LISBON SCHOOL OF ECONOMICS & MANAGEMENT
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MASTER

MONETARY AND FINANCIAL ECONOMICS

MASTER´S FINAL WORK

DISSERTATION

MONEY MULTIPLIER IN A FIXED EXCHANGE REGIME FRAMEWORK

RICARDO DAVID DE CASTRO MARTINS

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SUPERVISION:
ANÍBAL JORGE DA COSTA CRISTÓVÃO CAIADO

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ABSTRACT

This study provides a new empirical approach about the money multiplier process, using monthly monetary data from Angola since January 2012 until June 2018. The use of an ARDL model allows to test the long run relationship of both the money multiplier and the reserve to deposit ratio and consider the short-term adjustments from monetary shocks. The analysis focuses mainly on the level of concentration of the banking system, the degree of liquidity of banks' liabilities and the interest rate as determinants of the long-term ratios. Other country specific factors such as the foreign exchange rate spread and the non-performing loans ratio have been included to the analysis, to consider Angola's macroeconomic challenges. It was concluded that according to monetary theory, both the interest rate and the level of concentration of the banking system affect the long-term ratios. However, the non-statistical significance of banks' liabilities liquidity opens a policy recommendation for Angola's monetary policy.

JEL CODES: E51; E42; E58

KEYWORDS: money multiplier; reserve deposit ratio; fixed exchange regime; bank concentration

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INTRODUCTION

The money multiplier was and still is a central parameter of the money creation process. Its description, stability and even its existence sit at the core of monetary theory from its beginnings. Mathematically, it is just a ratio between a broad monetary aggregate and a narrow one, specifically the monetary base, the one that is controlled by the central bank. However, it is not the existence of a ratio that we will enquire about. We will search for the possibility of existence of a disequilibrium process that creates a multiple expansion of the money supply through the actions of a central bank.

Recently, the large injections of monetary base by the world leading central banks that caused money multiplier ratios to collapse, led to a debate concerning the role of the money multiplier in monetary theory. That discussion has origins on different debates that developed in monetary theory along the centuries, such as the Metallist vs Chartallist debate (about the origin of money), the Currency vs Banking School (about the convertibility of money), the Keynesian vs Monetarists (about the effects of monetary policy) evolving in recent years to the discussion about the endogeneity of the money supply (versus the exogenous – controlled by the Central Bank version).

This thesis contributes to the existing literature because it tries to regain some space for the money multiplier back in monetary theory by approaching it in a fixed exchange rate environment with a developing financial system that is constantly hit by shocks in its monetary base through foreign exchange flows which have short-run impacts on the multiplier. The stability of the reserves to deposits ratio will also be tested as a proxy to the multiplier process.

Our goal is to test with an Autoregressive Distributive Lags (ARDL) model if the increase in banking competition, the composition of the deposit aggregates and the interbank interest rate has any impact on the process of adjustment to monetary shocks that may be observed by the volatility of the reserves to deposits ratio and the money multiplier ratio.

The dissertation is organized as follows. Section 2 gives a review of the relevant literature on the money multiplier and Section 3 describes the theoretical approach concerning the process of money creation. In Section 4 we analyse Angola as the case study, and in Section 5 we present the data and the methodology. Section 6 enunciates the empirical results. In Section 7 we give some recommendations based on our results, and section 8 concludes.

LITERATURE REVIEW

Arthur Phillips, in 1921's *Bank Credit*, formulated the money multiplier process in a comprehensive way through a bank accounting registration of operations, as it was described only vaguely by previous Cambridge economists, as Alfred Marshall. After the exposition of the theory by Philips (1921), the money multiplier became a well-known device among monetarist economists, like Brunner and Meltzer (1964) that built a general model around the concept of the multiplier.

Friedman and Schwartz (1964), in their Monetary History extensively analysed the behaviour of monetary aggregates throughout US history with special emphasis to the monetary contraction that occurred during the Great Depression. They explained the Great Depression through a money multiplier framework, pointing to an increase in the currency ratio and afterwards of the reserve ratio as causes for the contraction in the broad monetary aggregates and therefore to nominal spending collapse and deflation.

The money multiplier gained special relevance in the nineteen eighties, with the rise of monetary targeting and forecasting. Johannes and Rasche (1979) built parametrical component estimation procedures to try to gain some predictability in the usage of the money multiplier for monetary control. Hafer (1984) stated that an aggregate projection of the multiplier was as good as a decomposition of the components. Hetzel (1986) questioned the direction of causality implied in the money multiplier, in a regime of interest rate targeting, focusing also on the non-orthogonality of monetary base with the multiplier, as some components of the multiplier are interest rate sensitive.

Nowadays, the division of opinions about the money multiplier occurs mainly in a difference of importance attached to the reserve position of commercial banks in the process of credit creation. Most new keynesian economists, monetarists and free banking theorists state that the money multiplier model would break whenever the policy interest rate reaches the zero-lower bound, because Treasury bills and money would become perfect substitutes, a liquidity trap (Krugman, 1998), or if the payment of interest on reserves shifts up that floor above zero, (Selgin, 2018). Another argument used is concerned about the permanency of the injection of monetary base (Beckworth, 2017). If the injection of monetary base is not supposed to be permanent, it should not have a great impact on the money creation process and therefore the money multiplier would be negatively affected by the injection.

The main criticism of the money multiplier model comes from the endogeneity side of the monetary debates. Lebourva (1962) explained that the causality of monetary creation was reversed, and instead of a money multiplier, the process of money creation was better described with a money divisor. That criticism was further developed by Lavoie (1984), Mosler (1995) and Fullwiler (2006) that stated that central bank operations passively create monetary base whenever there is a need to maintain an interest rate target. Godley and Lavoie (2006) further developed a broad monetary system that describes the money creation process endogenously, rendering irrelevance to the money multiplier.

This heterodox criticism has also been adopted by central bankers at least since Holmes (1969) discussed monetary control, stating that it is the Federal Reserve purpose to supply reserves to fulfil its interest rate target, but allowing commercial banks to make the first move, as bank credit creators, a position also taken by Bindseil (2004) when investigating the conduct of monetary policy, advocating therefore the reverse causality between bank reserves and loan creation. The Bank of England (McLeay et al; 2014) has comprehensively explained the reverse causality of the money multiplier in an interest rate targeting regime. Carpenter (2012) studied in a VAR analysis the relevance of money multiplier in the United States, only to conclude that it is unimportant in current day's monetary procedures.

In a fixed exchange regime, the money multiplier process is left untouched by theorists (except Lavoie, 2001) and so we will test it in this type of environment.

Di Bella (2005) tested the stability of the money multiplier process in Rwanda, choosing the reserve to deposit ratio as a proxy and using as determinants both the interest rate and the ratio of time deposits to total deposits. We will use both variables and include the concentration ratio for the banking system, as will be explained in section 3. Other variables will reflect Angola's macroeconomic challenges as will be clarified in section 4.

We will use an ARDL approach to test our hypothesis, even though it is not usually used in money multiplier studies. We have chosen it because of the advantages it has delivered in monetary studies, specially about the demand for money, such as Bahmani-Oskooee (2007) and Budha (2012). This kind of analysis allows us to study both the long run relationship and the short-run adjustment to shocks as will be described in section 5.

THEORETICAL APPROACH

The money multiplier is integrated in a more general framework, starting from the equation of exchange $MV = PT$, dating back to the Quantity Theory of Money (Hume, 1752), which states that a variation in the stock of money must have an impact in the level of prices in the long run (Keynes, 1923). Therefore, if a central bank wants to influence inflation it should control the money supply growth. However, even though acting as intermediaries, commercial banks create most of the money supply (Tobin, 1963), and it is only the monetary base, a central bank's liability, that is directly controlled. The equation of exchange could be further expanded to $mBV = PY$ (Beckworth, 2017), so that the base (B) times the money multiplier (m), reflects the medium of exchange (M) within the economy.

In the widely used introductory monetary economics textbook Mishkin (2007) there is a general description of the money multiplier process. It rests on a disequilibrium process created by the central bank as the monopolist creator of reserve balances (monetary base). Whenever the central bank buys a commercial bank's Treasury bill (or for that matter, any sort of purchase), it creates an equal amount of excessive reserves. Banks will try to avoid the low yield of a reserve asset, creating an additional bank loan (and corresponding deposit). As the deposit leaves the bank' balance sheet, it increases the level of other banks excessive reserves (the value of the deposit times one minus the required coefficient ratio). By trying to avoid the "hot potato" of low yielding bank reserves and creating deposits in the process, banks unknowingly create a multiple expansion of monetary aggregates.

Therefore, when in 2008, central banks reacted to the financial crisis by buying a large quantity of assets - and creating large amounts of bank reserves - some advocated that the increase in the monetary base would lead to further increases in lending which would in a multiplicative way produce large quantities of money, pushing up prices well above central banks targets. However, there was no such thing as a rise in inflation, because the multiplier decreased abruptly, as the denominator – monetary base – faced a higher percentage growth than any broad monetary aggregate.

To understand what happened and how is the money multiplier still useful, one needs to be knowledgeable of the hierarchical structure of money (Bell, 2001; Mehrling 2012). In a hierarchical monetary structure, the institution that sits atop of the "monetary pyramid" is not constrained to expand its assets and liabilities, expanding its liabilities whenever it wants to buy an asset. In a regime of flexible exchange rates, the central bank sits in the top of the monetary pyramid and therefore can create monetary base without constraints, by expanding its balance sheet.

A commercial bank also creates money (deposits) whenever it buys something (like the debt of an agent – bank lending) but as it will probably face adverse clearing, the availability of bank reserves may constrain the creation of bank credit and bank deposits. However, the level of bank reserves (component of the monetary base) can never be a constraint to multiple deposit creation within the banking system, if a flexible exchange rate central bank wishes so.

Other constraints will exist, like the amount of bank capital sometimes with a binding legal ratio, the credit worthiness of its borrowers and the inherent competition among financial intermediaries (Tobin, 1963). But reserves should never be a constraint, because a central bank must stabilize the payment system and therefore must create reserves on demand to both allow banks to fulfil its reserve requirements, to settle payments and to allow deposit withdrawals by customers (Fullwiler, 2008). By removing the reserve constraint, the central bank can fix the interest rate exogenously (Moore, 1988). Otherwise, if it wishes to control the level of reserves, the interest rate will be set endogenously, which may create a lot of financial disturbances coming from the volatility in the market interest rates.

Therefore most central banks nowadays, choose an interest rate target, the rate that better accomplishes its medium-term goals. In that sense, the money supply will become endogenous, and monetary base (through reserve requirements and/or currency) must follow along endogenously. When the central bank chooses to supply monetary base exogenously, it will not have a guaranteed multiplier effect. If the central bank is not paying interest on excessive reserves, an increase in reserves above the level desired by the system, will lead to a decrease in the interbank interest rate as banks lend extra reserves in the interbank market. The decrease in interest rates impacts all the interest rates within the economy and perhaps increase the amount of bank lending (generating more deposits). However, if the interest rate stops decreasing (because of the zero lower bound or interest on reserves) the increase of bank lending may stop, stopping the increase in the money supply and therefore decreasing the money multiplier as more reserves are injected.

The existence of interest on reserves creates therefore a decoupling between reserve balances and interest rates (Keister, 2008) that necessarily breaks the money multiplier whenever the central bank wishes to expand its balance sheet, above the level of desired reserve balances. The decoupling principle illustrates that the level of bank reserves and interest rates become independent giving the central bank an extra tool to steer the economy.

Therefore, the process of money creation by the banks will never be reserve constrained whenever the central bank is targeting interest rates in a flexible exchange regime. In this case, the stability of the money multiplier ratio is guaranteed by the action of the central bank and is more correct to view it as a money divisor (Lebourva, 1962).

In a fixed exchange regime, where the central bank has to maintain an amount of international reserves to redeem its liabilities (monetary base) the central bank will be constrained by its amount of international reserves and the ratio that it fixes them to the monetary base, which may create a central bank multiplier (ratio between monetary base and international reserves) and afterwards a money multiplier (ratio between broad money and monetary base) by controlling the amount of bank reserves and required reserve ratio.

In this sense, if the link is kept and Hume's price specie flow mechanism (Hume, 1752) operates, money will be in a way endogenous but determined not by the commercial banks and borrowers but by the balance of payments position. However, the determinants of the multiplier, the currency and the reserve ratio, may lead to variations in the equilibrium money multiplier and therefore to the evolution of the money supply. The hypotheses of personal currency hoarding as bank's reserve hoarding may lead to a decrease in the multiplier, but the stock of money will always be reserve constrained as there are two conversion rates to fulfil (the deposit-reserve parity and the reserve-foreign exchange reserve) to maintain both the stability of the banking system and the stability of the exchange rate. This mechanism could only work if the central bank fixed the supply of reserves. It has been shown that in a flexible exchange rate regime that will probably go against central banks goals. In a fixed exchange regime (specially in currency boards and dollarized regimes) the central bank should face the disciplinary force of the balance of payments and therefore it could act in a way that constrains the creation of deposits (by bank lending or other purchase by commercial banks), creating therefore the possibility of a money multiplier whenever the constraint is eased, by an increase in the supply of reserves or a decrease in the demand for it.

However, if central banks don't abide to a fixed ratio of international reserves to monetary base, there is an automatic sterilization process that will eliminate the process that a balance of payments imbalance may cause to money creation (Lavoie, 2001) and invalidating yet again the money multiplier model.

In Selgin (1988), the money multiplier is analysed as a stabilizer of nominal income to shocks in inside money demand, in a free banking monetary regime with a fixed supply of monetary base and no reserve requirements. Therefore, with a fixed supply of monetary base, whenever people demand more money the free banking system would increase the money supply to accommodate it and therefore the increase in money demand (fall in money velocity) would lead to an increase in money supply (and in the money multiplier as monetary base is fixed) to maintain monetary stability. This happens as banks decrease their precautionary demand for reserves when depositors lower the turnover of their deposits (increase in inside money demand), expanding credit to creditworthy borrowers (increase in inside money supply). The author states that this would work in a free banking monetary system but the existence of monetary controls by a central bank disenables the system to achieve rapidly and efficiently monetary equilibrium.

In the free banking example there is no central bank and therefore no reserve requirements and the monetary base is only variable by outside flows (balance of payments surplus). In our example (Angola), even though there is a central bank that fixes reserve requirements, they aren't completely distortionary, as we can observe by the high levels of excessive reserves. However, reserves are required for both demand and time deposits with the same coefficient (17% by June 2018). The monetary base is highly dependent on foreign exchange flows and therefore is quite susceptible to shocks, depending if the national currency is under or overvalued against the US dollar.

In Selgin (1994) the author proves theoretically that the money multiplier (using the reserve to deposits ratio as a proxy) responds to money demand shocks to achieve nominal stability. However, he concedes that the long run equilibrium of the reserve ratio may be influenced by the degree of competition in the banking system, by the composition of the deposit aggregates and by the interest rate.

As the deposit market share of a bank decreases, the probability that increasing loans lead to adverse clearing increases, as less costumers have their deposits in the expanding bank. Therefore, the demand for reserves by any individual bank should change inversely with its deposit market share. When a banking system becomes more competitive, there will occur an increase in reserve demand for larger banks that are losing market share combined with a decrease of demand by smaller banks that are gaining market share, which means the impact of bank concentration is ambiguous. The change in the degree of liabilities' liquidity allows banks to better manage the maturity of their assets. Therefore, with an increase of the time deposits share of total deposits, banks would demand a lower level of reserves to face adverse clearing, easing their liquidity constraint to expand credit. The interest rate usually acts as an opportunity cost to have idle balances.

The present study's objective is to test the equilibrium reserve ratio (as a proxy of the multiplier) when a banking system faces shifts in its structure of competition, when the interest rate moves and when the liquidity of the deposit liabilities changes. Moreover, we will include some country specific variables to take into account the current challenges the Angolan economy faces.

ANGOLA'S ECONOMIC FRAMEWORK

The choice of Angola is based on three important factors:

1. A fixed (or quasi-fixed) exchange rate in the period of analysis, which creates a systemic constraint for loan and deposit expansion;
2. Regular oil revenues monetization, which leads to regular injections of monetary base;
3. A developing interbank and secondary market for liquidity, which causes banks to have a high level of precautionary reserves.

During the years analysed, the exchange rate regime has varied between a dirty peg with the US dollar until December 2017 and a crawling band against the Euro since 2018, thus anchoring the Kwanza and therefore creating a constraint to excessive monetary expansions.

That constraint is easier or tighter depending on balance of payments flows. The foreign exchange inflows affect the monetary base because oil companies sell US dollars to the Banco Nacional de Angola to buy goods and services in national currency and the Government uses its US dollar oil revenues to spend in national currency (by monetizing it via central bank).

Those injections of reserve balances in the banking system are not perfectly sterilized by the central bank, causing regular big shifts in the monetary base and therefore in the money multiplier (because M2 is affected in a smaller proportion), even though in November 2017, the Central Bank has adopted the monetary base as its operational variable. Despite that volatility of reserve balances, the stability of the overnight interbank interest rate combined with the high levels of excessive reserves presupposes banks have a high level of demand for reserves (Figure 3 - Appendix). That high demand must be caused by the poorly developed market for funding liquidity and secondary market for financial assets, that causes a necessity for a high level of precautionary reserves to face adverse clearings.

During the period of analysis, the banking system has witnessed the entry of numerous foreign banks as the opening of several branches of new national banks. Even though it is still highly concentrated among its top five banks, it has been observed a decrease in market concentration, which theoretically could lead to a higher demand for precautionary reserves by the entering smaller banks and therefore to a minor adjustment of the banking system to monetary base shocks. However, the increase in competition has led to further financial developments in the interbank and secondary markets.

Starting in 2014, with the reduction of international oil prices, Angola faced a severe crisis with shortages of foreign exchange inflows penalizing the imports of goods and services. Banco Nacional de Angola, Angola’s central bank, restricted the foreign exchange market to specified sectors, to protect the deteriorating level of international reserves, which led to an increasing black-market spread. As the central bank controlled the foreign exchange auctions, banks started to hoard more reserves because of the implied uncertainty of foreign exchange auctions calendar and amounts sold.

At the same time, with the deteriorating economic conditions, the ratio of nonperforming loans started to increase, which created another dent on banks' willingness to expand loans to businesses and entrepreneurs.

In the next section we will describe the variables that we will use and the methodology chosen to conduct the study.

DATA AND METHODOLOGY

The data for the monetary aggregates, deposits, loans, reserves, interest rates, exchange rates are all retrieved from Banco Nacional de Angola's monetary accounts and other statistical bulletins, from 2012 until June 2018. All the variables selected were chosen in the national currency (AOA – Angolan Kwanza) not being considered foreign currency deposits and loans. The money multiplier is derived by the ratio of the broad money supply with the broad monetary base. The broad monetary base includes notes and coins in circulation, bank reserves (both free and required) and central bank short-term absorption instruments. The broad money supply includes notes and coins, demand deposits and time deposits. The ratio of reserves to deposits includes all the reserves (including absorption instruments) divided by the total amount of deposits. The foreign exchange rate spread is the spread between the black-market rate and the official central bank foreign exchange rate. Finally, the degree of bank competition is calculated using the Herfindahl index, representing the deposits' market share of banks in Angola's banking system.

The model chosen to test the hypothesises of long run determinants for the reserve ratio and money multiplier is the Autoregressive Distributed Lag (ARDL) model. This model includes lags of both the dependent and independent variables as regressors, which allows to test for cointegrating vectors among them (Pesaran and Shin, 1998). The advantage of this approach comparing to others is that it allows for different orders of integration among the chosen variables.

The cointegration relationship between the dependent variable and the regressors is estimated and the long-run parameter estimates are derived. Finally, we test for cointegration by deriving the conditional error correction in the cointegration bounds test of Pesaran, Shin and Smith (2001). This standard F-test or Wald-test is robust to whether variables of interest are I(0), I(1) or mutually cointegrated. The long-run relationship that we are investigating is the following one:

$$(1)\quad (r_t/td_t) = \beta_0 + \beta_1 log(HHI_t) + \beta_2 luibor_t + \beta_3(dd_t/td_t) + \beta_4 spread_t + \beta_5 npl_t + \varepsilon_t$$

where r_t is bank reserves, $td_t$is total deposits, HHI_t is the concentration index, $luibor_t$ is the interbank interest rate, dd_t is demand deposits, $spread$ is the foreign exchange spread and npl_t is the non-performing loans ratio. To give robustness to our investigation, we will test also the same model but with the money multiplier as the dependent variable (mm_t).

The error correction model representation of the ARDL allows to estimate the speed of adjustment to the long-run equilibrium. The coefficient of the error correction term (ECT), which represents the residual of the long-term equation, gives us the speed of adjustment to equilibrium in every period. If the model is correctly specified, we expect this coefficient (λ_0) to be negative and highly significant. We also included as control variables, dep_cred as the difference between bank deposits and bank credits; and rr_br, as the ratio between required reserves and bank reserves.

$$(2)\quad \Delta\left(\frac{r_t}{dt_t}\right) = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \frac{r}{dt}_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta \ln(HHI)_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta luibor_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta\left(\frac{dd_{t-i}}{td}_{t-i}\right) + \sum_{i=1}^{n} \beta_5 \Delta spread_{t-i} + \sum_{i=1}^{n} \beta_6 \Delta npl_{t-i} + \alpha 1 dep\_cred + \alpha 2 rr\_br_t + \lambda_0 ECT_{t-1} + \mu_t$$

To evaluate the performance of the model we provided tests for serial correlation, normality and heteroscedasticity in the residuals from our estimated equations. The CUSUM and CUSUMSQ residual tests have also been applied to test model instability. These tests are based in the cumulative sum of recursive residuals and squared residuals (Brown, Durbin and Evans, 1975).

EMPIRICAL RESULTS

The first step of our study is to check whether variables are stationary (in levels or first differences) before using them in the regressions. The Augmented Dickey Fuller (ADF) and Philips-Perron (PP) tests are used to determine the order of integration I(d) or the number of unit roots (if any) contained in each series of the variables. Both unit root tests state the presence of a unit root under the null hypothesis. Table 1 shows the results found for regressions with a constant term and with both a constant and a trend when testing for the presence of a unit root.

The unit root tests that include a constant and trend in test regression (Table 1) leads us to reject the null hypothesis of the presence of a unit root for log(HHI) and money multiplier, at 99% and 90% confidence levels, respectively. Both ADF and PP test statistics fail to reject the null of a unit root in each of the other variables at conventional test sizes. The ADF tests reject the hypothesis of two-unit roots at the conventional significance levels.

Table 1– ADF and PP unit root tests

Variable	Augmented Dickey-Fuller (ADF)		Philips-Perron (PP)	
	Constant	*Constant and trend*	*Constant*	*Constant and trend*
Test for unit root in levels (H_0: Series has a unit root)				
r_d	-1.839	-2.503	-1.606	-2.300
mm	-1.491	-3.257*	-1.037	-3.257*
log(HHI)	-1.446	-4.455***	-0.976	-4.273***
$luibor$	-0.186	-2.345	-0.334	-1.978
$spread$	-1.214	-0.980	-1.366	-1.465
npl	-1.013	-2.703	-0.969	-2.701
dd_td	-2.513	-2.611	-2.229	-2.397
rr_br	-2.264	-2.528	-2.365	-2.732
dep_cred	-0.795	-1.185	-0.846	-1.491
Test for unit root in first differences (H_0: Series has two unit roots)				
r_d	-9.110***	-9.085***	-9.745***	-10.113***
mm	-8.140***	-8.096***	-10.584***	-10.469***
log(HHI)	-14.871***	-14.768***	-16.248***	-16.129***
$luibor$	-6.915***	-6.943***	-6.840***	-6.821***
$spread$	-11.988***	-11.980***	-11.754***	-11.755***
npl	-8.931***	-8.872***	-8.930***	-8.896***
dd_td	-11.007***	-9.706***	-11.792***	-12.948***
rr_br	-7.507***	-7.457***	-7.562***	-7.488***
dep_cred	-8.088***	-8.045***	-8.140***	-8.098***

Notes: ***, **, * significant at 0.01, 0.05 and 0.10, respectively.

The existence of the long-run relationship between the reserve ratio and the explanatory variables has been tested using the F-bounds cointegration test of Pesaran, Shin and Smith (2001). Table 2 reports results for PSS cointegration test, showing signs of a cointegration relation at the confidence level of 1% level.

Table 2– F-statistic for cointegration relationships

Model (dep. variable)	*F-statistics*	*Critical value bounds of the F-statistic*			
		95%		99%	
		I(0)	I(1)	I(0)	I(1)
r_d	8.065	3.12	4.25	3.93	5.23
mm	5.998	3.12	4.25	3.93	5.23

Notes: If p-value<0.1 of F-statistics, reject the null hypothesis of no cointegration at the confidence level of 1% level.

The long run coefficients are displayed in Table 3. If we consider that the money multiplier has a theoretical negative relationship with the reserve ratio, we should expect opposite signs for the coefficients presented, as observed.

Table 3– Long-run ARDL estimation and cointegration testing (Unrestricted constant and trend)

	Dependent variable			
	r_d		mm	
	Coefficient	*p-value*	*Coefficient*	*p-value*
log(HHI)	-98.674	0.000	5.165	0.000
npl	0.756	0.000	-0.050	0.002
luibor	0.547	0.000	-0.025	0.034
dd_td	-0.131	0.623	-0.001	0.948
$spread$	0.032	0.018	-0.002	0.028
Diagnostic test	*Test statistic*	*p-value*	*Test statistic*	*p-value*
Serial correlation test (4)	0.846	0.503	1.589	0.192
Ramsey Reset test (2)	1.070	0.351	0.550	0.580
Normality test	1.614	0.446	0.768	0.681
Heteroskedasticity test	1.001	0.478	1.425	0.157

Notes: The Akaike Info Criterion is used to select the lag length for the ARDL model. LM test is the Lagrange Multiplier test of residual serial correlation; Normality test is based on skewness and kurtosis; Ramsey Reset test is the Ramsey test for omitted variables/functional form and the Breusch-Pagan-Godfrey heteroskedasticity test. If the F-statistic of the PSS cointegration test is above the upper critical value, one rejects the null hypothesis of no linear relationship (or cointegration).

From Table 3 we conclude that all the independent variables are statistically significant, except dd_td. The degree of competition in the banking system tends to decrease the money multiplier as banks increase their reserve ratio. An increase in 1% in HHI (which implies higher concentration) decreases the reserve ratio by 0,98 p.p. and increases the multiplier by 0.05, as a less competitive banking system has lower demand for precautionary reserves to avoid adverse clearing. This shows that an increase in reserve demand by larger banks that lose market share is superior the decrease in reserve demand of smaller banks that gain market share. An increase in the non-performing loan ratio has a positive impact in the ratio by reducing banks' willingness to lend, decreasing the money multiplier. The interbank rate has a positive impact on the reserve ratio (and negative on the multiplier) as it was expected because of the implied cost on interbank markets of a shortage of reserves when facing adverse clearing, when this cost increases banks will be more cautious to invest those same reserves. The foreign exchange spread also has an expected positive sign by increasing banks demand for reserves to face unexpected foreign exchange auctions by the central bank. Finally, the percentage of demand deposits to total deposits has an opposite sign to what would be expected. Nevertheless, it is not statistically significant, probably because of the reserve requirement regulation, as already explained. We will further explore this issue in the policy recommendation section.

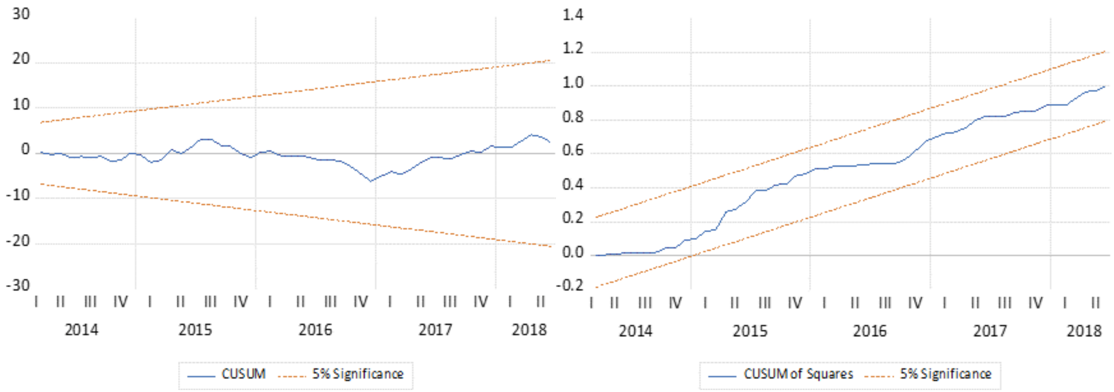
To specify the short-term equation, two other exogenous variables were included. The difference between total bank deposits and total bank lending and the ratio of the required reserves to total reserves. The difference between deposits and credits was included as a control variable in order to only be considered short-term adjustments in the reserve ratio and/or money multiplier that keeps the difference between deposits and credits constant, to avoid central bank intervention to stabilize the multiplier and only considering adjustments in the multiplier/reserve ratio that reflect the disequilibrium process that occurs when the banking system expands by creating deposits. The ratio of reserves was included in the short-term relationship to consider only the amount of reserves that are not legally required and that therefore provide the liquidity to generate the disequilibrium money creation process.

The coefficient of the error correction term for both models is negative and statistically significant, indicating that the cointegration relations as the models itself are correctly specified. The value of the error correction term for the reserve ratio (63%) implies relatively faster adjustment to shocks in the short run comparing to the money multiplier (56%). Nevertheless, in both cases more than half of the convergence is achieved in one period (month).

The diagnostic tests applied to the model show no evidence of serial correlation and heteroscedasticity. The RESET test implies a correctly specified ARDL model and the Jarque-Bera normality test indicates that the residuals are normally distributed for both models.

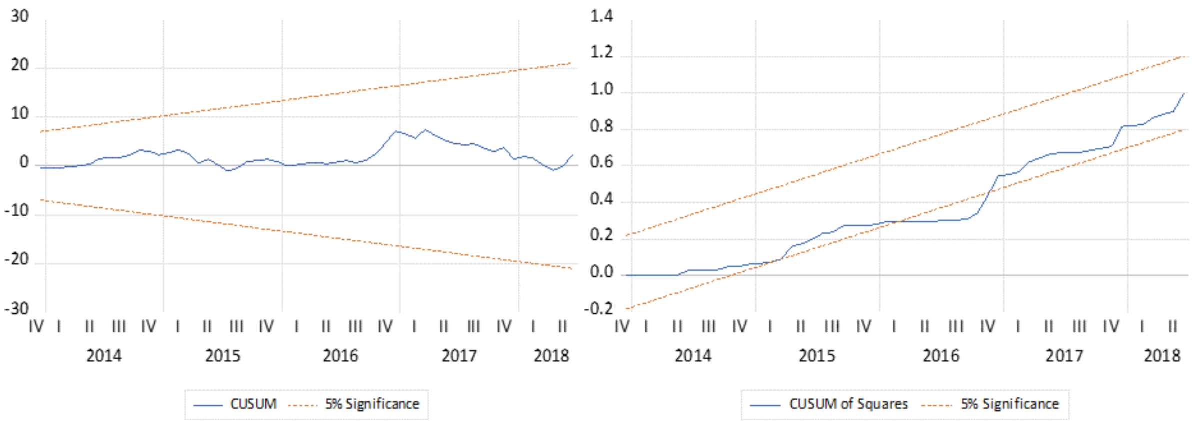
In the final stage, the stability of the long-run coefficients is examined by using the CUSUM and CUSUM squares tests. The graphical presentation of these tests is presented in the figures below.

Figure 1– CUSUM and CUSUMSQ residual tests for *r_d* model



Both the reserve ratio and the money multiplier are within the 5% bound in the CUSUM test for stability, however the money multiplier shows inferior performance in the CUSUMSQ test, which implies a better fit for the long run relationship of reserve ratio.

Figure 2– CUSUM and CUSUMSQ residual tests for *mm* model



POLICY IMPLICATIONS

Our study suggests that even though Angola's financial system is currently under development, up to a point that the money multiplier process may lose significance, the still underdeveloped interbank money market causes frictions that may cause the multiplier disequilibrium.

Therefore, and after observing that the liquidity of banks' deposit base is not statistically significant in determining the long-run reserve deposit ratio, the central bank must take steps to differentiate the required reserve ratio between time and demand deposits, with the purpose of enhancing banks incentive to deepen the financial instruments provided to their clients.

Furthermore, it would be interesting to see if the interbank interest rate volatility will increase, adding complexity to the central bank' task of managing liquidity, as the interbank market keeps on developing. When those features of the interbank market develop it is advisable for the central bank to set a narrow corridor system to enhance its ability to target interest rates. At that stage of monetary control, the reserve to deposit ratio may gain relevance to monetary policy, as the central bank supplies the amount of reserves demanded for the normal interbank market settlement process. When that occurs the money multiplier process loses relevance, leading to its stability ex-post and becoming a money divisor.

CONCLUSION

The money multiplier model has led recently to a great amount of interest in its impact in the conduction of monetary policy. After various studies questioning the money multiplier process in a flexible exchange rate regime where the central bank sets interest rates, our study purpose was to search for some applicability of the concept in a country with a fixed exchange regime and a poorly developed financial system.

Following Selgin's (1994) determinants for banks' reserve ratio, we tested the long run relationship between this ratio and the interbank interest rate, the liquidity of banks' deposits and the level of concentration of the banking system, considering recent distresses of the Angolan economy such as the black market spread and the non-performing loans ratio. However, the degree of liquidity of banks' liabilities isn't one of the main determinants of the reserve ratio and therefore of the money multiplier. This conclusion of our study opens the possibility for the Banco Nacional de Angola to differentiate their reserve requirements to allow banks, in their profit optimizing operations, to further develop Angola's financial system.

Therefore, our empirical analysis and results create a novel way to look to the multiplier process, first developed by Philips (1921), which may be applied in several other countries with similar economic environment, where liquidity mismatches may generate a monetary multiplier disequilibrium process.

BIBLIOGRAPHY

Bahmani-Oskooee, M., & Wang, Y. (2007). How stable is the demand for money in China?. Journal of Economic Development, 32(1), 21.

Bell, S. (2001). The role of the state and the hierarchy of money. Cambridge Journal of Economics, 25(2), 149-163.

Beckworth, D. (2017). Permanent versus temporary monetary base Injections: Implications for past and future Fed Policy. Journal of Macroeconomics, 54, 110-126.

Bindsell, U. (2004), "The Operational Target of Monetary Policy and the Rise and Fall of Reserve Position Doctrine", European Central Bank Working Paper Series, No. 372.

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. Journal of the Royal Statistical Society. Series B (Methodological), 149-192.

Brunner, K., & Meltzer, A. H. (1964). Some further investigations of demand and supply functions for money. The Journal of Finance, 19(2), 240-283.

Budha, B. B. (2012). Demand for money in Nepal: An ARDL bounds testing approach. NRB Economic Review, 21.

Carpenter, S., & Demiralp, S. (2012). Money, reserves, and the transmission of monetary policy: Does the money multiplier exist?. Journal of macroeconomics, 34(1), 59-75.

Di Bella, G., Hauner D., (2005). How Useful is Monetary Econometrics in Low-Income Countries? The Case of Money Demand and the Multipliers in Rwanda. No. 5-178. International Monetary Fund.

Friedman, M., & Schwartz, A. J. (1963). A monetary history of the United States, 1867-1960. Princeton University Press.

Fullwiler, S. T. (2006). Setting interest rates in the modern money era. Journal of Post Keynesian Economics, 28(3), 496-525.

Fullwiler, S. (2008). Modern Central Bank operations: the general principles.

Godley, W., & Lavoie, M. (2006). Monetary economics: an integrated approach to credit, money, income, production and wealth. Springer.

Hafer, R. W. (1984). Comparing Time-Series and Survey Forecasts of Weekly Changes in Money: A Methodological Note. The Journal of Finance, 39(4), 1207-1213.

Hetzel, R. (1986). A critique of theories of money stock determination, Federal Reserve Bank of Richmond Working Paper No. 86-6.

Holmes, A. (1969). Operational constraints on the stabilization of money supply growth. Controlling Monetary Aggregates,(Boston MA: Federal Reserve Bank of Boston), 65-77.

Hume, D. (1752) Of money, in 'Essays'. George Routledge and Sons.

Johannes, J. M., & Rasche, R. H. (1979). Predicting the money multiplier. Journal of Monetary Economics, 5(3), 301-325.

Keister, T., Martin, A., & McAndrews, J. (2008). Divorcing money from monetary policy. Economic Policy Review, Vol. 14, No. 2

Keynes, J. M. (2018). A tract on monetary reform (1923). Pickle Partners Publishing.

Krugman, P. R., Dominquez, K. M., & Rogoff, K. (1998). It's baaack: Japan's slump and the return of the liquidity trap. Brookings Papers on Economic Activity, 1998(2), 137-205.

Lavoie, M. (1984), 'The endogenous flow of credit and the post Keynesian theory of money', Journal of Economic Issues, 18 (3), 771–797.

Lavoie, M. (2001). 10. The Reflux Mechanism and the Open Economy. Credit, interest rates and the open economy: Essays on horizontalism, 215.

Le Bourva, J. (1992), 'Money creation and credit multipliers', Review of Political Economy, 4 (4), 447–466.

McLeay, M., Radia, A., & Thomas, R. (2014). Money creation in the modern economy.

Mehrling, P. (2012). 21 The inherent hierarchy of money. Social Fairness and Economics: economic essays in the spirit of Duncan Foley, 169, 394.

Mishkin, F. S. (2007). The economics of money, banking, and financial markets. Pearson education.

Moore, B. J. (1988). Horizontalists and verticalists: the macroeconomics of credit money. Cambridge University Press.

Mosler, W. (1995). Soft Currency Economics (No. 9502007). EconWPA.

Pesaran, M. H., & Shin, Y. (1998). An autoregressive distributed-lag modelling approach to cointegration analysis. Econometric Society Monographs, 31, 371-413.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

Phillips, C. A. (1921). Bank Credit: A Study of the Principles and Factors Underlying Advances Made by Banks to Borrowers. Macmillan.

Selgin, G. A. (1988). The theory of free banking: Money supply under competitive note issue. Rowman & Littlefield Pub Inc.

Selgin, G. (1994). Free banking and monetary control. The Economic Journal, 104(427), 1449-1459.

Selgin, G. (2018). Floored! How a Misguided Fed Experiment Deepened and Prolonged the Great Recession.

Tobin, J. (1963). Commercial banks as creators of money (No. 159). Cowles Foundation for Research in Economics, Yale University.

APPENDIX

Table 4– Data definition

Variable	Description	Unit
r_d	Ratio between total reserves and total deposits in national currency	%
mm	Ratio between M2 (money supply) and broad monetary base in national currency	units
HHI	Herfindahl-Hirschman Index of concentration of bank deposits	units
npl	Ratio of non-performing loans to total loans	%
luibor	Luanda Interbank Offered Rate (interbank interest rate)	%
dd_td	Ratio between demand deposits and total deposits	%
spread	Spread between black market and official exchange rate	%
dep_cred	Difference between total deposits and total credits in banking system	millions AOA
rr_br	Ratio between required and total bank reserves	%

Table 5– Descriptive statistics

	r_d	mm	HHI	npl	luibor	dd_td	spread	dep_cred	rr_br
Mean	30.66586	2.587198	1243.167	13.09116	10.94815	60.72241	66.78700	1070120.	59.91725
Median	28.25193	2.664429	1227.500	12.07000	6.395000	61.44873	41.85698	1298715.	54.99525
Maximum	52.77369	3.464886	1515.000	32.70000	23.67000	67.88374	234.5677	1998729.	89.99868
Minimum	20.84970	1.632563	1057.000	2.500000	2.940000	49.89093	4.259190	30516.00	38.39371
Std. Dev.	7.716190	0.462434	146.0162	8.259717	6.841488	4.042849	66.25124	667185.3	13.90870
Skewness	1.037760	-0.339622	0.287488	0.967043	0.630720	-0.544288	0.811743	-0.113884	0.475300
Kurtosis	3.132036	2.060429	1.538198	2.847288	1.921651	2.865135	2.479498	1.372665	1.955439
Jarque-Bera	14.05696	4.368543	8.019251	12.23303	8.950717	3.910350	9.446554	8.775321	6.482927
Probability	0.000886	0.112560	0.018140	0.002206	0.011386	0.141540	0.008886	0.012430	0.039107
Observations	78	78	78	78	78	78	78	78	78

Table 6 – The ARDL estimations of short-run relationships

	Dependent variable			
	r_d		mm	
	Coefficient	*p-value*	*Coefficient*	*p-value*
$\Delta\log(\mathrm{HHI})_t$	-0.300	0.02		
$\Delta\log(\mathrm{HHI})_{t-1}$	0.229	0.01		
$\Delta\log(\mathrm{HHI})_{t-2}$	0.129	0.05		
$\Delta\mathrm{npl}_t$	0.174	0.07	1.399	0.084
$\Delta\mathrm{npl}_{t-1}$	-0.278	0.01	1.116	0.161
$\Delta\mathrm{npl}_{t-2}$	-0.291	0.01	1.979	0.011
$\Delta\mathrm{npl}_{t-3}$	-0.291	0.01	-3.958	0.000
$\Delta\mathrm{dd\_dt}_t$	0.518	0.00	-2.981	0.001
$\Delta\mathrm{dd\_dt}_{t-1}$	0.513	0.00	-1.183	0.158
$\Delta\mathrm{dd\_dt}_{t-2}$	0.276	0.03	1.399	0.084
$\Delta\mathrm{spread}_t$	0.009	0.43	-0.028	0.719
$\Delta\mathrm{spread}_{t-1}$	-0.026	0.02	0.187	0.023
dep_cred_t	-3.36E-08	0.00	0.1E-06	0.046
rr_br_t	0.039	0.04	-0.228	0.090
ECT_{t-1}	-0.634	0.00	-0.557	0.00
$constant$	4.855	0.00	-19.80	0.000
$trend$	-0.006	0.00	0.036	0.000
R^2	0.618		0.548	
R^2_{adj}	0.510		0.450	

Figure 3 – Variables selected