile compared to the case of non-financial firms' debt and its growth pattern seems to suggest a cycle of 2-3 years sizeable growth followed by 1-2 years slowdown especially between 2006 to

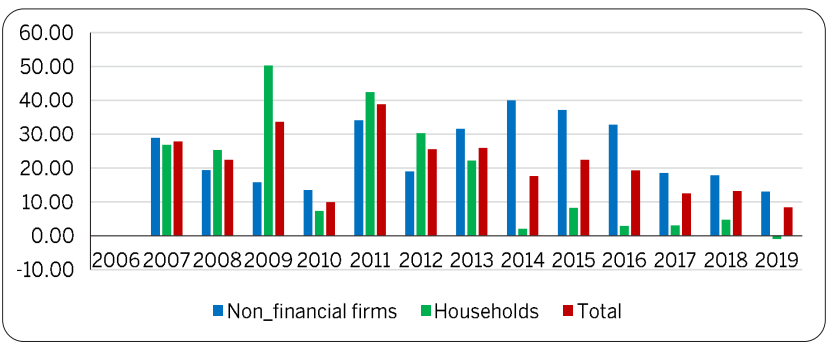
2014 (see figure 7). On average, outstanding households' debts recorded an annual growth of 18.8 percent between 2007 and 2018. Nevertheless, this growth pace has recently decelerated as displayed in figure 6. Since the period 2015 to 2018, the growth rate on annual basis averaged 4.7 percent due notably to slowdown in personal loans and mortgage loans despite absence of any significant change in non-performing loans in those particular sectors. Meanwhile, in the same period, non-financial firms' debt was expanding by around 17 percent on average, on annual basis, mostly boosted by borrowing from big companies.

Figure 5: debt to GDP ratio in Rwanda



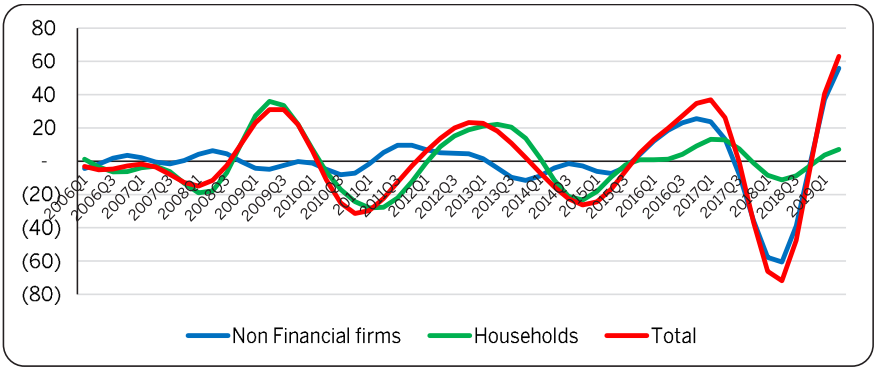

Source: National Bank of Rwanda

Figure 6: growth in outstanding loans (% YoY)




Source: National Bank of Rwanda

Figure 7: Estimated debt cycles (using band pass filter)




Source: National Bank of Rwanda

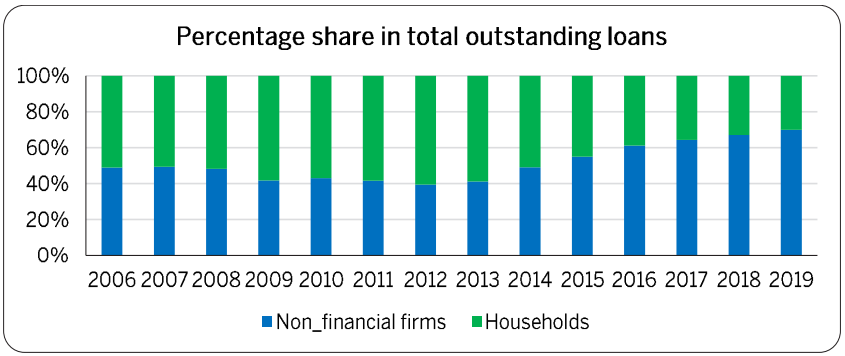
Looking at the evolution , the share of non-financial firms' debt has been gradually expanding compared to households' debt as displayed in figure 7 and this has been concomitant with diversification of Rwandan economy. New firms started operations while some existing firms continued to grow and requiring financing mostly from domestic banking sector. Back in 2006, the share of households' debt stood at 51 percent and peaked at 61 percent in 2012, before gradually falling to reach 33 percent in 2018.

Regarding households' debt, similar to developed and emerging markets, the bulk of households' debt in Rwanda is in form of mortgage debt to households. This share went up from 31.5 percent of total households' debt in 2009 to 50 percent in 2018, followed by consumption debt at around 28 percent in 2018. In comparison to other economies, mortgage debt accounted for more than 50 percent of total household debt in most advanced economies, against around 30 percent or less emerging market economies in 2016 (IMF, 2017). Dynamics in households' mortgage debt is aligned with development observed in real sector, as construction has been one of the key contributor to strong expansion of Rwandan economy for the last two decades.

Interest rates on households' loans are generally higher with a spread of around 1.5 percent from interest rates on non-financial firms' loans. This is due to a number of factors including the risk premium whereas a bulk of non-financial firms' loans is of

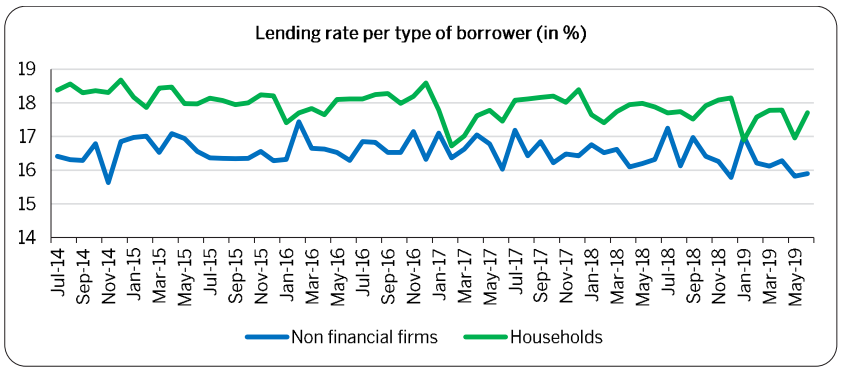
long-term maturity and a number of non-financial firms are well-established institutions with a relatively low risk profile.

Figure 8: Sectoral share in total loans




Source: National Bank of Rwanda

Figure 9: lending rates by type of borrower (%)

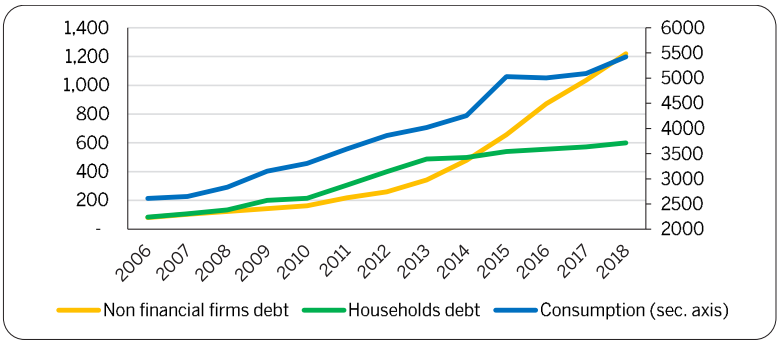



Source: National Bank of Rwanda

Overtime, growth in households' debt has been aligned with growth in consumption especially from 2006 to 2015 as illustrated in figure 10. During that period, peaks in households' debt growth and consumption were almost simultaneous, thereby suggesting a positive correlation between these variables.

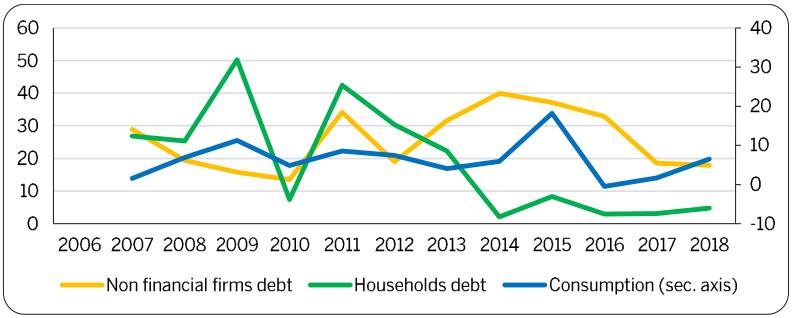
The co movement between non-financial firms' debt and consumption is less evident compared to households' debt.

Figure 10: Evolution of households' debt and consumption




Source: National Bank of Rwanda

Figure 11: Annual percentage growth in households' debt versus consumption

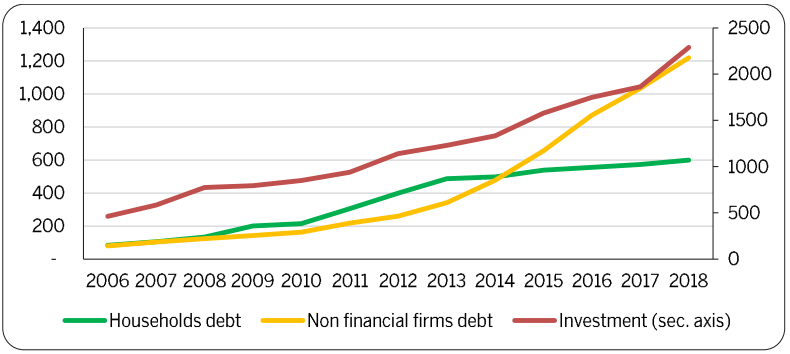



Source: National Bank of Rwanda

Co movement between households' debt and investment seems to be less evident compared to the previous case with consumption. Figure 12 and 13 show that in some period, co movement between two variables was quasi absent if not opposite. Alternatively, the link between non-financial firms' debt and investment is relatively more pronounced.

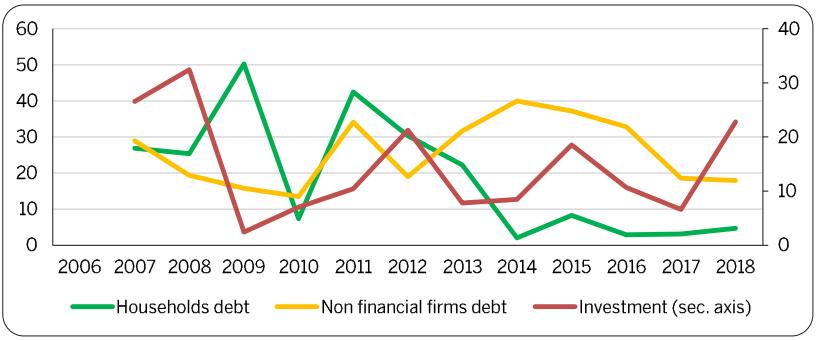
Overall, this preliminary analysis may suggest a strong link between households' debt and consumption and non-financial firms' debt with investment in Rwanda, which compel deeper analysis in the next sections.

Figure 12: Evolution of households' debt no financial firms' debt and investment




Source: National Bank of Rwanda

Figure 13: Annual percentage growth in debt versus investment




Source: National Bank of Rwanda

# 3. Literature review

## 3.1. Theoretical literature

Although in the wake of the 2008 GFC, the literature on the role of financial factors in macroeconomic fluctuations flourished, this has been an old topic in economic theory as illustrated by the work of Fisher on debt deflation in 1933, Minsky's financial instability hypothesis in the 80s and more recently Bernanke and Gertler financial accelerator, among others.

Fisher debt deflation theory in 1933 came just after the 1929 great depression, and postulated that the latter was a result of vicious circle of falling prices and subsequent increase in real debt burden (Eggertsson & Krugman, 2012).

Later on, Minsky's financial instability hypothesis underlined the role of credit supply pro-cyclicality in financial crisis. Minsky (1992) distinguishes three types of borrowers namely hedge borrowers, speculative borrowers and Ponzi borrowers. His hypothesis is that the economy has two financial regimes, one stable, another unstable, and a prolonged boom period would increase optimism and complacency about debt and this sow seeds of financial instability. For instance if inflationary pressures in boom period require intervention by monetary authority to curb inflation and negatively affect assets prices starting from Ponzi borrowers and lead to a financial crisis.

Of recent, Bernanke and Gertler (1990) highlighted how agency cost may lead to low investment and negatively impact on economic performance. The agency costs are results of investors' reliance on external finance, hence investors' net worth relative to their project is low and their interest diverge with those of their lenders.

Recent theoretical models on relationship between financial conditions/debt and economic performance, borrowed from the earlier work described in previous section. For instance, Fisher debt deflation and Minsky's financial instability hypothesis influence the New Keynesian model by Eggertsson and Krugman (2012). In this model, it is a debt overhang which, forces agents to rapidly deleverage and depress aggregate demand.

The model postulates that are not all debts in an economy are created equal and its distribution matters because, highly indebted agents would face different constraints compared to agents with low debt. The model assumes that some agents borrow but they are constrained by a debt limit. In case constraints forces indebted agents to sharply deleverage in the sticky price environment, output will fall and prices may fall pushing the economy to zero lower bound (Eggertsson & Krugman, 2012).

The negative effect of deleveraging on output and the role played nominal rigidities and policy constraints especially monetary policy in generating higher borrowing in real terms, has been highlighted in several models such as Farhi and Werning model (Farhi & Werning, 2013), Guerrieri and Lorenzoni model (Guerrieri & Lorenzoni, 2017), etc.

Guerrieri and Lorenzoni (2017) model shows that nominal rigidities would lead to a larger drop in output when there is a tightening of borrowing conditions. The model assumes heterogeneous agents and households borrow and lend in order to smooth temporary income fluctuations. A shock on credit conditions reduces consumption and output; the effect is larger when nominal rigidities prevent downward interest rate adjustment, which could have a positive effect on consumption. The model also shows that the effect of shock on lending conditions can be more severe in case of shock to credit spread, which would affect a larger number of borrowers, contrary to a shock on credit limit, which would affect highly indebted borrowers.

The adverse effect of household deleveraging can also be worse in case some households have a high marginal propensity to consume (Rognlie et al., 2014). Besides, in addition to credit constraints, liquidity constraint by indebted households can also be important in explaining recession following a borrowing tightening as shown in Midrigan and Philipon model (Midrigan & Philippon, 2011). Similar to other models highlighted, homes prices are important as they represent the collateral value and their changes affect liquidity constraints (Midrigan & Philippon, 2011).

Minsky in 1986 and Kindleberger in 1978 pointed out the issue of behavioral biases that may also explain fluctuations in credit cycles and output (Mian & Sufi, 2018). One example is when biases lead to preference for current consumption over future consumption (IMF, 2017). As forecasts by economic agents tend to be influenced by recent events while most of economic times series are mean reverting in the long run,

economic agents expectations would overstate the long run persistence in good times or bad times (Fuster et al., 2010).

### 3.2. Empirical literature

The objective of this paper is to take stock of international experience and assess macroeconomic effects of household debt versus corporate debt in Rwanda. The literature on developing countries is scanty as empirical literature has mostly focused on developed countries and at some extent to emerging countries and often confirmed the insights from theoretical models, on the negative effect of household debt on economic performance in medium term. The fact that financial sector in developing countries is still growing and households' debt has not yet reached higher levels may be the reason why.

Empirical literature is extensive and used different approaches (local projection methods, panel analysis, vector auto regression, etc.) with mostly panel data. Here, the focus is on the recent literature, which attempted to assess and contrast households and corporate debt role in driving business cycles.

Empirical literature on effect of households' debt versus corporate debt generally supports the insights from theoretical model especially, the negative relationship between households' debt and economic growth in the medium term, across countries. Recent studies such as Mian and Sufi (2018) attempt to distinguish demand driven and supply driven credit booms as source of change in debt levels, in line with the earlier work by Mian et al. (2017), and other influential papers such as Jorda et al. (2014) and Krishnamurthy and Muir (2017). On this, different measures of excess credit to GDP ratio (e.g. Jorda et al., 2013), spread (e.g. Lopez-Salido et al., 2017) and institutional facts such as banking deregulation are used to proxy expansion in credit supply.

Empirical evidences in developed countries brought up the debt overhang and high level of households' debt to GDP ratio as one of the factors that may amplify the negative relationship between households' debt and economic growth in the long run, because they may constrain households borrowing capacity or lead to a severe drop in households consumption and ultimately economic growth. Studies by Mian and

Sufi (2010) and Mian et al. (2017) for the case of US and Lombardi et al. (2017) for 54 developed and emerging countries confirmed the negative relationship between household debt and consumption and growth in the long run.

For the case of US, Mian and Sufi (2010) used first difference regression on single equation at county level to examine the role of households' leverage in 2008 GFC and highlighted how household debt to GDP ratio had reached unprecedented level in 2007 prior to the crisis. Considering the different patterns of households' debt across US counties in the run up of the GFC, their results show that counties with high household leverage experienced more severe recession and sharp decline in consumption for durable and residential investment. Dynan (2012) using household level data in US also found that highly leveraged homeowner household recorded the largest decline in their consumption during the same period, following notably the reversal in house prices. Important to note that Dynan (2012) used first difference regression and data at household level to take into account wealth effects and therefore demonstrated that effect exerted by high household on consumption is strong.

While Dynan (2012) empirical strategy controlled for wealth effects, Mian et al. (2017) argued that focusing on data on firm level or households' level might miss spillovers from credit supply shocks. Using State level first difference regression equation for boom and bust period and also panel regression, results revealed that credit supply shocks boosted the economy mostly via local demand than firms' productive capacity and was highly cyclical as the contraction in credit due to debt overhang or banking sector issues led to a downturn in the economy. Specifically, States in the US, which had deregulated their banking sector, had stronger increase in credit supply, which led to higher increase in house prices, residential construction and GDP and thereafter experienced a worse recession, unemployment and decline in house prices compared to other states due to downward nominal wage rigidity, debt overhang and banking sector issues.

It is argued that the upsurge in household leverage has been associated with and fueled by housing price bubbles and when the latter burst, it worsened households' leverage. A number of empirical studies such as Jorda et al. (2013) and Jorda et al. (2014) using local projection methods demonstrated the role of housing prices in credit booms and business cycles. Even prior to 2008 GFC, Debelle (2004) study for

the case of Netherlands suggested that change in housing prices have an influence on the extent of effect of household indebtedness on macro economy and considering some European countries experiences, the increase in households' indebtedness implied more vulnerabilities and would amplify effect from other shocks especially those affecting households' income.

After 2008 GFC, Jorda et al. (2013) and Jorda et al. (2014), formally studied these linkages. With a long time series dating back to 1870, they show an upsurge in households' leverage especially due to mortgage lending in developed countries and these credit booms not only drive business cycles but also the resulting recessions are worse than normal recessions and are associated with high likelihood of financial crisis. Similarly, Jorda et al. (2015) reached the same conclusion with a sample of 14 developed countries over 140 years, using local projection methods and different measurement of excess credit (deviation of bank credit to GDP ratio from its mean).

Debt services also account in the transmission from households' debt and future economic growth according to Drehmann et al. (2017). Using local projection methods as in case of Jorda et al. (2014) and data from 1980 to 2015 for a panel of 17 countries, this study show that credit booms imply higher debt services in the future. In addition, while credit booms exert a positive effect on output in the short run, this turns into a negative o effect in the medium term, driven by higher debt services.

Policy constraints are also another issue highlighted by empirical studies as one factor that amplifies the negative relationship between households' credit growth and GDP growth in medium term. In a study on a sample of 30 countries, Mian et al. (2016) used both VAR framework and local projection method on single equation and confirmed the negative relationship between credit supply-induced household debt growth and subsequent GDP growth contrary to the case of non-financial firms' debt. Besides, increase in debt would fuel consumption and imports, which lead to a deterioration in trade balance. This study highlighted the influence of policy constraints especially monetary policy constraints such as proximity to zero lower bound and fixed exchange rate regime.

While the issue of policy constraints such as zero lower bound was mostly a post 2008 Global financial crisis phenomenon, Brunnermeier et al. (2019) highlighted the role of policy cyclicality especially monetary policy in the case of US. Results from

Bayesian VAR indicated that monetary policy reactions to inflation during credit booms is the main driver of downturn in industrial production. In addition, the downward movement in industrial production following an increase in households' credit was rather small but more predictive than credit to business.

Regarding emerging economies, some have experienced credit cycles for the last decades, with an upward trend in the level of debt to GDP ratios and a number of studies have naturally looked at that phenomenon and concluded that the macroeconomic effect of households' credit is stronger as in the case of developed countries.

For instance, Bahadir and Gumus (2016) examined the macroeconomic effects from households' credit and business credit using real business cycle model with two sectors namely non-tradable sector credit and tradable sector credit. In the model, credit shocks are shocks to the borrowing limits by economic agents, in a small economy real business cycle model calibrated to Turkey. The results indicate that credit shocks are one of drivers of business cycles in emerging economy and generate different patterns depending on whether credit is to households and business. Credit shocks have an impact notably on output, consumption, investment, real exchange rate and trade balance. In particular, consumption increase after a positive credit shock and decline in the second period and the decline is stronger for households' credit shocks. The output also increase on impact mostly from non-tradable sector but decline in the second period. In addition, households' credit lead to an appreciation of real exchange rate and its negative effect on trade balance is relatively lower compared to business credit.

Other studies which had a sample including emerging countries such as Beck et al. (2008) and Angeles (2015) also concluded to the difference in terms of effects of firms versus households' credit, as only the former is are associated with economic growth. Angeles (2015) also highlighted the positive effect of firms' credit to growth while households' credit exerted a negative effect on growth for selected developed and emerging countries using both GMM and single equation with data from 1960 to 2010.

Regarding Rwanda, to the best of our knowledge, no empirical evidence on macroeconomic effect of household debt vs firms' debt. However, recent studies by

Kigabo et al. (2015), Karangwa and Gichondo (2016) and Nyalihama and Kamanzi (2019) used macro data on Rwanda and indicated a positive relationship between credit to the economy and economic growth, without distinguishing households' credit with firms' credit.

In summary, almost all empirical studies reviewed suggested a positive relationship between households' debt, firms' debt and output in the short run while in the medium run this relationship became negative mostly in the case of households' debt. Studies opted for different empirical methods ranging those using micro data from credit registry, micro data at states or county level to macro data at country level and for some country cases, results were almost similar. For instance, a study by Kim (2016) for the US found evidence of positive feedback between household debt and output in short run while in the long run, this relationship turns negative, thereby corroborated the insights from other studies previously cited using recent micro data for the US.

In addition, most of studies selected a panel of countries while others considered one country. Hence, estimation methods also ranged from GMM panel estimation (e.g. Angeles, 2015), Structural VAR (e.g. Brunnermeier et al., 2019; Kim, 2016), local projection methods (e.g. Jorda et al. 2013; Jorda et al.,2014) and Mian et al. (2016) and OLS with instrumental variables to deal with the issue of endogeneity, common in macro studies (e.g. Beck et al. 2008; Dynan, 2012).

## 4. Methodology

### 4.1. Empirical model

While many studies have used micro data in order to capture the relationship between households' debt, consumption and output, some of the micro data especially long series on household income and real estate prices are partially available for the case of Rwanda. Therefore, the present study borrows from influential studies such as Mian et al. (2017) and other studies conducted on one country using macro data such as Kim (2016) for the case of US.

Given the objectives of this study, several models are estimated. In addition, this study slightly departs from other studies (e.g. Kim, 2016; Mian et al., 2016) on the same topic, which used vector auto regression analysis with GDP, non-financial firms' debt to GDP and households' debt to GDP (in addition Mian et al. (2016) used mortgage sovereign spread as an instrument and also did additional estimations using local projection. Meanwhile Kim (2016) used debt, GDP and net worth). The present study evaluates the effect of households' and non-financial firms' credit to other key macro-economic variables notably real effective exchange rate.

Vector auto regression framework is appropriate in our context, considering the issue of endogeneity, which is usually present in studies using credit aggregates and output and the limited availability of appropriate instruments. Although, using macro data may disregard some micro realities, macro data may also help to better capture the overall and feedback effects because economic agents' choices have spillovers to other agents in the economy.

The empirical analysis is based on the following structural VAR model:

$$AY_t = C(L)Y_t + Bu_t \dots\dots\dots (1)$$

Where Yt is a vector of endogenous variables (households' debt to GDP, non-financial firms to GDP, real GDP, real consumption, real investment, real effective exchange rate and real monetary conditions index), L is the lag operator, A,B and C are matrices and ut is a vector of normally distributed errors (ut~N (0, I)).

Prior to model estimation, unit root tests allow determining whether series are stationary or not. In presence of some non-stationary series, the empirical analysis is based on the following vector error correction model:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \varphi_1 \Delta Y_{t-1} + e_t \dots\dots\dots (2)$$

Where Yt is a vector of endogenous variables as previously listed, $\alpha$ is the loading matrix and $\beta$ is matrix of the cointegrating vectors, $\varphi$ is a matrix of contemporaneous coefficients, et is a vector of normally distributed errors (et~N (0, I)).

In addition to households' debt to GDP ratio, firms' debt to GDP ratio and real GDP, we assess channels via which, debt affects real GDP by examining the effect of

households' debt and non-financial firms' debt on consumption and investment. In line with finance-growth nexus literature, other key macro variables that are likely to be affected by debt such as real effective exchange rate are also considered. Nevertheless, housing prices, which are an important variable when assessing the macro effect of household debt, are not included due to data availability.

Indicator of households and firms' debt will be their respective outstanding credit over GDP ratio. Following Mian et al (2016), the ratio are normalized by calculating the outstanding credit to previous period nominal GDP. According to Mian et al. (2016), it is important to consider debt relative to the size of the economy. Secondly, lagging the GDP avoids to capture innovation to GDP in measuring debt evolution.

While a number of empirical studies used leverage indicators (where debt is considered in relation to assets value), it is not the case for this study due to data availability. For the case of Rwanda, there is a very short series of housing price index, while debt services and households net wealth data are quasi absent and yet, these variables could help to better measure the households and firms' leverage. Besides, other standard measures of market sentiments or risk taking such as corporate bond spread are not available as the local financial markets are still developing.

### 4.2. Identification strategy

Kim (2016) VAR estimation opted for generalized impulse, which did not require specific restrictions on error structure. Mian et al. (2016), in addition to local projection methods, also assessed dynamics with SVAR using in first attempt a recursive identification and ordering household debt to GDP ratio behind and in second attempt, identifying a household credit supply shock using an instrument derived from the mortgage sovereign spread. The present study borrows from these recent studies by using a recursive identification and orders households' debt in the last position in all models estimated, in order to capture a households' debt shock.

The same strategy allowed identification of credit supply shocks in a number of studies such as Lown and Morgan (2006) on linkages between credit cycle and business cycles in US, and Ciccarelli et al (2010) on credit channel of monetary policy in Euro Area and US.

## 5. Empirical results

Before estimating models, stationarity properties of each series are investigated using the Augmented Dickey–Fuller (ADF) test and the Phillips–Perrorn (PP) test. All series have unit root (except real monetary conditions index and real investment), hence the use of VECM to assess the effect of households' debt and non-financial firms' debt on real GDP, consumption and investment. The table below reports the result of stationarity tests.

**Table 1: Results of unit root test**

| Variables | ADF | | KPSS | |
|---|---|---|---|---|
| | Probability | Results | Value | Results |
| log of real GDP | 0.002 | I(0) | 0.125 | I(1) |
| real monetary conditions index | 0.000 | I(0) | 0.139 | I(0) |
| log or real consumption | 0.112 | I(1) | 0.145 | I(1) |
| log of real investment | 0.053 | I(0) | 0.061 | I(0) |
| Households' debt to GDP | 0.408 | I(1) | 0.423 | I(1) |
| non-financial firms' debt to GDP | 0.701 | I(1) | 0.217 | I(1) |
| log of real effective exchange rate | 0.694 | I(1) | 0.166 | I(1) |

Source: Authors estimations

As discussed in the methodology, we use recursive methods in attempt to identify structural shocks, with households' debt ordered last in various models estimated. Ordering real GDP first allows capturing demand shocks, hence the shock to households' outstanding debt to lagged GDP is considered as from a "supply shock". Each model also includes the real monetary conditions index as a proxy of monetary policy to control for the effect of monetary policy and primary fiscal deficit as a measure of fiscal policy given its importance in Rwandan economy. Nevertheless, the primary fiscal deficit is included as an exogenous variable.

Johansen cointegration is used and as this method is VAR based, it allows to assess the dynamic effect of shock to households' debt via impulse responses, but also the long run relationships. Before estimation, the lag length specification is based on both Akaike and Schwarz criterion and assumes that a cointegration vector contains a constant, but no linear trend.

### a. Households' debt, non-financial firms' debt and real GDP

Different models are estimated in order to evaluate the relationship between households' debt and non-financial firms' debt with real GDP and assess whether consumption and investment play a role in that relationship. The next table shows that cointegration relationships were present in all models.

Table 2: Johansen cointegration test results

| Model | trace test results |
|---|---|
| Real GDP | 2 cointegrating equations |
| Real consumption | 1 cointegrating equation |
| Real investment | 2 cointegrating equations |
| Real effective exchange rate | 2 cointegrating equations |

Source: Authors estimations

Johansen cointegration test on the first model which includes real GDP, RMCI, non-financial firms' debt and households' debt (both normalized to previous period GDP) indicates two cointegrating equations (from trace statistics maximum while Eigen value test suggested one). Results point out that both households' debt and non-financial firms' debt exert a positive effect on real GDP in the long run, although the effect from household's debt is relatively weaker.

These results slightly contrast with a number of other studies reviewed, which suggested rather a negative effect of households' debt on real GDP. Nevertheless, some similarities with other empirical evidences would be that in the case of Rwanda; the positive effect of households' debt is not as strong as the effect of non-financial firms' debt. On this, it is also important to recall that debt level relative to GDP are still lower in Rwanda compared to the case of emerging and developed markets and till the recent past, banks used to provide more credit to households than corporate sector.

Table 3: VECM estimation results (long run real GDP equation)

| Dependent variable: Log of real GDP | | |
|---|---|---|
| | Coefficients | t statistic |
| RMCI | 0.046*** | -6.083 |
| Non-financial firms' debt to GDP | 0.070*** | -12.714 |
| Households' debt to GDP | 0.040*** | -3.459 |
| C | 6.142 | |

Source: Authors estimations
*** Statistically significant at 1%, ** statistically significant at 5%

Table 4: VECM estimation results (long run real consumption equation)

| Dependent variable: Log of real consumption | | |
|---|---|---|
| | Coefficients | t statistic |
| RMCI | 0.045*** | -5.924 |
| Non-financial firms' debt to GDP | 0.065*** | -11.969 |
| Households' debt to GDP | 0.033*** | -2.953 |
| C | 6.007 | |

Source: Authors estimations
*** Statistically significant at 1%, ** statistically significant at 5%

Table 5: VECM estimation results (long run real investment equation)

| Dependent variable: Log of real investment | | |
|---|---|---|
| | Coefficients | t statistic |
| Log real GDP | 0.939*** | -3.217 |
| RMCI | 0.034** | -2.416 |
| Non-financial firms' debt to GDP | 0.031 | -1.569 |
| Households debt' to GDP | -0.032 | 1.534 |
| C | -0.986 | |

Source: Authors estimations
*** Statistically significant at 1%, ** statistically significant at 5%

A number of empirical studies have suggested that households' debt mostly affects consumption while non-financial firms' debt boosts investment and this would explain their contrasting effect on real GDP. We assessed these relationships and results reveal that both households' debts and non-financial firms' debt boost consumption in the long run.

Regarding investment, coefficients for both households' debt and non-financial firms' debt are not statistically significant at 5% level. However, their signs reveal some key insights. On one hand, non-financial firms has a positive sign, as it would be expected that its influence on investment is positive. On the other hand, households' debt coefficient is negative; suggesting that the latter may have had a crowding out effect on non-financial firms' debt and subsequently slow down investment. One caveat to

mention is that due to data availability, investment measured here also include an important share of public sector investment, which does not necessarily depend on domestic banking sector financing.

Therefore, the quasi absence of households' debt effect on investment in the long run, may explain why its effect on real GDP in long run is rather subdued compared to non-financial firms' debts. Indeed, this is in line with the fact that Rwandan households borrow mainly for consumption, hence more loans to households may imply less loans to non-financial firms that use most of borrowed funds to invest.

### b. Households debt, non-financial firms' debt and external balance

Considering the importance of external balance in developing economies with high and rapid economic growth such as Rwanda, this study extended the analysis of households' debt effect on one of external balance indicators namely real exchange rate, as long series on current account data on quarterly basis were unavailable.

Similar to previous section, another alternative model was estimated including the real effective exchange rate. Results revealed that both households' debt and non-financial firms' debts exert a depreciation effect on real effective exchange rate , and the effect from households' debts is relatively stronger. This could be because Rwanda has mostly been importing consumption goods.

Regarding other variables, real GDP increase seems to lead to real effective exchange rate appreciation as theory suggests, although its coefficient is not statistically significant.

**Table 6: VECM estimation results (long run real effective exchange rate equation)**

| Dependent variable: Log of real effective exchange rate | | |
|---|---|---|
| | Coefficients | t statistic |
| Log real GDP | -0.312 | 1.268 |
| Non-financial firms' debt to GDP | 0.040*** | -2.733 |
| Households' debt to GDP | 0.052** | -2.584 |
| C | 5.803 | |

Source: Authors estimations

*** Statistically significant at 1%, ** statistically significant at 5%

For all four models, diagnostic test results are somehow mixed. All four models have no issues of correlation as suggested by LM correlation test results (see in appendix). However, except the real exchange rate equation, other have issues of normality in residuals as suggested by Jarque Berra test.

### c. Discussion of results

Empirical results suggest quite a number of similarities with previous studies on emerging and developed countries but also some differences. Recent literature generally found that households' debt positively affects economic growth in short run while in the medium term, this relationship became negative contrary to corporate debt, which had a sustainable positive effect on economic growth. For the case of Rwanda, our results rather suggest that the positive effect from households' debt is positive in long run although it is relatively weaker compared to the positive effect from non-financial firms' debt. Important to note also is the difference in our methodology with some of the studies on developed and emerging markets.

Households' debt have had a higher share in total private debt in Rwanda for quite long time till recently, and loans were used for both consumption and investment especially in residential housing. Given that private sector financing in Rwanda were initially low, the increase in debt level was necessary to meet the need for finance in Rwandan economy contrary to the case of developed markets where high debt level are prone to quickly turn into a debt overhang in case there is an increase in indebtedness. Literature (e.g. Arcand et al., 2012) has highlighted that the debt level can also affect the relationship between increase in debt and subsequent economic growth.

Another similarity resides in channels via which households' debts impact on economic growth. Results from previous section suggest that in Rwanda, households' debt impact on real consumption is positive while its effect on real investment seems to be negative in the long run. According to the literature, the effect of households' debt turns negative in medium term when debt accumulation obliges households to adjust their consumption and investment downward. In fact, this may partly be the case in our study, given the relatively subdued effect of households' debt on economic growth from empirical results. While households borrow to consume and

invest especially in residential housing, borrowing of non-financial firms on the other side is likely to boost their productive capacity and expansion overtime, which would likely sustain economic growth going forward.

The effect of households' debt on real investment in Rwanda is one counterintuitive result from this study. Nevertheless, the fact that real investment in Rwanda also includes a non-negligible share of public investments which do not necessary depend on private sector borrowing may partly be the reason.

Regarding external balance, it is evident that increase in both households' debts and non-financial firms' debts lead to a deterioration of external balance, thereby mirroring foreign inflows to supplement domestic sources in financing the economy. While, this is normal for fast growing economy like Rwanda, it has strong policy implications. On one side, it is paramount that debt accumulation leads to strong economic growth, which would ensure sustainability of our external balance going forward.

Despite many insights from our results, there are some caveats worthy to highlight. One is unavailability of long series on assets prices and households' net worth in Rwanda, which could shed more lights on macro-economic effect of households' debt. Secondly, our sample period includes the period where economic growth was more Government led with external financing playing a big role. Lastly, banking sector financing to households is a part of overall households' debt as there is a portion of households' debt from informal sector.

## 6. Conclusion

This study attempted to examine the macroeconomic implications of households' debt in Rwanda as a developing country and to assess whether macroeconomic effects of households' debt differ from those of corporate debt in Rwanda. Notably, the effect on output, consumption, investment and external balance.

Most of recent studies on the same topic used micro level data in panel analysis focusing mostly on developed and emerging countries. Due to data availability, this study uses macro data in vector autoregressive framework to capture feedback

effects. Building on some recent studies, we broaden the analysis to contrast effect from households' debt and corporate debt on external balance in addition to output, consumption and investment.

Results suggested rather a positive effect from households' debt on output in long run although it is relatively weaker compared to the positive effect from non-financial firms debt. Similar to recent empirical evidences, households' debt impact on real consumption is positive as for non-financial firms' debt, while the long run effect on investment seems to be negative. In addition, increase in households' debt and non-financial firms' debts lead to depreciation of real effective exchange rate. Depreciation effect from non-financial firms' debt is also evident though relatively lower.

These results depart at some extent from recent empirical evidences on the negative effect of households' debt accumulation to economic growth in the medium term. Nevertheless, results point out that despite the long run positive relationship between households' debt and economic growth in Rwanda, this is relatively weaker compared to the case of non-financial firms' debt. Considering that financial development is still at early stage in Rwanda, these results are consistent with the literature on the impact of high indebtedness level on macroeconomic effect of increase in debt.

Regarding investment, the fact that an important portion is from the Government may be one of the reasons why the effect from private debt is somehow elusive. Apparently, the effect of non-financial firms' debt seems to be positive while for households' debt, the effect seems to be negative.

Another contribution of this study was to evaluate the effect on external balance. On this, results revealed that increase households' debts lead to depreciation of real effective exchange rate and exert more depreciation pressures than non-financial firms' debts. The fact that Rwanda has mostly been importing consumption goods may be one of the reasons.

Consistent with these results, the main implications from this is that macroeconomic implications from both households and corporate debts are generally positive and current initiatives to bolster financial inclusion and depth would contribute to sustaining economic growth in Rwanda.

It is also important for policymakers to consider these differences in macroeconomic implications of households' debt accumulation versus corporate debts. In the ongoing journey of economic transformation, both type of debts will continue to grow, as Rwanda will be catching up with emerging and developed countries and efforts geared towards promoting financial inclusion would likely lead to more households' debt and growth benefits in the long run. Therefore. In designing monetary policy, macro prudential policy and other structural policies such as financial inclusion, BNR should take into account the level and dynamics of private credit but also to its composition (e.g. households vs corporate).

In addition, business friendly environment would boost more lending to corporate sector and enhance long-term economic growth benefits. On this, close collaboration between Government, financial sector and private sector to alleviate existing corporate sector' financing constraints is paramount.

Recurrent current account deficits implied that foreign borrowing has been supplementing domestic sources in financing the economy. Therefore, this debt accumulation should lead to strong economic growth, which would ensure sustainability of Rwanda external balance going forward. Boosting domestic saving is also another avenue to mitigate recurrent external imbalances.

Although real effective exchange rate depreciation following debt accumulation could serve as stabilization tool, it is also important for policymakers to balance the financing needs and the need for macroeconomic stability especially the external balance.

One caveat from this study lack of micro data on households' wealth and assets prices, which could help to better gauge households' leverage at different level of income and assess the macroeconomic implications. This could be an avenue for future research.

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## Appendices

### 1. Cointegration test

#### a. Real GDP equation

| Unrestricted Cointegration Rank Test (Trace) | | | | |
|---|---|---|---|---|
| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
| None * | 0.585 | 72.038 | 47.856 | 0.000 |
| At most 1 * | 0.330 | 30.711 | 29.797 | 0.039 |
| At most 2 | 0.215 | 11.921 | 15.495 | 0.161 |
| At most 3 | 0.012 | 0.544 | 3.841 | 0.461 |
| Trace test indicates 2 cointegrating eqn(s) at the 0.05 level | | | | |
| * denotes rejection of the hypothesis at the 0.05 level | | | | |
| **MacKinnon-Haug-Michelis (1999) p-values | | | | |

#### b. Real consumption equation

| Unrestricted Cointegration Rank Test (Trace) | | | | |
|---|---|---|---|---|
| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
| None * | 0.574 | 69.204 | 47.856 | 0.000 |
| At most 1 | 0.297 | 29.078 | 29.797 | 0.060 |
| At most 2 | 0.200 | 12.507 | 15.495 | 0.134 |
| At most 3 | 0.042 | 2.027 | 3.841 | 0.155 |
| Trace test indicates 1 cointegrating eqn(s) at the 0.05 level | | | | |
| * denotes rejection of the hypothesis at the 0.05 level | | | | |
| **MacKinnon-Haug-Michelis (1999) p-values | | | | |

#### c. Real investment equation

| Unrestricted Cointegration Rank Test (Trace) | | | | |
|---|---|---|---|---|
| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
| None * | 0.522 | 83.750 | 69.819 | 0.003 |
| At most 1 * | 0.465 | 49.757 | 47.856 | 0.033 |
| At most 2 | 0.297 | 21.010 | 29.797 | 0.357 |
| At most 3 | 0.071 | 4.823 | 15.495 | 0.827 |
| At most 4 | 0.031 | 1.445 | 3.841 | 0.229 |
| Trace test indicates 2 cointegrating eqn(s) at the 0.05 level | | | | |
| * denotes rejection of the hypothesis at the 0.05 level | | | | |
| **MacKinnon-Haug-Michelis (1999) p-values | | | | |

d. Real exchange rate equation

| Unrestricted Cointegration Rank Test (Trace) | | | | |
|---|---|---|---|---|
| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
| None * | 0.410 | 55.796 | 47.856 | 0.008 |
| At most 1 * | 0.334 | 31.545 | 29.797 | 0.031 |
| At most 2 | 0.153 | 12.860 | 15.495 | 0.120 |
| At most 3 * | 0.107 | 5.226 | 3.841 | 0.022 |
| Trace test indicates 2 cointegrating eqn(s) at the 0.05 level | | | | |
| * denotes rejection of the hypothesis at the 0.05 level | | | | |
| **MacKinnon-Haug-Michelis (1999) p-values | | | | |

## 2. Diagnostic test

### a. Real GDP equation

| VEC Residual Serial Correlation LM Tests | | | | | | | |
|---|---|---|---|---|---|---|---|
| Null hypothesis: No serial correlation at lag h | | | | | | | |
| Lag | | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
| | 1 | 16.724 | 16 | 0.404 | 1.059 | (16, 89.2) | 0.406 |
| | 2 | 9.663 | 16 | 0.884 | 0.589 | (16, 89.2) | 0.885 |
| | 3 | 10.450 | 16 | 0.842 | 0.640 | (16, 89.2) | 0.843 |
| Null hypothesis: No serial correlation at lags 1 to h | | | | | | | |
| Lag | | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
| | 1 | 16.724 | 16 | 0.404 | 1.059 | (16, 89.2) | 0.406 |
| | 2 | 35.410 | 32 | 0.310 | 1.128 | (32, 93.8) | 0.321 |
| | 3 | 40.465 | 48 | 0.772 | 0.804 | (48, 82.9) | 0.793 |
| *Edgeworth expansion corrected likelihood ratio statistic. | | | | | | | |

### b. Real consumption equation

| VEC Residual Serial Correlation LM Tests | | | | | | | |
|---|---|---|---|---|---|---|---|
| Null hypothesis: No serial correlation at lag h | | | | | | | |
| Lag | | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
| | 1 | 11.667 | 16 | 0.767 | 0.719 | (16, 89.2) | 0.768 |
| | 2 | 12.777 | 16 | 0.689 | 0.792 | (16, 89.2) | 0.691 |
| | 3 | 11.867 | 16 | 0.753 | 0.732 | (16, 89.2) | 0.755 |
| Null hypothesis: No serial correlation at lags 1 to h | | | | | | | |
| Lag | | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
| | 1 | 11.667 | 16 | 0.767 | 0.719 | (16, 89.2) | 0.768 |
| | 2 | 27.965 | 32 | 0.671 | 0.859 | (32, 93.8) | 0.680 |
| | 3 | 44.866 | 48 | 0.602 | 0.911 | (48, 82.9) | 0.632 |
| *Edgeworth expansion corrected likelihood ratio statistic. | | | | | | | |

### c. Real investment equation

| VEC Residual Serial Correlation LM Tests | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Null hypothesis: No serial correlation at lag h** | | | | | | | |
| **Lag** | | **LRE* stat** | **df** | **Prob.** | **Rao F-stat** | **df** | **Prob.** |
| | 1 | 18.733 | 25 | 0.810 | 0.724 | (25, 72.1) | 0.815 |
| | 2 | 40.050 | 25 | 0.029 | 1.772 | (25, 72.1) | 0.031 |
| | 3 | 19.368 | 25 | 0.779 | 0.752 | (25, 72.1) | 0.785 |
| **Null hypothesis: No serial correlation at lags 1 to h** | | | | | | | |
| **Lag** | | **LRE* stat** | **df** | **Prob.** | **Rao F-stat** | **df** | **Prob.** |
| | 1 | 18.733 | 25 | 0.810 | 0.724 | (25, 72.1) | 0.815 |
| | 2 | 73.041 | 50 | 0.018 | 1.650 | (50, 67.2) | 0.028 |
| | 3 | 88.020 | 75 | 0.144 | 1.172 | (75, 47.3) | 0.281 |
| *Edgeworth expansion corrected likelihood ratio statistic. | | | | | | | |

### d. Real exchange rate equation

| VEC Residual Serial Correlation LM Tests | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Null hypothesis: No serial correlation at lag h** | | | | | | | |
| **Lag** | | **LRE* stat** | **df** | **Prob.** | **Rao F-stat** | **df** | **Prob.** |
| | 1 | 13.364 | 16 | 0.646 | 0.830 | (16, 74.0) | 0.649 |
| | 2 | 13.922 | 16 | 0.605 | 0.867 | (16, 74.0) | 0.608 |
| | 3 | 23.190 | 16 | 0.109 | 1.533 | (16, 74.0) | 0.111 |
| **Null hypothesis: No serial correlation at lags 1 to h** | | | | | | | |
| **Lag** | | **LRE* stat** | **df** | **Prob.** | **Rao F-stat** | **df** | **Prob.** |
| | 1 | 13.364 | 16 | 0.646 | 0.830 | (16, 74.0) | 0.649 |
| | 2 | 24.680 | 32 | 0.819 | 0.740 | (32, 75.4) | 0.827 |
| | 3 | 47.231 | 48 | 0.504 | 0.961 | (48, 63.7) | 0.553 |
| *Edgeworth expansion corrected likelihood ratio statistic. | | | | | | | |

# Structure of capital flows and exchange rate: The case of Rwanda

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## Abstract

In this paper, we analysed the link between capital inflows and real exchange rate movements using vector auto regressive model on quarterly data that spans from 2000 to 2018. The results showed that the real exchange rate not only depends on fundamental variables such as terms of trade, productivity differential and trade openness but, also on capital flows. Most importantly, we showed that the response of exchange rate to capital flows depend on its types. While the overall capital flows showed a depreciation effect on real exchange rate, public flows carry the burden of the appreciation effect. Among private flows, FDI and other private foreign liabilities excluding FDI are associated with a real exchange rate depreciation while remittances appreciate the real exchange rate. These findings have implications for the future direction of macro-economic policies notably management of capital flows in the context of price based monetary policy.

**Key words:** Capital flows, current account and real effective exchange rate

**JEL Classification:** F31, F32, F41

## 1. Introduction

Several factors such as financial liberalization and innovations, spread of information technology, globalization and proliferation of institutions have contributed to upsurge in international capital inflows (Dua & Sen, 2013). Capital inflows are desirable in developing countries as recipients countries can finance investment and foster economic growth, as well as increase welfare by facilitating consumption smoothing (Magud et al., 2011). Nevertheless, they can have also some negative consequences. Massive capital inflows put pressures on the exchange rate of the domestic country's currency (Ghosh & Qureshi, 2016; De Paula et al., 2013), thereby reducing the trade competitiveness of the economy. In the open economy macroeconomics, the real effective exchange rate (REER) is a pivotal variable in a country's level of trade. An appreciation of the REER, arising from capital inflows, damages competitiveness of export sectors, thus increasing internal and external borrowings, expanding fiscal deficits and worsening the current account imbalance (De Paula et al., 2013; Rashid & Husain, 2013). Sy and Tabarraei (2010) argue that the rise of capital inflows imposes a trade-off between some short run negative consequences following a real exchange rate appreciation as competitiveness reduces and long run economic growth through investments in education, health, etc. In light of this view, rising capital inflows affect economic growth in the long-term.

In the analysis of the impact of capital flows on exchange rate, the effects differ depending on their structure, with equity investment (like foreign direct investment) usually associated with positive effects since they tend to be more stable compared to debt flows (Lane & McQuade, 2013). Debts inflows were found to have a significant role in the movement of exchange rate than equity flows since the latter are generally concentrated more in the tradable sector, leading to a lower pressure on the nominal exchange rate and prices in the non-tradable sector (Bukovšak et al., 2017).

Over the last two decades, Rwanda has seen massive increase of capital flows, to finance the investment demand in excess of national savings. Regarding the composition of these capital flows, Rwanda capital inflows have been consistently dominated by official transfers (mainly grants) and concessional public borrowings, but in recent years, the share of foreign direct investment, remittances and private borrowings have started to rise. In terms of volume, net FDI liabilities reached USD 301.6 million (i.e. 3.2 percent of GDP) in 2018 from an average of USD 37.2 million (or

0.9 percent of GDP) between 2000 and 2009. Similarly, remittances grew considerably averaging USD 173.8 million (2.2 percent of GDP) over 2010-2019 from an average of USD 31.9 million (0.8 percent of GDP) during 2000-2009. On the other hand, official current and capital transfers decreased sharply, averaging 9.3 percent of GDP from 14.0 percent over the same periods.

Despite the growing and changing structure of capital inflows to Rwanda, few studies have analysed their impact on exchange rate. (Gasana & Mulindabigwi, 2016) assessed the effect of foreign aid inflows on the real exchange rate in Rwanda. Their study revealed that the country's foreign assistance depreciates the real exchange rate. To our best knowledge, no other researchers have tried to assess the effect of different types of capital flows on exchange rate in Rwanda. It is in sight of this background, that this study aims to analyse the trends and compositional shifts in capital flows in Rwanda and examines the effects they could have on the FRW exchange rate.

Using quarterly data for the period 2000-2018, we use vector auto regression (VAR) framework to analyse the effect of different types of capital flows on real exchange rate in Rwanda. The results show that public flows (the sum of government foreign liabilities and transfers) are positively correlated with appreciation of the real exchange rate. Among private flows, only remittances has a negative effect (appreciation) on real exchange rate. FDI and other private flows (mainly loans) tend to depreciate the real exchange rate with FDI holding the highest depreciation effect.

The rest of this paper is organized as follows. Section two analyses the development of capital inflows and other macroeconomic variables in Rwanda, section three reviews the literature on the relationship between capital flows and exchange rates. Section four describes the model and data while Section five reports the empirical results and section six concludes and discusses the policy implications of the research findings.

## 2. Capital flows and exchange rate behaviour in Rwanda

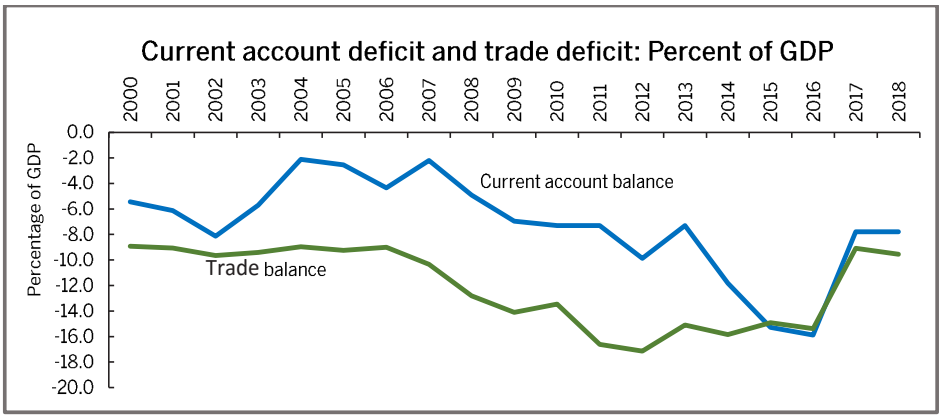
In this section, we present some key aspects of capital inflows in Rwanda and underlying macroeconomic developments. We first analyse Rwanda's current

account deficit and its key drivers. In the second sub-section, we analyse the composition of external financing and its compositional shift over the reviewed period and lastly we look at the impact of these foreign flows on REER in Rwanda.

Rwanda has consistently been running a current account deficit over the last eighteen years, which has been financed by large inflows of capital from abroad. Bailey and Millard (2001) stipulate that for any current account position, there must be equal and offsetting capital flows. Looking at the main drivers of Rwanda current account deficit, merchandise trade deficit has been the major factor, despite huge massive inflows of current and capital transfers obtained over these years. Low exports diversification of Rwanda's exports base (based primarily on minerals and agricultural exports commodities) and a growing domestic demand, following high infrastructure investment, explain the developments in the trade deficit. The gap between the current account deficit and trade deficit, reflects the fact that Rwanda has been earning massive transfers (official current and capital transfers, and private transfers mainly remittances), as payments of returns on foreign capital remain small[10]. However, in the recent periods the improving deficit of trade in goods is partly thanks to rising exports receipts coupled with a deceleration in imports growth (annual exports and imports growth averages 13.1 percent and 0.8 percent respectively during 2015-2018) significantly plummeted this gap amid the slowdown in official transfers.

[10] Return on investment in form of dividend, retained earnings and interest average 0.7 during 2000-2012 and 2.2 percent of GDP during 2013-2018.

Figure 1: Rwanda current account balance: percentage of GDP 2000-2018



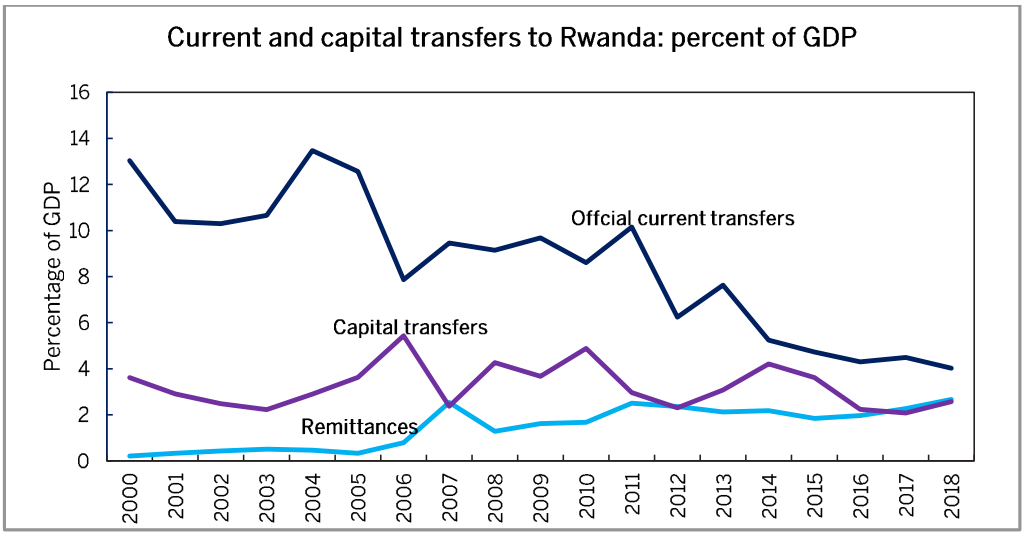

Source: National Bank of Rwanda

Capital inflows to Rwanda have been rising since it embarked on the path of liberalization and significant economic reforms, including privatization, investment facilitation and trade liberalization, which helped achieve strong economic growth (Mashayekhi et al., 2014). Total inflows (foreign aid, remittances, and foreign liabilities) represent an annual share of 19 percent of GDP during 2000-2009, which surged to 21 percent of GDP between 2010 and 2018, despite a high growth base in the later period. A favourable economic and investment climate, characterized by solid growth, moderate inflation, political stability, infrastructure development, ease of doing business, facilitates productive activities that attract foreign investment.

The Rwanda economy experienced spectacular rise in capital inflows largely dominated by foreign aid (government transfers both current and capital) and government borrowings. While government transfers are decreasing from their peak in 2010, still they represent a big share (43.6% over 2010-2018 from 73% during 2000-2009) of Rwanda's external financing. On the other hand, Rwanda has experienced a substantial increase in remittances inflow. There has been nearly a seventy-fold increase in remittances to Rwanda since 2000 with remittances growing from USD 3.6 million in 2000 to USD 254 million in 2018. Inflows from remittances accounted for 14 percent of the total inflows in 2018, inching closer to the inflows from FDI and capital grants, while representing 40 percent of official grants (the sum of current and capital transfers) and 46 percent of total government external

liabilities. The findings of a survey conducted by BNR in 2018 on the use of remittances flows revealed that the households receiving international remittances spend more at the margin on investment goods (nearly a half), especially, on housing and education, and spend less, at the margin, on food items (see appendix1). Several factors have contributed to this growth in remittances. First, several researchers have showed that remittances are mainly driven by economic conditions in developed countries (UNCTAD, 2011). Secondly, government policies to sensitize Rwanda diaspora to participate in the country's economic development and the emergence of technologies that have eased the cost of remitting money, have contributed to this growth. Lastly, the shift to remitting money using formal channels like banks and Money Transfer Operators (e.g. Western Union, Money Gram etc.) have improved data captivity, increasing remittances numbers.

Figure 2: Current and capital transfers to Rwanda




Source: National Bank of Rwanda

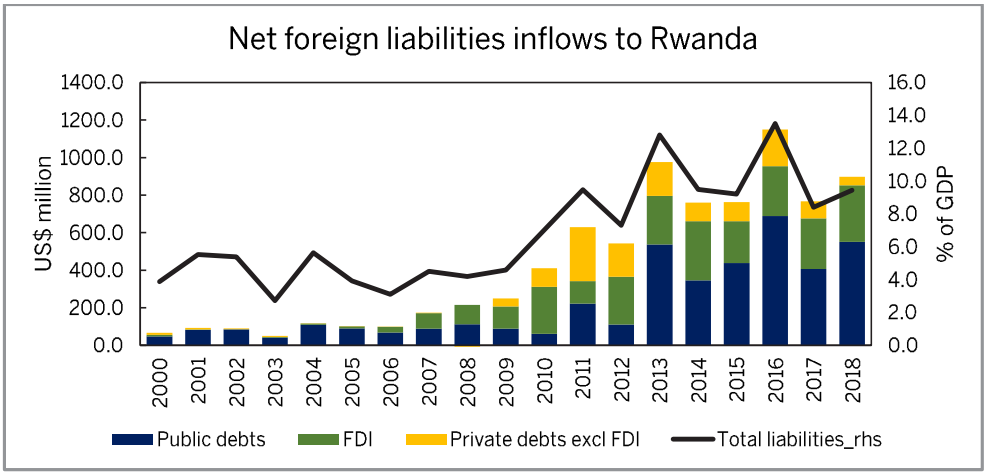
Similarly, private foreign liabilities went up significantly mainly supported by economic conditions and government policy plans to build a strong private sector, which is expected to be the engine of economic growth. Private external liabilities (the sum of FDI and other private external debts) almost doubled, rising to 55 percent share of total inflows during 2010-2018 from 28 percent annually over 2000-2009.

An explanation to this phenomenon is justified by the economic and political reforms that took place during the period under analysis. These reforms include empowering the private sector by increasing investments in priority sectors and rising Rwanda's external connectivity and boosting exports. Therefore, following insufficient local finances, foreign liabilities surged to fund these investments with emphasis being laid on persuading long-term capital flows rather than short term volatile flows.

Foreign liabilities had been significant but not huge between 2000 and 2009, accounting for, on average, 4.3 percent of GDP but then more than doubled to nearly 10 percent of GDP annually during 2010-2018. Looking at the type of foreign liabilities to Rwanda, debt inflows account for, on average, 71 percent of total foreign liabilities during 2000-2018, despite rising inflows of equity capital. FDI rose significantly both in size and as percent of GDP. FDI flows to Rwanda accounted for 0.4 percent of GDP annually between 2000 and 2006, before jumping to 2.1 percent of GDP during 2007-2009. Since 2010, FDI flows increased further averaging 3.2 percent of GDP annually. The flows in FDI were largely driven the developments on the demand side including ease of doing business, political stability, high domestic economic growth, stable macroeconomic conditions and investment incentives.

Regarding, the breakdown of capital inflows by sectoral structure and maturity, long-term public borrowings and inter-company loans (FDI) dominate Rwanda's total foreign liabilities. The share of government borrowing to total foreign liabilities averaged 72 percent during the 2000-2009 before plummeting by almost a half accounting for 45 percent between 2010 and 2018 period, reflecting a sustained growth of private inflows mainly composed of FDI and debts. Looking at private borrowings, inter-company lending (FDI debts and equity) averages 35 percent of the total foreign inflows over the last eight years while debt inflows account for 16 percent. Looking at maturity of foreign debts, long-term instruments hold a lion share with short-term debts accounting for, on average, 2 percent during 2010-2018 period.

Figure 3: Net foreign liabilities to Rwanda



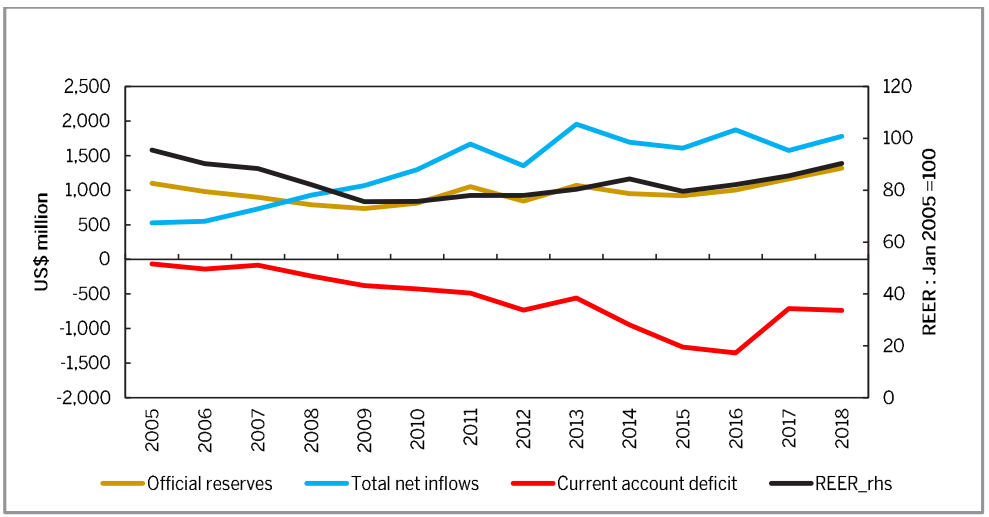

Source: National Bank of Rwanda

Figure 4 presents the trend of current account deficit, capital inflows, official reserves and real effective exchange rate during the period 2005-2018. The current account deficit measures a country's change of net foreign wealth (Calvo et al., 1993). A country that run a current deficit must finance their imbalance either by capital inflow (both public and private) or by reduction in its official reserves, which both reduces the country's net wealth.

The observed rise of capital inflows have been associated by a surge in the country's current account deficit mainly driven by the growth in imports partly reflecting the rapid growth in the economy over this period, but with less exchange rate volatility. Grenville and Gruen (1999) stated that increased capital inflow cannot be absorbed (through a bigger current account deficit) without a rise in the real exchange rate, so instead the capital inflow boosts foreign exchange reserves and thence domestic liquidity, which drives up domestic prices. By contrast, Combes et al. (2011) argue that small-scale interventions, with authorities accumulating fewer reserves, can raise pressure on the nominal exchange rate and lower inflation. Looking at the figure 4, the net capital inflows was matched by a widening current account deficit and an increase in official reserves.

The effect of capital inflows on Rwanda francs (FRW) can be split into two episodes. The first episode from 2005-2009 was characterized by appreciation of FRW in real terms. Huge inflows that accounted for one-fifth of GDP combined with lower current account deficit (4 percent of GDP), explain the behavior of real effective exchange rate (REER) in this episode. The second episode (2010-2018) was characterized by high economic growth (average annual growth of 7.2 percent) due to structural changes of the economy (high investment in services and industry sectors and value addition in agriculture) generated a higher current account deficit (10 percent of GDP annually) mainly driven by the deficit from merchandise trade. Trade deficit rose significantly over this period averaging 14 percent of GDP annually owing to increased domestic demand of investment and intermediary goods to support the sustained high economic growth. However, the relative REER depreciation was mild averaging 2 percent annually over this period. This small depreciation of REER amid a wider trade deficit could be explained by the absorption of capital inflows through spending on imports of tradables.

Figure 4: Trends of official reserves, capital inflows, current account deficit an REER




Source: National Bank of Rwanda

## 3. Literature review

The International Monetary Fund (IMF) classifies capital flows into three broad categories: Direct Investment, Portfolio Investment and Other Investment. These flows represent the financing of a country's current account deficit in addition to its official reserves. However, for a number of developing countries including Rwanda, a bulk of foreign inflows received have mostly been in form of aid and private transfers, explaining their inclusion in this study.

The traditional specification of the exchange rate determination model suggests that all capital inflows have similar impact on the exchange rate (Combes et al., 2011). However, some authors have recently with mixed results, hypothesized specific impacts on the composition of capital inflows, highlighting the role of official flows, FDI, and remittances.

Moreover, the relation between the real exchange rate and capital inflows can be seen as depending on the exchange rate regime of an economy. With a fixed exchange rate, capital inflows potentially increase inflation where the scope of these pressures depends on whether inflows are driven by autonomous factors or by an increase in domestic money demand and on the response by monetary authorities to the inflows. In a number of countries, a surge in capital flows led to a credit boom when monetary authorities failed to sterilize them (Combes et al., 2011). A higher capital inflow raises money supply and inflationary pressures spread within the economy, contributing to an increase in the relative prices of non-tradable. A sterilization policy can dampen real appreciation, but with relative costs of sterilization (Calvo et al., 1993) which lead to doubt about its long-term sustainability. Indeed, when the exchange rate is fixed, a sterilization policy leads to higher interest rates, further increases capital inflows. Moreover, holding foreign assets with lower interest rates than domestic ones generates quasi-fiscal losses for central banks, leading them to give up the policy in the medium or long term.

With a floating exchange rate, capital inflows lead to an appreciation of the nominal exchange rate, enhancing a fall in the relative prices of imported goods and a shift away from the consumption of non-tradable. Exchange rate flexibility ensures that monetary policy is somewhat independent of capital inflows. By introducing uncertainty, a more flexible exchange rate could discourage short-term speculative

flows and reduce financial system vulnerability, particularly when supervision and regulation are poor (Calvo et al., 1996; López-Mejía, 1999). Hence, a flexible exchange rate regime would penalize the capital flows that generate the most real appreciation.

Numerous empirical studies examined the effect of capital inflows on exchange rate with no emphasis on the structure of these flows (Calvo et al., 1993; Gelman et al., 2015; Rashid & Husain, 2013). Other several studies analyzed the nexus between capital inflows and exchange rate arguing that the types of the included capital inflows matter and have varying effects on exchange rate (Brooks et al., 2004; Siourounis 2004; Hau & Rey, 2006; Sy & Tabarraei, 2010; Magud et al., 2011; Ifeakachukwu & Ditimi, 2014). In this study, we focus on the second group of studies.

Siourounis (2004) analyzed the impact of capital flows on exchange rates using monthly data from 1988 to 2000 to U.S vis-à-vis the UK, Germany, Japan and Switzerland. Siourounis found that net equity flows from portfolio investments significantly appreciate the exchange rate while bonds do not have any impact on exchange rate movement. Brooks et al. (2004) looked at various kinds of capital flows, including foreign direct investment flows, portfolio flows and debt flows can contribute to the development in dollar against the Euro and the yen. Their results from regression analysis revealed that that net portfolio flows between the Euro area and the United States had a significant impact of the euro/dollar exchange rate, while foreign direct investment flows appear to be less significant for the exchange rate volatility. Similarly, using daily, weekly and monthly data for 17 OECD countries, Hau and Rey (2002) found that portfolio equity flows have become increasingly important over time and correlate strongly with exchange rates. Hansen and Storgaard (2005) used monthly data to analyse the impact of capital flow on krone. The regression results from weekly data show a significant relation between the exchange rate and capital flows from portfolio investments basis, while capital flows from FDI and other capital imports do not have any impact on krone rate.

Athukorala and Rajapatirana (2003) used pooled annual data for the fourteen countries in Latin America and Asia over the period 1985 to 2000 to analyze the effect of disaggregated capital inflows into FDI and other capital flows (both private and public flows). Using regression analysis, they showed that other capital flows significantly appreciate the exchange rate, though with different magnitude between these two regions, while FDI inflows are associated with depreciation of the real

exchange. They hypothesized that depreciation stemming from FDI flows generally tends to have a more tradable bias compared to the other types of capital flows.

Javorcik (2004) stated that as FDI flows relate to investment in imported machinery and equipment; these imports do not suffer from constraints in local supply capacity and thus have almost no appreciation effect. As countries with a better investment climate attract more FDI, local productive capacity could improve before FDI flows, reducing pressure on the real exchange rate (Combes et al., 2011). In similar view, Lartey (2007) revealed that appreciation of the real exchange rate due to FDI, which is seen to be more stable, compared with other capital flows, is less than appreciation due to more volatile private flows that do not necessarily increase productive capacity, such as portfolio investments.

Combes et al. (2011) revealed that both public and private inflows resulted in the appreciation of real effective exchange rate. Among private inflows, portfolio investment has the biggest impact on appreciation, almost seven times that of foreign direct investment or bank loans while private inflows have the smallest effect. Further, the study used a *de facto* measure of exchange rate flexibility and observed that a more flexible exchange rate helps to dampen appreciation of the real effective exchange rate caused by capital inflows. Regarding official flows, the authors argue that their use dictates the impact they could have on real exchange rate. Lueth and Ruiz-Arranz (2007) and Chami et al. (2008) find that remittances act as a buffer, helping to smooth consumption, if they increase when the recipient economy is suffering an economic downturn. In this case, they help to keep recipient economies stable by compensating for foreign exchange losses due to macroeconomic shocks. These countercyclical remittances do not have much effect on the real exchange rate. In contrast, Lueth and Ruiz-Arranz (2007) estimate a vector error correction model for Sri Lanka to determine the response of remittance receipts to shocks in macroeconomic variables using quarterly data for the period 1996–2004. They find that remittances are procyclical and decline when the Sri Lankan currency weakens, reflecting their usefulness as shock absorber.

In analyzing the phenomenon of Dutch Disease in developing countries, Lartey (2007) showed that foreign aid significantly over-valued exchange rate. Nwachukwu (2008) did a similar analysis, used same technique, and supported the results from Lartey. Using annual data for the period 1980 and 1990, Rajan and Subramanian,

(2009) looked into a manufacturing panel for 47 countries. They find that foreign aid are associated with real exchange rate appreciation, which negatively affect the export sectors, especially manufacturing industries. Similarly, Sy and Tabarraei, (2010), using data from the Pooled Mean Goup (PMG), suggested that foreign aid are associated with an exchange rate appreciation in the short run and in the long-run. In contrast, Sackey (2001) and Tareke (2005) analysed the effect of aid dependence on Ghana's exchange rate using data for the period 1962–1996 and 1970-2002, respectively. Both studies showed that the aid inflows depreciate the real exchange rate.

Studies for the dynamic of Rwanda exchange rate have been analysed extensively but few of them analysed the impact brought by capital inflows. Gasana and Mulindabigwi (2016) analysed the effect of foreign aid on Rwanda exchange rate. Using vector autoregressive model on times series data from 1980 to 2013, Gasana and Mulindabigwi (2016) suggested that foreign aid significantly contributed to the depreciation of the real exchange rate in Rwanda. The results from their study contradict the phenomenon of Dutch disease.

In view of these mixed results combined by the fact that few studies have been conducted on Rwanda, this study seeks to close this gap and analyse the effect of capital inflows on Rwanda exchange rate. This study will follow similar studies in developing countries by expanding the definition of capital inflows to add current transfers (i.e official assistance and remittances) and capital transfers.

## 4. Methodology

This section describes data and the empirical methodology for measuring the impact of capital flows on exchange rate in Rwanda. While several studies have measured the aggregate effect of capital flows on exchange rate, many other studies found a very strong reason to hypothesize that this effect depends on the structure of the capital inflows.

### 4.1. Econometric model

We use a vector auto regression (VAR) framework to determine the impact of real exchange rate to changes in different types of capital flows and a block of other macroeconomic variables drawn from the existing literature. Lueth & Ruiz-Arranz (2007) showed three different assumptions VAR models are commonly used. First, when most of the variables are endogenous, suggesting a multi-equation estimation. Second, if the variables are non-stationary in levels, suggesting an estimation in the first differences. Finally, when the variables are cointegrated, suggesting the inclusion of the cointegration relationship as an additional regressor. We first conduct the non-stationarity, followed by tests for cointegration and estimation a vector error correction model (VECM).

Since our main objective is to find varying effects of each type of capital flows on exchange rate, we first need to untangle capital inflows. This study adopted the classification of Combes et al. (2011). They noted that the aggregate total capital flow is the sum of private and public flows. The former includes FDI, portfolio investment, private current transfers and other private foreign liabilities. We treat remittances and FDI separately from the total private capital flows to see the impact they could have on exchange rate given their increasing trend. On public flows, Combes et al. (2011) defined them as the sum of official loans, official current transfers, debt instruments (such as government bonds issued by the domestic public sector) and debt forgiveness in the capital account (including relief granted by the IMF). While trying to remain parsimonious, public flows is the sum of official current and capital transfers as well as public loans.

Therefore, the coverage of capital inflows in this study is as follows:

$$\boldsymbol{Capital\ inflows = FDI + remittances + other\ private\ flows + public\ flows} \quad (1)$$

The disaggregation of capital flows as reflected in equation (1) depend on varying effect these flows could have on exchange rate. Bukovšak, et al. (2017) suggested that the distinction between flows going to the tradable and the non-tradable sector is the key to analyzing why different types of capital flows could produce different effects on the exchange rate. The disaggregation of these capital flows as per equation above assumes that public flows are directed towards non-tradable sectors while private flows, most importantly FDI and private loans, are biased towards

tradable. Combes et al. (2011) stated that in countries with supply constraints, public flows target to enlarge basic infrastructure and higher consumption, putting more pressure on the relative price of domestic goods causing real exchange rate to appreciate. In contrast, private flows target tradable sectors and are associated with higher investments that contribute to significant imports of goods, depreciating the real exchange rate.

In addition, this study uses a set of macroeconomic indicators chosen to represent policies implemented to compensate for the real exchange rate effect of capital flows. The selection of this set of variables was drawn from existing empirical studies (Nuwagira & Kigabo, 2014; Nuwagira & Muvunyi, 2016; Rodrik, 2008). These variables include terms of trade (TOT), relative productivity of home tradables proxied by GDP per capita (RGDP), capital flows (KA) and the degree of trade openness (OPEN). In addition, several empirical studies found that real exchange rate respond increases in interest rate (Bukovšak et al., 2017).

Thus, the model found to be significantly associated with real exchange rate movements in Rwanda is as follows:

$$\boldsymbol{REER_t = f\,(RGDP, TOT, OPEN, KA, i)} \qquad (2)$$

Where: $REER_t$is the real effective exchange rate; RGDP: Gross Domestic Product per capita, $TOT_t$ is the terms of trade, $OPEN_t$ is trade openness; $KA_t$ is the total capital inflows and $\boldsymbol{i}$ is the interest rate.

*GDP per capita* was used as proxy for productivity gap that captures the potential Balassa-Samuelson effect (Combes et al. 2011; Sy & Tabarraei, 2010). The Balassa-Samuelson effect assumes that productivity grows faster in tradable than in non-tradable sectors, which is translated into higher wages of tradable sector that spill over to non-tradable sectors and raises wages. Assuming prices for tradable are internationally determined and homogenous across countries, soaring wages in non-tradable sector cause the relative price of non-tradables to increase, fueling domestic inflation and appreciating the real exchange rate.

*Terms of Trade* measures the relative price of export and import. The effect of terms of trade is decomposed into two effects: the income and substitution. The income effect suggests that more goods can be bought as terms of trade improve. On the

other hand, the substitution effect is the result of declining relative prices of imported goods and falling demand for non-tradable goods, which reflects in the depreciation of the real exchange rate (Sy & Tabarraei, 2010). Therefore, the impact of terms of trade on exchange rate depends on which component dominates the other. Improvement in the terms of trade would cause exchange rate to appreciate if the income effect outpaces the substitution effect.

*Openness to trade* is the sum of exports and imports of goods and services in current USD. Trade openness also reflects the prices of non-tradables through income and substitution effects. Easing of restrictions on trade as results of trade liberalization has a positive effect (depreciation) on prices of tradables through the income effects and a negative effect (appreciation) through substitution effects. (Edwards, 1988) argued that income effect is likely to dominate. It is thus expected that trade liberalization will push up the price of tradables relative to non-tradables, leading to depreciation of REER (Combes et al., 2011).

Regarding capital inflows, *remittances* measures the percentage of workers' remittances, compensation of employees, and migrant transfers in current USD. The positive or negative effects of remittances on REER depend on whether they are procyclical or countercyclical (Rajan & Subramanian, 2009). FDI includes debt-creating liabilities to foreign investors and direct investment in the form of equity. Other things remain constant, a rise in FDI depreciates the real exchange rate (Sy & Tabarraei, 2010).

*Other private flows* combine private foreign liabilities excluding those recorded under FDI and other private transfers. It is therefore the sum of other investment (loans, currency and deposits, trade credits and other account payables), portfolio investment (equity and debts securities) and other private transfers excluding remittances.

*Public flows* represent the sum of official current transfers and capital transfers as well borrowing by the government. Public borrowing is the sum of short-term and long-term foreign liabilities in form of loans, trade credits and other payables. *Interest rate* is proxied by the interbank rate.

In the first part of the analysis, we estimate the impact of aggregated capital inflows on exchange rate. Later the variable of interest $KA$ will be decomposed according to equation 1 to assess the impact of each type of capital flow on the REER.

### 4.2. Data

Although a longer sample would be preferable, the start period of this study was limited by the availability of the Rwanda balance of payments of statistics, which start in 2000. The data were constructed at quarterly[11] frequency over the period 2000-2018. Data on all capital flows are collected from BNR Balance of Payments (BOP) Statistics. Data on GDP are from National Institute of Statistics of Rwanda (NISR). Regarding data transformation, a logarithmic transformation was applied to all the variables except interest rate and terms of trade.

## 5. Results and data analysis

We start our analysis by testing the order of integration. We employed the Augmented Dickey Fuller (ADF) and Phillips-Perron unit root tests to examine whether variables are integrated of order one or zero. Results from Table 1 indicate that all the variables are non-stationary in levels (have unit roots) and stationary in first differences. In other words, all the series in the model are integrated of order one.

[11] Almost all variables were obtained on annual basis and then the authors disaggregated them to get quarterly data.

Table 1: Unit roots test for non-stationarity (Sample: 2000Q1–2018Q4)

Table 1: Unit roots test for non-stationarity (Sample: 2000Q1–2018Q4)

| | Level | | Difference | | Order of Integration |
|---|---|---|---|---|---|
| | t-ADF | t-PP | t-ADF | t-PP | |
| Exchange rate | 2.24 | 2.20 | 5.71* | 5.08* | I(1) |
| RGDP | 0.69 | 0.03 | 5.65* | 21.62* | I(1) |
| Terms of trade | 2.57 | 1.03 | 3.13* | 5.85* | I(1) |
| Trade openness | 2.30 | 2.58 | 3.86* | 11.07* | I(1) |
| interest | 2.11 | 1.26 | 8.75* | 15.25* | I(1) |
| Total capital inflows | 1.84 | 1.17 | 3.65** | 9.77* | I(1) |
| FDI | 0.80 | 0.65 | 10.41* | 10.51* | I(1) |
| Remittances | 1.38 | 1.39 | 9.02* | 9.06* | I(1) |
| Other private flows | 2.37 | 0.02 | 2.43* | 10.48* | I(1) |
| Public flows | 1.75 | 1.65 | 2.63* | 10.76* | I(1) |

Note: *, **: denote rejection at 0.01 and 0.05 significance level

Source: Authors' estimation

As a second step, we employed the Johansen's cointegration to estimate the long-run relationships between REER and the explanatory variables in the model. Before estimating the model, we first specified the number of lags in the VAR model. Krznar and Kunovac (2010) suggested that the number of lags in the VAR model can be chosen discretionary depending on the size of the sample provided that the selected lags length produce a correct model that doesn't contradict the VAR model assumptions. In light of this view, depending on the size of the sample and the number of regressors, this study used a lag length of four (p= 4)[12]. To test that our model with the number of lags chosen is not incorrect, we tested for serial correlation using the LM test. The results of the LM test as showed in appendix 2 indicated that there is no autocorrelation between errors, which leads to the conclusion that our choice of the lag number is not incorrect.

[12] The optimum number of lags by Akaike information criterion were six.

Results from Table 2 indicate one and two cointegrating equations for the trace statistic and maximum eigenvalue, respectively. Therefore, both tests confirm the long-run relationship between real effective exchange rate and key fundamental variables (GDP per capita, terms of trade, openness to trade, and interest rate) and capital inflows.

Table 2: Cointegration test

Table 2: Cointegration test for LREER, LRGDP,LGOV, TOT, LOPEN I and LKA

| Hypothesized Number of Cointegration Vector(s) | Eigenvalue | Trace Statistic | Maximum Eigenvalue Statistic |
|---|---|---|---|
| None | 0.61 | 136.23* | 68.03* |
| At most 1 | 0.42 | 67.20 | 38.58** |
| At most 2 | 0.21 | 28.61 | 16.70 |
| At most 3 | 0.10 | 11.90 | 7.48 |
| At most 4 | 0.04 | 4.43 | 3.07 |
| At most 5 | 0.02 | 1.36 | 1.36 |

Note: *, ** denote rejection of the null hypothesis at the 0.01 and 0.05 percent significance level, respectively

Source: Authors' estimation

In order to estimate the long-run relationship between the variables in this study we opted to use one cointegrating equation as suggested by the Trace Statistic. The results of the long-run relationships between real effective exchange rate and the set of fundamental variables and capital inflows are presented in the table below. In the first model, we analysed the long-term relationship between REER with its regressors where capital captures the sum of all types of capital inflows. In the second model, we decomposed capital inflows as defined previously.

The main interest was to analyse the behavior of real exchange rate on capital inflows. Regression results showed that total capital inflows depreciate real exchange rate due to depreciation pressures brought by FDI and other private capital flows that outpace appreciation pressures from remittances and inflows to public sector.

Looking at each type of capital flows, FDI and other private inflows tend to depreciate real exchange rate while public flows and remittances appreciate the real exchange rate. The divergence of the effect among various types of capital inflows is explained by the relative orientation towards tradable versus the non-tradable sector. Specifically, an increase of FDI by 1 percent results in a depreciation of the real exchange rate by 0.14 percent. Similarly, there is a 0.05 percent depreciation of real exchange rate when private inflows surges by 1 percent. Results on FDI are in line with previous studies (Athukorala & Rajapatirana, 2003; Bukovšak et al., 2017), which suggest that FDI and private flows have a higher tradable bias compared to other capital flows. Bukovšak et al. (2017) suggested that FDI inflows associated with imports of machinery and other capital goods may raise the demand for foreign exchange, which then eases appreciation pressures on nominal exchange rate, or result into decline in prices due to the increased competition or productivity, and consequently transmit into real depreciation.

On the other directions, public inflows has the biggest impact on real exchange rate appreciation compared to remittances. An increase in public inflows by 1 percent results in appreciation of the real exchange rate by 0.15 percent. Ouedraogo (2017) argues that government borrowing is more likely to increase the demand for and the price of non-tradable goods and thereby cause an appreciation of the real exchange rate. Regarding remittances, the size of the impact on real exchange rate is slightly less than that of public inflows. The rise of remittances by 1 percent will bring about an appreciation of the real exchange rate by 0.12 percent. These results explain the use of remittances for investment purposes, increasing the demand for and prices of non-tradables and driving the REER to appreciate.

Regarding other variables form the model, results from model 1, indicate negative (appreciation) significant relationship between REER and productivity proxied by GDP per capita, trade openness and interest rate. The regression results between REER and a country's productivity captures the Balassa-Samuelson relationship, which suggests that a country's real exchange rate will appreciate over time as its productivity in the traded sector, and hence level of income, rises. More specifically, if one country has an increase in the productivity of its tradable sector, other things equal, real wages will increase in both the tradable and non-tradable sectors. As result increased productivity in tradable sector coupled with no productivity change in non-tradable sector, prices in the non-tradable sector go up relative to tradeable sector

domestically, translating into the appreciation of real exchange rate. These results are consistent with the theory and the results of empirical studies for different countries (Nuwagira & Muvunyi, 2016; Bukovšak et al., 2017). In addition, increase in trade openness and interest rate are associated with appreciation of real exchange rate. The effect of trade openness on real exchange rate depend on trade policy in place (Edwards, 1988; Warr, 1986). Our results indicate that the deterioration in the current account deficit together with the increase in demand for and prices of nontradables contributed to the appreciation the real exchange rate. Lastly, improving terms of trade depreciate the real exchange rate, suggesting that the substitution effect dominate the income effect. In comparison with other studies in Rwanda, these results on trade openness and terms of trade contradicts those of (Nuwagira & Muvunyi, 2016).

The speed of the adjustment reflected by the coefficient of error correction term is about −0.11 in the first model and -0.27 in the second model. Comparing the two models, these results imply that the movements of the REER within a quarter correct over a tenth and nearly a third respectively of the gap between the REER and equilibrium REER as determined by the fundamentals.

Table 3: Long-term relationships estimates and error correction term

Table 3: Long-term relationships estimates and error correction term: 200Q1-20118Q4

| | Model 1 | Model 2 |
|---|---|---|
| Error correction term | -0.11 | -0.27 |
| | [2.37] | [2.23] |
| Log(RGDP) | -0.31 | -0.57 |
| | [1.56] | [3.94] |
| Log(Trade openness) | -0.71 | -0.2 |
| | [6.15] | [4.55] |
| Terms of trade | 0.01 | 0.03 |
| | [5.35] | [8.47] |
| interest | -0.05 | -0.02 |
| | [5.56] | [6.10] |
| Log(Total capital) | 0.48 | |
| | [3.52] | |
| Log(FDI) | | 0.14 |
| | | [9.27] |
| Log(remittances) | | -0.12 |
| | | [7.59] |
| Log(other private inflows) | | 0.05 |
| | | [6.66] |
| Log(public inflows) | | -0.15 |
| | | [3.8] |
| $R^2$: | 0.5 | 0.61 |

**Note:** Model1 indicates the regression of REER on all explanatory variables where with aggregated capital inflows. Model2, is the regression of REER on all key fundamental variables and disaggregated capital inflows (FDI, remittances, other private inflows and public flows). A rising REER indicate depreciation.

Source: Authors' estimation

## 6. Conclusion and recommendations

This paper examines the empirical effect of movement in exchange rate and different type of capital flows in Rwanda. We use Vector Auto Regressions to estimate the differential impact of type of capital flows on exchange rate using quarterly data spanning the period 2000 to 2018. Several empirical studies have been conducted on the impact of capital flows on real exchange rate. These studies are divided into two strands: those who analysed this relationship with no emphasis on the

composition of capital flows and those who treat their effects separately. This study oriented its analysis in the second group for two reasons. First, to the best knowledge of this study, no such analysis has been in the context of Rwanda. Secondly, Rwanda has been reliant on inflows in form of aid but recently highly diversified to FDI, remittances and loans. This study, therefore, wanted to test what impact these varying flows could have on real exchange rate.

The results show that the composition of the capital flows matter when analyzing their impact on real exchange rate. We document that a 1% percent increase in public/government inflows is associated with 0.15% appreciation of the real exchange rate against a 0.12% appreciation from remittances. On the contrary, a rise of 1% on FDI and other private inflows results in exchange depreciation of 0.14% and 0.05%, respectively. These results support the recent theoretical and empirical work that the composition of capital flows matter in analyzing their effects on exchange rate.

Overall, the empirical results are indicative of the effects massive capital flows, seen in recent years, has on exchange rate movements. This paper clearly shows policy makers should treat capital flows differently. If monetary policy makers respond to deviations of exchange rate from their long-run equilibrium level, as part of their pursuit for stable inflation, particular attention should be paid in government flows as a potential determinant of exchange rate movements. In addition, our findings have strong implications for the future direction of macro-economic policies to examine the movement in real exchange rate.

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## Appendix 1: Survey on remittances

In order to update the estimation coefficient of formal cash passing through banks transfers and informal cash passing through hand to hands, the Statistics Department conducted a survey on a sample of 27 big forex bureaus in Kigali City. During the survey period, on average 21,518 clients visited Forex Bureaus on monthly basis for money exchange (i.e 21,884; 19,634 and 23,035 in January, February and March of 2018, respectively). A sample size of 549 clients was selected based on the Cochran sampling method (William G. COCHRAN (1977).

This analysis only captures data on channels of receiving remittances and the use of these receipts.

### a. Chanel of receiving remittances

By channel, in value terms, the formal represents 81 percent against 19 percent for informal. Formal channel includes bank account, money transfer operators (MTOs) and mobile networks operators (MNOs). Informal channel assembles courier, cash in hand from friends and relatives abroad, money brought from abroad by himself, international commuters and other.

Channels used to receive remittances in Rwanda

| | Volume | | Value in USD | |
|---|---|---|---|---|
| | Number | Percent | Value in USD | Percent |
| Formal (I) | 135 | 72 | 49,507,024 | 81 |
| Bank account | 18 | 10 | 8,193,465 | 13 |
| MTOs | 113 | 60 | 40,912,559 | 67 |
| Mobile money | 4 | 2 | 401,000 | 1 |
| Informal (II) | 54 | 28 | 11,791,822 | 19 |
| Post office/ courier | 2 | 1 | 347,600 | 1 |
| Friends / relatives abroad | 27 | 14 | 6,131,220 | 10 |
| Friends/ relatives Rwanda | 11 | 6 | 1,538,490 | 3 |
| Brought by myself /abroad | 4 | 2 | 1,435,000 | 2 |
| Bus transportation | 2 | 1 | 513,000 | 1 |
| Other | 8 | 4 | 1,826,512 | 3 |
| Total (I+II) | 189 | 100 | 61,298,846 | 100 |

### a. Use of remittances

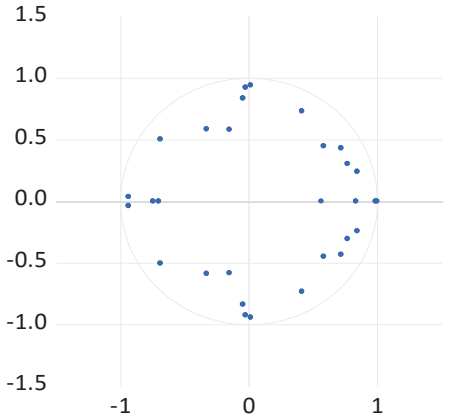
Regarding the use of money received, the survey showed that 50.3 percent of remittances goes in consumption and 49.7 % in investment. Within consumption category, the big share of remittances value goes to the general household expenses (37 percent), and special occasion (8 percent). On investment side, education comes first (24 percent), followed by house building and house maintenance (16 percent), businesses (6 percent), and health (4 percent) as shown in the table 6 below.

Use of remittances in Rwanda: Survey 2018

| Use of money | Volume | | Value in USD | |
|---|---|---|---|---|
| | Number | Percent | Value in USD | Percent |
| Consumption | 126 | 66.7 | 30,855,593 | 50.3 |
| General Households Expense | 104 | 55 | 22,881,977 | 37 |
| Special Occasions | 11 | 6 | 4,790,234 | 8 |
| Emergency or disaster | 2 | 1 | 90,800 | 0 |
| Debt repayment | 1 | 1 | 2,020,000 | 3 |
| Transfer to other households | 2 | 1 | 260,000 | 0 |
| Other | 6 | 3 | 811,982 | 1 |
| Investment | 63 | 33.3 | 30,443,253 | 49.7 |
| Education | 29 | 15 | 14,493,815 | 24 |
| Health | 13 | 7 | 2,379,600 | 4 |
| House building/maintenance | 12 | 6 | 9,537,338 | 16 |
| Business | 7 | 4 | 3,445,900 | 6 |
| Land purchase | 1 | 1 | 86,600 | 0 |
| Saving in banks or SACCOs | 1 | 1 | 500,000 | 1 |
| Total | 189 | 100 | 61,298,846 | 100 |

## Appendix 2: VAR stability

Inverse Roots of AR Characteristic Polynomial




## Appendix 3: VEC Residual Serial Correlation LM Tests

VEC Residual Serial Correlation LM Tests
Date: 01/29/20 Time: 14:35
Sample: 2000Q1 2018Q4
Included observations: 71

Null hypothesis: No serial correlation at lag h

| Lag | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
|---|---|---|---|---|---|---|
| 1 | 42.71093 | 36 | 0.2050 | 1.214016 | (36, 152.1) | 0.2101 |
| 2 | 22.71703 | 36 | 0.9584 | 0.607476 | (36, 152.1) | 0.9594 |
| 3 | 25.63017 | 36 | 0.9003 | 0.691448 | (36, 152.1) | 0.9024 |
| 4 | 44.57839 | 36 | 0.1545 | 1.274416 | (36, 152.1) | 0.1589 |
| 5 | 50.06074 | 36 | 0.0598 | 1.455639 | (36, 152.1) | 0.0623 |

Null hypothesis: No serial correlation at lags 1 to h

| Lag | LRE* stat | df | Prob. | Rao F-stat | df | Prob. |
|---|---|---|---|---|---|---|
| 1 | 42.71093 | 36 | 0.2050 | 1.214016 | (36, 152.1) | 0.2101 |
| 2 | 76.11085 | 72 | 0.3477 | 1.060868 | (72, 158.1) | 0.3747 |
| 3 | 115.3842 | 108 | 0.2958 | 1.058627 | (108, 133.3) | 0.3755 |
| 4 | 176.3975 | 144 | 0.0343 | 1.254862 | (144, 101.4) | 0.1120 |
| 5 | 221.1790 | 180 | 0.0198 | 1.165433 | (180, 67.3) | 0.2369 |

*Edgeworth expansion corrected likelihood ratio statistic.

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