THE EMPIRICAL IMPLICATIONS OF MONEY MULTIPLIER WITH REGIME SHIFT IN BANK LIQUIDITY: THE MOROCCAN EXPERIENCE

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Abstract

The main propose of this paper is to discuss one of the fundamental assumptions of the money multiplier framework, which is the stability of the relationship between the monetary base and the money supply. Such an assumption is questionable, especially in Morocco, where the money market shifts from a situation of excess liquidity to illiquidity. As we consider the regime shift as a bias that must be thwarted by econometrics, and not as justification to simply reject the paradigm of the money multiplier, we try therefore to take it into account in modeling the money multiplier by using cointegration test structural change occurring at unknown date.

Keywords

Monetary policy, bank liquidity, cointegration with regime shift, econometrics of time series.

1. Introduction

In most research papers dealing with the stability and the predictability of the money multiplier, time series methods are used and preferred over other econometric methods. Thus, we can classify empirical studies that have focused on this topic into two main categories, one involving uni-varied time series models and the other being the set of bi-varied explanatory models.

Indeed, authors like Ray and Madhusoodan (1992) have made use of univariate test applied on the money multiplier in order to assess its stability. Furthermore, Sen and Vaidya (1997) as well as Nachnae (1992) and others tested the hypothesis of stability and predictability of the money multiplier based on bi-varied models linking the monetary base to the money supply.

The main criticism with regard to these empirical studies is their theoretical basis which assumes the existence of a prior and potential common trend between the monetary base and the money supply. However, such an assumption is far from being true. Indeed, and after liberalization and financial innovation, countries have experienced a change in the status of their money markets. This is the case of Morocco, wherein there were a succession of two different situations of bank liquidity since the 2000s, the first being a structural excess liquidity and the second being a situation of under liquidity.

This structural change in bank liquidity challenges the assumption on which the aforementioned papers base their empirical models, namely the stability of the money multiplier. Empirically, such a change should be introduced in the specification of the model.

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3 In this kind of studies, we do not calculate the money multiplier, it is supposed to be the long run relationship, if any, between the money supply and bank liquidity.
Thereby, in our work, we start with an overview of the theoretical model of the money multiplier and its foundations, then we will highlight the liquidity situation in Morocco and we finally propose the tool to take into account the liquidity regime shift model, inspired from cointegration model with endogenous breakpoint.

2. The money multiplier framework

The money market is the main source to refund commercial banks. Therefore, the central bank plays the role of lender of last resort and implements its monetary policy in order to regulate the money creation of commercial banks.

Theory teaches us that the monetary base should serve as a basis for broad money. By introducing the money multiplier as it was formalized by Phillips (1920), we have:

\[ M = k \times BM \] (1.1)

\( K \) : is the money multiplier and \( BM \) is the monetary base. The monetary base, or "central bank money", is the currency issued directly by the central bank and consisting of banknotes and bank reserves. Thus, the monetary base is held either by individuals in the form of coins and paper money, either by banks in the form of bank money liquidity. The first component of the monetary base is the ultimate form of money because having a fiat and a legal value in a given area; it enjoys superiority in terms of trust.

With regard to bank reserves, the second component of the monetary base, it is explained by the fact that commercial banks must deal with interbank settlements while they are compelled to daily cash needs. Thus, from a balance sheet point of view, the monetary base is the sum of two components of the balance sheet of the central bank and it is therefore the amount of banknotes in circulation outside the banking system and the amount of bank reserves deposited in central bank as required reserves and excess reserves.

Following the classification of Higgins (1980), bank reserves can be considered from two points of view:

\[ RB = RBP + RBNP \] (1.2)

\[ RB = RO + RE \] (1.3)

In equation (1.2), bank reserves are expressed in terms of their resources: reserves lent by the central bank \( RBP \) and not lent reserves \( RBNP \). Equation (1.3) shows the use side by distinguishing between reserves that banks are required to have in the central bank and the excess available beyond the regulatory threshold.

Putting \( ro \) and \( re \) cf respectively as the reserve requirement ratio, the excess reserves ratio and the rate of coin circulation, we have:
While the monetary base can be expressed as follows:

\[ BM = CF + RO + RE = DB \left( cf + ro + re \right) \] (1.5)

Where:

\[ DB = \frac{BM}{(cf + ro + re)} \] (1.6)

Since the money is equal to the sum of bank deposits and currency in circulation, then the equation (1.2) can be rewritten as follows:

\[ M = DB + CFM = (1 + cf)DB \] (1.7)

From there, the link between the operational tools of monetary policy and real activity can be extracted by rewriting equation (1.1) as follow:

\[ M = \frac{(1 + cf)}{cf + ro + re}BM \] (1.8)

In equation (1.8), the money multiplier K becomes:

\[ K = \frac{(1+cf)}{cf+ro+re} \]

The introduction of the money multiplier has shown the link between the monetary base and monetary aggregate as a first step, and then reveals the link between the balance sheet position of the central bank and economic activity.

Thus, the required reserve ratio is an important tool to regulate the money creation made by commercial banks. So, the central bank controls the price level and influences real activity. However, the central bank can use this policy instrument if only the following conditions are met:

- The stability of the money multiplier;
- The possibility of total control over the monetary base.

Thus, one of the major issues of monetary economics is the stability and predictability of the money multiplier, such a long-term stability is often lacking if we consider results of empirical tests about the relationship between monetary base and money supply. Also, the assumption of stability and predictability is rejected by the simple observation of the money
market in countries that have experienced a change in the bank's liquidity position, namely Morocco.

2. Regime shift in bank liquidity in Morocco: Stylized Facts

Moroccan banks had operated within constantly changing international environment and had more flexibility. Since the financial liberalization and the capital opening occurred in nineties, the Moroccan banking sector continue to fulfil its mission of allocating financial resources to the economy in an environment where market forces are preferred to administered rate policy. Thus, the Moroccan banking sector, which has become increasingly subject to exogenous fluctuations, should have stability. Structural break occurred on the money market liquidity is one of these fluctuations. From 1996, when banking conditions became liberalized, we can talk about two sub-periods, a period of structural excess liquidity from 1996 until the end of 2007, followed by a period of lack of liquidity in the money market which has started since the beginning of 2008.

Indeed, like the other countries of the MENA region and the Economic and Monetary Community of Central Africa, Morocco has experienced a situation of excess liquidity in the money market. Trying to explain this excess liquidity, factors relating to the structure of the Moroccan economy can be used and the structure of savings in Morocco is the most decisive factor. Until 2006, the savings in Morocco was mainly financial ones and substantially liquid in the form of financial assets with short maturities. In this context, bank loans remained relatively low for such a structure of savings is incompatible with long-term financing.

Moroccan banks benefited too from very low money market rates and preferred to borrow the money they lend to the economy from the money market rather than tap into their cash surpluses, so bank reserves have seen their prices fall. This excess liquidity has been increased by privatization inflows which were injected in the money market and also by the inflows from tourism and workers remittances. Otherwise, banks could hardly invest their excess cash on the foreign exchange market, which hitherto remained highly regulated.

This period of excess liquidity was followed by a period of lack of liquidity since the beginning of 2008. Under liquidity occurred with the drastic fall in foreign financial assets mainly due to the deterioration of the trade balance and, consequently, the deterioration of the balance of payments. Transfers from Moroccan workers living abroad also declined. The “Office Chérifien du Phosphate”, having most of its investments in the money market, have removed from the of money market since October 2008 in order to finance the outsourcing of its pension fund. These resources, despite their injection into the banking system, have being reinvested in a form other than broad money. This increase in non-monetary resources was accompanied by foreign financial investments. Indeed, and as a part of economic openness and liberalization than a year old Moroccan monetary authorities begin opening measures and capital, commercial banks have wanted to take advantage of arbitrage opportunities offered by the opening and placed. Today, Bank Al Maghrib, Morocco’s central bank, considers the situation described above as a structural lack of liquidity.
4. Money multiplier using cointegration test with endogenous structural break

Before the multivariate econometric modelling, an analysis of the properties of each univariate time series is required. This preliminary analysis allows us to identify the common characteristics of each variable and decide on how it will be introduced in the econometric model. The identification of the order of integration and the extraction of any deterministic component are important steps to avoid estimation bias from a fallacious regression. Indeed, the presence of a unit root determines the choice of the estimation method and the model itself. Dickey and Fuller (1981) is a classic of the econometric literature on the presence of unit root in the time series. The Augmented Dickey Fuller (ADF) test has the null hypothesis of non-stationarity of the series. The principle of the test is that the first difference of all series \( \Delta x_t \) is assumed to be generated by an autoregressive process \( AR(p) \) having one of the three following representations:

\[
\Delta x_t = \alpha + \beta + \rho x_{t-1} + \sum_{i=1}^{p} \phi_i \Delta x_{t-i} + \epsilon_t \tag{2.1}
\]

\[
\Delta x_t = \rho x_{t-1} + \sum_{i=1}^{p} \phi_i \Delta x_{t-i} + \epsilon_t \tag{2.2}
\]

\[
\Delta x_t = \alpha + \rho x_{t-1} + \sum_{i=1}^{p} \phi_i \Delta x_{t-i} + \epsilon_t \tag{2.3}
\]

Hence, \( x_{t-1} \) is the observation by which the stored past values affect the present values of \( x \) and the error term \( \epsilon_t \) is a white noise. The \( p \) terms introduced into each of the three models are used to control autocorrelation. The autocorrelation order is unknown, so the optimal \( p \) is determined by using minimizing information criteria; from the general model to the particular, we must choose the model that minimizes information criteria, namely the Akaike criterion (AIC), Schwartz criterion (SC) and Hannan-Quin criterion (HQ). With ordinary least squares (OLS), the theoretical models mentioned above are estimated to find the appropriate one which is considered to be the process generating \( x_t \). Thus, the ADF test is conducted according to a sequential strategy from the general model (2.1) to the smallest (1.3) while involving several decisions. Approach combining simple tests and tests forced is adopted to identify the appropriate theoretical model of the process generating the time series in question.

Simple tests are one-side hypothesis tests since we have only two, \( H_0 \) and \( H_1 \), as follows:

\[
\begin{align*}
H_0 &: \rho = 0 \\
H_1 &: \rho < 0
\end{align*}
\]
The decision rule for a fixed significance level of 1%, 5% or 10%, is the comparison of the calculated value of the coefficient \( \tau \) with the critical value that we can find on the Fuller (1996) table.

Regarding simultaneous tests, they are required to assess the validity of the estimated theoretical model. For simultaneous testing of the model (2.1), it involves the joint hypothesis of the nullity of the coefficient \( \rho \), conditional on the nullity of the coefficient \( \beta \) associated with the trend in the presence of a constant:

\[
H_0^3 : (\alpha, \beta, \rho) = (\alpha, 0, 0)
\]

This hypothesis is tested against the following alternative hypothesis:

\[
H_1^3 : (\alpha, \beta, \rho) = (\alpha, \beta, 1)
\]

The Fisher test is used to compare the calculated value with the threshold \( F_3 \) tabulated by Dickey & Fuller (1981).

After the ADF test, we can estimate a linear combination of the time series which can be interpreted as an equilibrium relationship in the long term. Cointegration analysis presented by Granger (1983) and Engle and Granger (1987) is considered one of the most innovative concepts in econometrics. The cointegration analysis allows to clearly identify the true relationship between two variables by finding the existence of a cointegration vector and eliminating its effect, if any. The cointegration vector space is infinite, even if there is only one cointegration vector linearly independent. By \( n \) linearly independent vectors cointegration we mean \( n \) cointegration vector directions different, each being represented by an infinite number of vectors that are multiples of each other. The Engle and Granger method is based on the arbitrary assumption that there is only one cointegration vector among the variables to be modelled, so \( n = 1 \).

The cointegration model is therefore estimated by OLS and we can say that the two variables are cointegrated when the residuals have the following properties:

- It is stationary I(0);
- It has no stochastic trend;
- It has no unit root;
- It has a constant variance.

In order to test for the presence of a potential point of failure in the long-run relationship between the monetary base and the money supply, we use the modified cointegration test of Gregory and Hansen (1996) from the Granger test (1987).

The date of the breakpoint is considered to be endogenous. It means that it is an unknown date to be identified empirically from the stochastic characteristics of the joint movement of the two series. While the null hypothesis of the test is the absence of a common long-term trend, the alternative hypothesis of this test is the presence of a cointegration relationship with
predetermined breakpoint. A dummy variable is used to detect the date of the breakpoint occurred during the study period $T$:

$$
\phi_t = \begin{cases} 
0 & \text{si } t \leq T_t \\
1 & \text{si } t > T_t 
\end{cases}
$$

Depending on the equilibrium relationship between the two variables, the breakpoint can be detected depending on the modelled regime shift:

- **Level Change:**
  
  $$
  M_t = \alpha MB_t + \lambda_1 + \phi_2 \lambda_2 + \epsilon_t
  $$

- **Level change with single linear trend:**
  
  $$
  M_t = \alpha MB_t + \lambda_1 + \phi_2 \lambda_2 + \beta t + \epsilon_t
  $$

- **Trend and level change:**
  
  $$
  M_t = \alpha MB_t + \lambda_1 + \phi_2 \lambda_2 + \beta_1 t + \phi_1 \beta_2 t + \epsilon_t
  $$

- **Level and coefficient change with single linear trend:**
  
  $$
  M_t = \alpha_1 MB_t + \phi_2 \alpha_2 MB_t + \lambda_1 + \phi_2 \lambda_2 + \beta t + \epsilon_t
  $$

- **Trend, level and coefficient change:**
  
  $$
  M_t = \alpha_1 MB_t + \phi_1 \alpha_2 MB_t + \lambda_1 + \phi_2 \lambda_2 + \beta_1 t + \phi_1 \beta_2 t + \epsilon_t
  $$

The date of regime change is the breaking point with the minimum value of the Dickey Fuller statistic. This value is then compared to thresholds tabulated by Gregory and Hansen. Thereafter, the stability of the cointegration can be tested using the test $Lc$, and supF meanF Hansen (1992) and the CUSUM-SQ test of Brown, Durbin and Evans (1975). Finally, the application of this model can be done on aggregated data as well as disaggregated data combining the components of the monetary base.
5. Conclusion

In this paper, we discuss one of the fundamental assumptions of the money multiplier framework, which is the stability of the relationship between the monetary base and the money supply. This hypothesis has to be tested, especially in Morocco, where the monetary base has a break in 2008 when the money market shifts from excess liquidity to illiquidity. We tried to take into account the structural change of bank liquidity in the money multiplier model, such as we consider the lack of stability as a bias to thwart it by econometrics and not as justification to simply reject the paradigm of the money multiplier.

Finally, although the model has been specified, it must be supplemented by an application on the Moroccan data to test its robustness to capture the breakpoint in bank liquidity. We consider that the standard co-integration test does not give rise to a common trend between the monetary base and the monetary aggregate and that the use of the model with endogenous structural break may be more efficient. The advantage of this model is in the fact the date of the breakpoint is identified endogenously by the intrinsic dynamics of the model and not exogenously by choosing arbitrarily a given date.

References:


