

# ON THE CONDUCT OF THE MONETARY POLICY IN TUNISIA: STRENGTHS, WEAKENESSES AND OPERATIONAL GUIDELINES

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## **Abstract**

Tunisia has been undertaking reforms of its financial sector as part of broader macroeconomic adjustment program and structural reform since 1987. The main objectives of the reforms are (i) to curb inflation, (ii) to make real interest rates positive and (iii) then to lower them so as to stimulate the investment and to promote savings. In order to reach these goals, Tunisian monetary authorities decided to adopt a monetary targeting strategy. The aim of this paper is threefold. First, it seeks to provide a description of the central characteristics of the Tunisian monetary policy. Second, it examines the relevance of the preconditions of the implementation of the monetary targeting strategy in the light of the recent developments of time series econometrics. Third, it aims at checking whether the Central Bank of Tunisia succeeded in orienting the expectations of the economy. It has been found using causality, cointegration and exogeneity tests that the monetary targeting preconditions are not gathered yet. It is found also that the official target announcements did not provide optimal guidance to economic agents regarding the future course of the money supply. Our analysis highlighted the difficulties of implementing a monetary targeting strategy especially under the financial stability restriction; it casts serious doubts on the feasibility of such strategy. Finally, our paper concludes that the central bank of Tunisia, which is regarded by the international Monetary Fund (IMF) as a monetary targeter, should instead be seen as having followed a discretionary monetary policy with a focus on price stability.

**Key Words:** Monetary Targeting Strategy, Central Bank, Monetary Policy, Expectations.

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## 1. Introduction

Tunisia has been undertaking reforms of its financial sector as a part of broad macroeconomic adjustment program<sup>1</sup> and structural reforms since the ending of 1986. The reforms undertaken aimed mainly at improving the monetary management, fostering the development the financial markets and strengthening the banking system. More precisely, the principal goals of the reforms are, to curb inflation, to make real interest rates positive and to lower them so as to stimulate the investment and to promote savings, to improve banking supervision and introduce more market-based instruments of monetary policy (IMF, 1997, 2000). Towards these ends, many measures have been decided; the most important of them concerns the conduct of the monetary policy, which is thought to be specifically in line with the objective of supporting the growth and curbing inflation. It was thought that the central bank of Tunisia (henceforth CBT) should take up policy rule instead of adopting a discretionary policy. Economic theory suggests indeed that monetary policy tends to have an inflationary bias when monetary policy is discretionary (Barro and Gordon, 1983). This bias can be eliminated if the monetary authority is able to pre-commit itself to a policy rule that would ensure price stability in the long run. Therefore, the selection of a strategy that the central bank should follow is of great importance, as it represents not only a structure for the filtering and the processing of information, but also a guide for external communication with the public (Issing, 1996; Svensson, 1996a, 1996b).

The monetary targeting strategy (henceforth MTS) is the framework taken up by the CBT in order to achieve price stability. The MTS basic idea is to anchor the expectations of the economic agents. In order to lower inflation rates, the CBT has attempted to follow a simple growth rule<sup>2</sup> for a proper monetary aggregate that is officially stated as a target; once these targets are announced, economic agents have to decide whether to rely on these official projections or whether to form their own expectations (Friedman, 1968). Thus, decision to rely on monetary target announcements depends on the accuracy of the stated targets compared to available alternatives for generating expectations. The MTS rests on the choice of the monetary target which is ideally should be highly correlated with the goal, easier to control than the goal, easier to observe and visible so that central bank's communication with the public on the one hand, and public prediction of monetary policy on the other hand, are facilitated (Cukierman, 1996; Svensson, 1996a). Therefore, a complete assessment of a MTS should in principal consist of checking not only if the necessary conditions (the necessary conditions) are fulfilled but also whether the CBT succeed in guiding the public's expectations (the sufficient condition). At the operational ground, three main conditions have to be fulfilled when it comes to the effectiveness and the relevance of the MTS: (i) the target aggregate must be controllable, (ii) there should be a viable link between the target aggregate and the policymaker's final objective and (iii) the CBT has to succeed in influencing the expectations generating process.

A great number of studies (Svensson, 1996a, 2000; Cukierman, 1996; Friedman, 1968 and 1995; Friedman and Kuttner, 1993 and 1996; Issing, 1996 and 1997; Mishkin, 1999; Mishkin and Savastano, 2001; Ford and Morris, 1996) have shown on theoretical and empirical grounds that, for a MTS to be effective and sound, some preconditions must be fulfilled.

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<sup>1</sup> An entire description of the program is beyond the scope of this paper.

<sup>2</sup> The major modern argument in favor of monetary targeting came from (Barro and Gordon, 1983), who have shown that the problem of dynamic inconsistency is liable to a non-inflationary stance. If there is no such commitment, the outcome in terms of inflation and unemployment will be worse than if there was a commitment.

Some of these studies focussed on the controllability aspect and nothing was said about the money-prices link (Ford and Morris, 1996); conversely, others studies have emphasized the money-prices relationship and they neglected the controllability condition analysis (Friedman and Kuttner, 1993 ; Mishkin and Savastano, 2001). In the particular case of Tunisia, our current bibliographical research reveals that no serious empirical assessment or analysis has been devoted to check whether the prerequisites of the MTS are gathered or not yet. For instance, Najeh and Bouaziz (1990) showed that M2 was not controllable; they pointed out, using monthly data during the period 1978-1990 that the multiplier was instable. In a more recent paper, Treichel (1997), using cointegration tests, has examined the relationship between the monetary base and the money supply (M2); and he concluded that M2 was controllable and could be considered as a sensible intermediate target. Nevertheless, these studies have some caveats and they are methodologically unsounded. On the one hand, a study like that of Najeh and Bouaziz (1990) used some descriptive statistics without taking into account the non-stationary nature of the data; the authors did not exploit the long run information contained in the data. On the other hand, Treichel's work has emphasized the long run relationship between money base and prices and nothing was said about the short-run dynamics. The inspection of the short-run dynamics is mandatory especially when it comes to the controllability issue. Moreover, these studies share the same drawback: they did not examine the money-prices relationship and according to our knowledge, no research has been devoted to seriously analyze the linkage between the intermediate target and prices in Tunisia.

Basically, the following main reasons motivated our research. First, seeing that the primarily objective of the Tunisian's stability orienting monetary policy strategy was to orient efficiently public's expectations, one should wonder if the CBT, after an experience of about 16 years, succeeded in reaching its goals or not yet. If yes, could it do better? But if it did not, could we explain why? And could we propose an alternative strategy or improve the existing one? Second, the experiences of industrialized countries have shown that when inflation falls to single digit levels (as is the case of Tunisia), money growth rates will be likely to lose informational content and become less useful indicators of monetary policy. Better still, these studies have pointed out that changes in the financial system may have altered the time series properties of the monetary aggregates and may have changed the observed relationship between monetary targets and money base. For these reasons and seeing that Tunisia knows all these changes, it seems judicious and reasonable to appraise the central bank's experience of an emerging country like Tunisia. Third, this research improves upon the existing studies by showing how to make a complete and a proper assessment of a MTS. It uses advanced econometric techniques especially, stationary tests, cointegration tests, short and long run causality tests, exogeneity tests, error correction models and expectation models, to assess not only the controllability of the M2 aggregate but also its link with prices. These tools will allow us to appraise the prerequisites of the implementation of the MTS, to gauge the impact of the CBT announcements of the monetary targets on the expectations generating process of economic agents and therefore to draw robust policy implications about the monetary policy of the CBT.

The purpose of this paper is threefold. First, it seeks to provide a description of the central characteristics of the Tunisian monetary policy. Second, it examines the relevance of the preconditions of the implementation of the MTS in the light of the recent developments of time series econometrics. Third, it seeks to check if the CBT succeeded in orienting the expectations of the public. The plan of the paper is as follows. Section 2 starts with a description of the Tunisian financial structure. In section 3, a special emphasis is given to the

contribution of the preconditions in the success of a monetary targeting strategy. Section 4 opens with the description of the non-stationary features of the individual time series. Then the econometric methodology is presented. All the focus of section 5 is on the checking the relevance of the preconditions of the success of a MTS. The assessment of the impact of the *CBT* announcements on the expectations generating process of economic agents is mainly emphasized. Finally, section 6 summarizes the main findings, draws some policy implications and reports the concluding remarks.

## **2. Financial Structure and Monetary Policy**

Following a balance of payments crisis in 1985-86, Tunisia started a stabilization program, as well as a structural adjustment program of economic and financial liberalization. The objective was to move from controlled economy and an administratively managed financial system towards an open and market oriented system with a reduced direct involvement of the state. Measures taken to reform the financial and banking systems since 1987 included eliminating progressively credit allocation controls by abolishing credit ceilings and preferential interest rates. Interest rates were progressively freed, but the *CBT* maintained a strong involvement in their determination. Reforms of the financial system included the development of non-bank financial institutions and the capital market. Like many other developing countries, Tunisia has a dual financial system: a legal financial system and an illegal financial one. What we are more interested in here is the legal financial system, which covers the financial markets and financial institutions. Prior to 1987, Tunisia's financial markets were rather incomplete and simple. Since that time, after the beginning of the reform era, Tunisia has been gradually trying to establish complete financial markets in order to meet the demands of the liberalization and of the sustained growth.

The Tunisian financial system consists of the central bank (*CBT*) and many other financial institutions which are by 2001: 13 deposit money banks, 8 development banks of which 2 are state-owned and 6 are joint ventures between Tunisian and other Arab states, 7 off-shore banks, 8 private leasing companies and 1 saving institution. Commercial banks are allowed to collect deposits of any maturity, provide short- and medium-term credit, and may engage in long-term credit operations for up to 3% of their deposit basis. Other financial institutions include: 2 merchant banks and 2 factoring companies, 20 mutual funds, 19 capital risk companies, 16 insurance companies; the stock exchange, brokerage houses, and the central depository for securities (Alaya, 2001).

Despite the gradual development of the other financial institutions such as the stock market, mutual funds and leasing companies, the intermediation of saving and the financing of economic activity in Tunisia remain dominated by the banking system. Following a gradually evolving financial liberalization, interest rates on several loans were deregulated since 1987. They were liberalized in 1987, 1994 and 1996. Nevertheless, some deposit rates remained regulated. Indeed, interest rates on sight deposits (up to 3 months) must not exceed a ceiling of 2%, and those on special savings deposits, which accounted for about 40% of total deposits of the public in the banking system at the end of 1998, are set at 2% below the money market rate. Saving accounts dedicated to housing financing have a fixed credit rate of 5.25%.

It must be kept in mind that the main financial instruments available to individuals since 1990 are bank deposits, shares and promissory notes by the finance and securities companies<sup>3</sup>. On the borrowing side, the primary sources of finance are loans from various financial institutions, shares issues, and for larger companies, foreign borrowing. Though other financial instruments, such as commercial paper or certificates of deposit play only minor, they continue evolving over years. The debt instrument markets, such as the short-term money market and long-term non-equity bond market are not well developed. The treasury bills, which were introduced mainly to finance the budget deficit, were issued until March 1989, in two different forms. The transferable treasury bills, which were introduced in 1989 with maturities ranging from 13 weeks to 7 years, and have been sold to the public through the banks, are highly liquid instruments. Banks are indeed required to buy them back from their clients at face values (with only a small discount for operation costs). The second types of bills are the negotiable treasury bills; they were introduced in 1993 with the view to supply a long-term financial instrument and fostering the development of a secondary market. They are auctioned to stock exchange intermediaries and listed on the stock exchange.

### **3. Monetary Targeting Strategy**

As seen from the previous section, the adopted reforms led the CBT to alter its conduct of the monetary policy; it carried on a monetary strategy focused on controlling inflation. This strategy is identified, by the IMF and Arab Monetary Fund (AMF), as a monetary targeting strategy (Karam,2001). This strategy belongs to a set of four broad monetary policy strategies that can produce a nominal anchor that credibility constraint the discretion of the central bank over the medium term<sup>4</sup>. In what follows, we will present the foundation and the preconditions of the monetary targeting strategy.

#### **3.1. Foundation**

The MTS comprises roughly three elements: the first element consists rests on information conveyed by a monetary aggregate to conduct the monetary policy. In the monetary policy process, some measure of money is often served as an intermediary target, standing between the central bank's ultimate policy goals of sustainable economic growth with price stability and the operating targets used for day-to-day (or week-to-week) policy to attain the ultimate goals, the central bank may aim at money as an intermediate target as if achieving its target is achieve the final policy objectives. The second element is the announcement procedure. In fact, a prominent role is assigned to money stock, in relation to which a quantitative reference value for the rate growth of that aggregate has to be announced publicly at the end of each year  $t$  for the year  $t+1$ . This announcement procedure is the chief characteristic of the MTS. The principal motivation behind setting annual targets and achieving them is to guide the

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<sup>3</sup> The banking law of 1994 allowed credit institutions to expand into previously forbidden financial activities (leasing, credit institutions and foreign exchange loans), and established the Stock Exchange Commission to supervise the Tunisian Stock Exchange. Money market interventions by the CBT were facilitated via the buying and selling of government bonds between the CBT and credit institutions. This measure reflects the need to switch to indirect instruments of monetary policy in the new deregulated environment. The new banking of July 2001 instituted further important reforms of the financial sector; more specifically, it covers two main aspects: the first focuses on the liberalization of the banking sector, which will put an end to present system of specialization of the banking entities while the second, will serve to consolidate the protection of the depositors. The new banking law aimed at further strengthening competition between development banks and commercial banks, effectively creating a unified legal basis of universal banking.

<sup>4</sup> For details on the others monetary strategies, one can see for instance Mishkin and Savastano (2001).

expectations of the economy to lower inflation rates. The last element that MTS comprises is an accountability mechanism that precludes large and systematic deviations from the monetary targets.

Economists concur (Issing, 1996; Mishkin, 1999a, 1999b; Mishkin and Savastano, 2001) in the belief that a MTS has at least the following advantages. It enables the bank to adjust its monetary policy to deal with domestic considerations; it allows, indeed, some scope for monetary policy in order to deal with transitory output fluctuations and even certain external shocks. It enables also the bank to choose goals for inflation that may not be necessary similar to those of other countries. Moreover, such strategy is easy to monitor since information on whether the central bank is complying its targets is readily known and available almost immediately. Therefore, when compared to the targets announced by the central bank, the actual figures for monetary aggregates that are typically reported within few weeks generate informative signals. These signals enlighten the public and markets about not only the stance of the monetary policy but also about the intentions of the authorities to keep inflation in check; they can consequently help fix inflation expectations and produce less inflation (Friedman and Kuttner, 1996). Monetary targets have also the advantage of being able to promote almost immediate accountability for monetary policy makers to keep inflation low and so help constrain the monetary policy maker from falling into the time-inconsistency trap.

### **3.2. The Prerequisites**

A MTS is said to be successful if it shows that it is able to exhibit all the above advantages; and for that to be, a set of necessary conditions ought to be fulfilled: first, the operating variable has to be controllable; this condition requires in turn a flexible exchange rate system which is currently operated by Tunisia, albeit with interventions to maintain the exchange rate around some target level; second, the monetary multiplier should be stable (predictable); third, the intermediary target must be controllable; and fourth, there should be a strong link between M2 and the ultimate policymaker's objectives. All these conditions are necessary, and obviously the effectiveness of the monetary policy will strongly depend on them. The stability of the demand for money function is another necessary condition that ought to be checked; in addition, the MTS presupposes that monetary policy is not dictated by fiscal considerations (lack of fiscal dominance). To conserve space, the present paper does not focus on all these conditions; only the most important of them will be emphasized.

It is also possible that a central bank succeeds in guiding the economy expectations although some of the necessary conditions are not fulfilled. That is why one should assess empirically the influence of the announcements on the expectations of the economy. This condition is the sufficient. In what follows, only the two most important necessary conditions along with the sufficient one will be stressed on and appraised empirically. In particular, we will explain with some details how and to what extent these conditions are useful for the conduct of the monetary policy.

#### **3.2.1. The Controllability of the Intermediate Target**

The monetary aggregate target must be well controlled by the central bank; otherwise, the monetary aggregate may not provide clear signals about the intentions of the policy makers and thereby make it harder to hold them accountable. The controllability necessitates, in turn, the followings: First, in order to regulate the liquidity in the economy, the monetary authority

must choose a monetary aggregate which incorporates the instruments the monetary authority uses to implement its policy. Second, the relationship between the monetary aggregate and the money supply (the money multiplier) must be stable and predictable. Provided that the monetary base is under the control of the monetary authority, the determination of the reasons behind the changes in the money multiplier becomes important in the implementation of the monetary policy; otherwise, it will not be possible for the central bank to achieve its primary objective of providing the price stability by controlling the money multiplier as much as possible (Mishkin, 1999a and 1999b).

Evidence from the past periods suggests that there is a high degree of association between the monetary base and the money supply. The monetary authority could in principal control a larger portion of the changes in the money supply by controlling the size of changes in the money base. Nevertheless, there are some other factors, such as changes in the composition of deposits between demand and time deposits and commercial bank's behavior in holding excess reserves, which are all said to be outside the control of the monetary authority. All these factors are included in the money multiplier<sup>5</sup>. Therefore, the predictability of the money multiplier and the degree of control of the monetary authority over the money base gain importance in determining the money supply.

### 3.2.2. The Linkage with the Ultimate Goal

The monetarist theory assigns a prominent causal role for money growth supply in the inflationary process; talking of this, Friedman said that inflation is always and everywhere a monetary phenomenon. According to monetarists, there must be a strong and reliable relationship between the goal variable and the target aggregate in the long run (Friedman, 1984). The causality tests between money supply and prices provide, in principal, evidence on the validity of the monetarist hypothesis. Specifically, empirical support for the monetarist position will be indicated only if changes in the money supply Granger-cause prices changes in the long run; the monetarists recognize it's preferable that no reverse link exists. Nevertheless, such link could emerge especially when it comes to an economic environment with low inflation rates and an increasing financial integration<sup>6</sup>; in such case, not only a reverse link could exist, but also, the relationship between the two variables may become weak and instable. If there is velocity instability, so that the relationship between the monetary aggregate and the goal variable is weak, then monetary aggregate targeting will strongly lack precision and hence often will not work (Mishkin and Savastano, 2001). On the other hand, if *only* a strict reverse relationship is found (that is when prices Granger-causes money supply), then the monetarist hypothesis will be contradicted in favor of some alternative hypothesis (Darrat, 2000).

If money lacks predictive content, then it has no useful role as either an information variable, an intermediate target (see for instance Friedman and Kuttner, 1992)<sup>7</sup>. A weak relationship signifies that hitting the target will not produce the desired outcome on the goal variable; consequently, the monetary aggregate will no longer provide an adequate signal about the stance of monetary policy. Therefore, the monetary targeting will not help fix inflation

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<sup>5</sup> The relationship among the money supply, the money multiplier can be written as follows:  $M2=k.B$

<sup>6</sup> This was the main problem with the MTS in industrialized countries (see for instance Friedman, 1995 and Friedman and Kuttner, 1993)

<sup>7</sup> An information variable is one that provides information about future economic activity and, in particular, about variables in the CBT's objective function, while an intermediate target is a variable target, which is a variable that the central bank, explicitly, tries to hit by altering its monetary instrument.

expectations and be a good guide for assessing the accountability of the central bank. Better still, a weak relationship between the target monetary aggregate and inflation will make it difficult for the CBT to be transparent and accountable to the public. Nevertheless, this does not necessarily imply that monetary policy will be expansionary or irresponsible; rather, it will complicate greatly the central bank's communication with the public and the markets and, consequently, impair its credibility (Cukierman and Meltzer, 1996; Cukierman, 1996).

A Looser relationship may, nevertheless, suffice for money to be used as an information variable rather than as a causal variable in achieving the ultimate policy objectives<sup>8</sup>. It should be noted also that the presence of predictive content does not necessarily imply that M2 would make a good intermediate target. For that to be the case, M2 must be, in addition as explained in the previous section, controllable and must have a significant effect on economic variables that the CBT ultimately wish to influence. That is why, we believe that short run dynamics have to be analyzed too; a close relationship is of little use to policymakers trying to control inflation over the next quarter or year.

### **3.3 Announcements and Public's Expectations**

One of the most important necessary conditions for the success of a MTS is the announcement of the targets on the intermediary aggregate. The basic idea behind these announcements is to guide the public's expectations. The announcement procedure allows in principal the central bank to anchor the expectations and produce less inflation. The information signals, which are produced when the targets announced are compared to the actual monetary aggregate, enlighten economic agents about the intentions of the CBT. Therefore, the assessment of the announcements effect on the public's expectations formation is constructive. For a central bank like the CBT carrying out a MTS, it is indeed useful to know and to assess whether its announcements are credible (Cukierman and Meltzer, 1986). As a consequence, the assessment process should rest on the models of expectations (Tobias, 1999).

## **4. The Conduct of the Monetary Policy in Tunisia**

The primary objectives of Tunisian monetary policy in legislation include preserving (internal and external) the value of the currency and to support the economic policies of the government<sup>9</sup>. The monetary policy strategy of the CBT assigned a prominent role to money growth. In particular, the deviations of current M2 growth from a reference value is interpreted as an indicator of the risk to price stability. Currently, the CBT develops a notion of the appropriate growth of the money supply and the amount of refinancing according the following three steps procedure. First, the growth of M2 is set at 2% below the projected growth of nominal GDP. Second, under the assumption of a roughly constant multiplier, the amount of base money supply consistent with the target growth of M2 is calculated. Third, taking into account projected net international reserves and the credit requirement of the agricultural sector, the CBT determines the quantity of liquidity to be distributed through the

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<sup>8</sup> An information variable is one that provides information about future economic activity and in particular about variables in the objective function of the CBT; the information on money is required to adjust monetary policy operations during some time interval in response to the actual money growth that departs from the intermediate target, but not necessarily to restore the target itself.

<sup>9</sup> <<http://www.bct.gov.tn>>

refinancing facilities<sup>10</sup>. On a weekly basis, these amounts are fine-tuned taking into account the perceived financing needs of the commercial banks.

At the operational level, the monetary program prepared by the CBT at the beginning of each year  $t$  defines the monetary policy for the year  $t+1$ . Till recently, its formulation focused on the determination of the appropriate growth of M2 on the basis of projections for real output growth, inflation, interest rates, and the desired external balances. From the projected path of M2, an estimate of the required increases in net domestic credit was calculated given a separate assessment of the credit needs of the private sector, the Bank could derive the credit expansion to the public sector was consistent with these projections (Treichel, 1997). But one should wonder if the technical conditions are met or not yet?

## 5. Data Description and Econometric Methodology

### 5.1. Data Description

The quarterly data used in this paper cover the period 1987:Q1 to 2000:Q1. The monetary aggregate variable employed is broad money M2 that is the sum of narrow money and quasi-money<sup>11</sup>. The price variable is the Consumer price index (CPI). Several sources of these data are available: the National institute of Statistic (INS), central bank of Tunisia, International Financial Statistics (IMF, various issues), International Financial Statistics (IMF, CD-ROM, 2001). Our data have been collected from the quarterly Financial Statistics Bulletin (various issues) for M2, and from the National Institute of Statistics for the CPI. These variables are seasonally adjusted. The annual targets are announced in the central bank web site and in the *Budget Economique* (various issues).

### 5.2. Unit roots tests

We start by establishing the time-series properties of the individual variables. The aim here is simply to show that the variables are integrated of the same order. An integrated variable is a variable that is not stationary that is, which exhibits no tendency return to its original value following a disturbance. The existence of non-stationarity in a time series does not inevitably imply that the time series has a unit root. A non-stationary series having a unit root is called Difference Stationary series. If the non-stationary series does not have a unit root it is instead called a trend Stationary series (Nelson and Plosser, 1982). Our focus here is on the DS series. The tests for unit roots are performed sequentially using Perron-Phillips and Dickey-Fuller tests.

The results point out that the null hypothesis of integrated series of order one is not rejected by the data as shown by the statistics ( $t_{\mu}$  and  $t_{\tau}$ ). When the series in their first differences are considered, both tests reject the null hypothesis as shown in the third and the sixth column of table 1 Given these results, one can conclude that all the variables are integrated of order one, I(1).

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<sup>10</sup> Tunisia maintains relatively strict controls on capital account transactions.

<sup>11</sup> M2 = M1+Quasi-money, where M1=Fiduciary money + Credit balance of checking accounts + Current accounts opened next to the CCP and next to registered intermediaries and Quasi-money = Forward deposits + Certificates of deposit + Foreign accounts in foreign currencies opened by residents and non-residents + Sight investments which could not be used directly as a settlement.

Table 1: *Unit Roots tests*

Variable	Dickey-Fuller			Phillips-Perron		
	H <sub>0</sub> :I(1)		H <sub>0</sub> :I(2)	H <sub>0</sub> :I(1)		H <sub>0</sub> :I(2)
	t <sub>μ</sub>	t <sub>τ</sub>	t <sub>μ</sub>	T <sub>μ</sub>	t <sub>τ</sub>	t <sub>μ</sub>
b	-0.362	-3.47	-9.364°	-1.053	-2.7	-3.708*
m <sub>2</sub>	-0.512	-1.777	-9.198°	-0.958	-2.454	-3.907*
p	-5.884	-0.668	-5.287°	-2.474	-0.703	-2.967*

## 5.2. The VAR Methodology

In order to characterize the long run equilibrium relations between the variables mentioned, we start with the following basic closed VAR model with Gaussian errors

$$\Delta X_t = \sum_{i=1}^k A_i \Delta X_{t-i} + \Phi_t + U_t \quad (1)$$

where  $X$  is the vector of the  $p$  variables of the system, assuming  $X$  to be  $I(d)$  with  $d \leq 1$ , such that  $(p \times p)$  coefficient matrices,  $\Phi_t$  a vector of deterministic terms and exogenous variables and  $U_t$  residuals following a normal distribution  $N(0, \Sigma)$ . A reparametrisation of this VAR( $k$ ) results in an error-correction form :

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Phi_t + U_t \quad (2)$$

Here  $\Pi$  is an  $(p \times p)$  coefficients matrix, which contains information about long run relationships between the variables in the data vector.  $\Pi$  can be factorized according to the number  $r$  ( $0 \leq r \leq p$ ) of linear independent cointegration vectors :  $\Pi = \alpha \beta'$  where  $\alpha$  is the  $(p \times r)$ -matrix of adjustment coefficient and  $\beta$  the  $(r \times p)$ -matrix of cointegration vectors (Johansen (1988)).

The multivariate tests to be performed on the data depend on how potentially significant deterministic trends are modeled. The technical framework for this analysis is the  $p$ -dimensional vector error correction model that allow for quadratic deterministic trends in the (data generating process) DGP and linear trends in cointegrating vectors. This general VECM can be expressed as :

$$\Delta X_t = \alpha \begin{pmatrix} \beta \\ \mu_1 \\ \delta_1 \end{pmatrix} X_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \alpha_{\perp} \mu_2 + \alpha_{\perp} \delta_2 \cdot \text{time} + U_t \quad (3)$$

The parameters  $\alpha \mu_1$  and  $\alpha \delta_1$  measure the effect of the deterministic components on the long run properties of the model, while  $\alpha_{\perp} \mu_2$  and  $\alpha_{\perp} \delta_2$  measure the effect on the common-trends, or growth-rate, components. Five alternative specifications of the deterministic components of the model are embedded in Eq.(3), depending on the values of  $\mu_i$  and  $\delta_i$ . These specifications give rise to the following models :

*Model 1:*  $\delta_i$  and  $\mu_i$  (where  $i=1,2$ ) are unrestricted so that there may be linear trends in the growth rate (that is  $\delta_2 \neq 0$ ) which implies that there are quadratic trends in the levels of the vector  $X$ ; this is the most general specification.

*Model 2:*  $\delta_2=0$  which excludes quadratic trends from the DGP but allows for the possibility of a deterministic drift in the cointegrating vector(s) and in the data as well.

*Model 3:*  $\delta_1=\delta_2=0$  which implies no linear trend in the cointegrating relationships but allows for linear trends in the level of the data itself (through  $\mu_2 \neq 0$  operating on  $\Delta X$ ), and non-zero intercepts in the cointegrating vector;

*Model 4:*  $\delta_1=\delta_2=0$  and  $\mu_2=0$ , which implies that the only deterministic components in the data are the intercepts in the cointegrating relationship.

*Model 5:*  $\delta_1=\delta_2=\mu_1=\mu_2=0$ , which assumes no deterministic components in the model, that is all stationary components have mean zero.

Obviously, one could not test all these specifications. It would be more judicious to discard the ones deemed to be the most unlikely. With regard to data at hand, Model 1 should be discarded since none of the series depict a quadratic trend. Similarly, Model 5 has to be ignored because it is with little interest in practice. It remains to be seen which among the remaining specifications is the most appropriate facing the data at hand.

When implementing the Johansen method cointegration technique a number of crucial empirical decisions have to be made. The first decision concerns the lag-length in the VAR, for which we used the Schwartz Bayesian Information Criterion as an a priori sign and a check on normality and autoregressive properties of the estimated residuals ex post. Secondly, in order to determine the appropriate specification of the deterministic components in the VAR model, one can proceed as in Johansen (1992) by recouring to the so-called Pantula principle. We remind that the Pantula principle suggests to test the rank of the long run model by estimating the three model versions sequentially from the most restricted to the less restricted. The model is not valid until the null hypothesis  $\text{Rank}(\Pi)=r$  ceases to be rejected using the Trace test. Better still, it is also possible to test for the rank condition along with determining the right deterministic components in the cointegration space and/or short-run model.

### 5.3. Causality Analysis

Since the greatest part of the empirical work focuses on the causality analysis, we will expose the methodology adopted by the paper in the context of the VAR model. By definition, a variable  $x$  Granger-causes another one, say  $y$ , if the knowledge of the past of  $x$  helps to get better forecasts of  $y$ . Tests can be performed in a reduced form model, such as the VAR representation. Since we are dealing with (potentially) cointegrated  $I(1)$  variables, it seems sensitive to use the VAR model in its ECM representation (Engle and Granger, 1987). In such representation, at least one of the variables is caused by the long run residuals, therefore by the levels of the others variables; this is the well known property of causality within a system of cointegrated variables (Granger, 1988). When testing causality between variables that are cointegrated without taking into account the long run relationship between them, it is then possible to find no causal relationship (Granger, 1988 ; Hunter, 1990 and 1992). Nevertheless,

considering the error correction terms ( $\hat{z}_{t-1}$ ) into the equation reintroduces the information lost in the differencing process, thereby allowing for long run as well short-run dynamics. Moreover, by including  $\hat{z}_{t-1}$  in the equations, a second channel is introduced through which Granger causality could be detected<sup>12</sup>. In order to show how causality tests should be implemented, we consider a bivariate VECM model:

$$\Delta x_t = a_1 + \lambda_1 \hat{z}_{t-1} + \sum_{i=1}^s \psi_{1i} \Delta x_{t-i} + \sum_{i=1}^s \phi_{1i} \Delta y_{t-i} + u_{1t} \quad (4)$$

$$\Delta y_t = a_2 + \lambda_2 \hat{z}_{t-1} + \sum_{i=1}^s \phi_{2i} \Delta x_{t-i} + \sum_{i=1}^s \psi_{2i} \Delta y_{t-i} + u_{2t} \quad (5)$$

When there is no long run relationship between the variables of interest or when such relationship exists but not accounted for, that is when the error correction terms ( $\hat{z}_{t-1}$ ) are omitted, the causality test reduces to the following null hypothesis<sup>13</sup>:

$$H_{Eq2,0}^{\Delta} : \phi_{2i} = 0, \quad i \in \{1, 2, \dots, s\} \quad (6)$$

Eq.(6) represents the usual way to test if x Granger-Causes y. Economists refer to this kind of causality by short-run causality or  $\Delta$ -causality (Hunter,1992 ; Toda and Phillips,1993,1994). In contrast, when the long run information is reintroduced (via the error correction term  $\hat{z}_{t-1}$ ), one opens up an additional channel of Granger-causality so far ignored by standard tests. This type of causality is known as long run cointegrating causality (LR-causality); the corresponding null hypothesis is:

$$H_{Eq2,0}^{LR} : \lambda_2 = 0 \quad (7)$$

The concept of long run or cointegration causality is somewhat related to weak exogeneity (Urbain,1992; Johansen,1992). Empirically, when it is found that  $\hat{\lambda}_2$  is not statistically different from zero (when the null  $H_{Eq2,0}^{LR}$  is not rejected), y is said to be weakly exogenous for long run parameters. In such case x will not thought to cause y in the long run. In the converse case, one can conclude that x Granger-causes y in the long run. When the two feedback coefficients,  $\lambda_1$  and  $\lambda_2$ , are negative and statistically different from zero, one can say that there is a long run bi-directional relationship between the two variables. In sum, one should consider the following null hypothesis when it comes to test if x Granger-causes y:

$$H_0 : H_{Eq2,0}^{LR} \cap H_{Eq2,0}^{\Delta} \quad (8)$$

It is pointed out that under some regularity conditions (Toda and Phillips, 1993, Theorem 2) the distribution of the Wald statistics associated to the null hypothesis represented by Eq.(8) is  $\chi^2(n_1 n_2 k)$ ;  $n_1$  stands for the rank of adjustment coefficients matrix,  $n_2$  for the rank of cointegration vector and k for the VAR model order.

<sup>12</sup> Granger (1988) notes that cointegration between two or more variables is already sufficient to indicate the presence of causality at least in one direction.

<sup>13</sup> The exponent  $\Delta$  means that the null hypothesis concerns the short-run causality, whereas the exponent LR (see Eq.7) signifies that the null is the long run (or cointegration) causality; for reasons of simplicity and to conserve space, throughout this section, we suppose that the interest of the modeler is emphasized on testing if x Granger-cause y (and not the converse).

## 6. Empirical Assessment

### 6.1. Controllability of M2.

A convenient way to gauge controllability of a monetary aggregate is to examine the statistical association between the aggregate in question and the monetary base, the latter is being a major policy instrument, which is commonly considered under the effective control of policymakers. Therefore, one may regress the M2 aggregate against the monetary base (B). When the aggregate exhibits a high correlation then it could be judged policy controllable since its movements are more closely associated with similar changes in the policy instrument. When the non-stationary nature of the monetary aggregates is taken into account, it will be of course more suitable to address this question by having recourse to the cointegration theory. Therefore, policy controllability should be based on cointegration and error-correction modeling. If a reliable long run relationship exists, that is if the two variables are cointegrated, the intermediary aggregate will be deemed controllable in the long run. And an error-correction model should be elaborated. Short-run dynamics may be more relevant from the policy perspective, and studying such dynamics requires the estimation an error correction model.

In order to assess of the link between the monetary base and the money supply, the hypothesis of cointegration between them is addressed based on the Johansen procedure described above. Tests of the number of cointegration relationships consist of the maximal eigenvalue ( $\hat{\lambda}_{\max}$ ) and trace statistics, where  $\hat{\lambda}_{\max}$  tests for at most  $r$  cointegrating vectors against an alternative of exactly  $r+1$  cointegration relationships; while Trace tests for at most  $r$  cointegrating vectors against an alternative of at least  $r+1$  vectors. The test statistics are  $-T \ln(1 - \hat{\lambda}_{\max})$  and  $-T \sum_{i=r+1}^n (1 - \hat{\lambda}_i)$ , respectively. Johansen and Juselius(1990) suggested that the maximal eigenvalue test has greater power than Trace test, so we use both tests to check for consistency. Before reporting the results, it should be noted that some preliminary estimations<sup>14</sup> allowed us to choose the right specification of the deterministic component. With this preferred specification which corresponds to *MODEL 4* (see section 4.2), the optimal lag order is  $k=2$ ; this lag structure allows the model to bend a lot of hypothesis and specifically the normality hypothesis. This latter hypothesis justifies the use of the asymptotic critical values<sup>15</sup>.

The results (see table 2, Panel A) show that the data reject the null hypothesis of zero cointegration vector between the two variables whatever the specification of the alternative: the two tests reject the null hypothesis. But, when the null is that there is at most one long run relationship between the variables, our results show that both trace and the maximum eigenvalue test statistics are less than the 5% critical values given in Johansen and Juselius (1990,Table 2A) suggesting the presence of a cointegrating vector between M2 and B.

The above results are confined to the long run horizon; yet, short-run dynamics may be more relevant from the policy perspective, and studying such dynamics requires the estimation of

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<sup>14</sup> These estimations are not reported.

<sup>15</sup> Whatever the critical values (asymptotic or corrected for finite-sample biases), the results of the cointegration test are unchanged.

Table 2: *Johansen Tests for cointegration*

H0	H1	Trace	H0	H1	$\lambda_{\max}$
PANEL A : Tests for B and M2					
r=0	r ≥ 1	39.75*°	r=0	r=1	32.72*°
r ≤ 1	r ≥ 2	7.03	r ≤ 1	r=2	7.03
PANEL B : Tests for P and M2					
r=0	r ≥ 1	54.92*°	r=0	r=1	52.303*°
r ≤ 1	r ≥ 2	2.617	r ≤ 1	r=2	2.617

Note : \* signifies that the null is rejected at a risk of 1% and ° means that it is rejected at a risk 5%.

regression equations linking monetary base to the M2 intermediary aggregate. Since the latter exhibits a significant cointegrating relationship with M2, the proper regression is to estimate the error correction model VECM<sup>16</sup>:

$$\Delta \hat{m}_t = -0.035 \hat{z}_{t-1} + 0.371 \Delta m_{t-1} + 0.065 \Delta b_{t-1} \quad (9)$$

(4.498)                      (2.622)                      (-1.681)

adj R<sup>2</sup>=0.695    BJ(2) = 3.175    Q(4) = 1.781

$$\Delta \hat{b}_t = -0.348 \hat{z}_{t-1} + 1.036 \Delta m_{t-1} - 0.216 \Delta b_{t-1} \quad (10)$$

(0.009)                      (2.150)                      (-1.640)

adj R<sup>2</sup>=0.378    Nor = 1.727    Q(4) = 1.457

Seeing that there is a potent long run relationship binding the money and prices and in order to get an idea about the direction of long run causality, we decided to test for the weak exogeneity of these variables. The exogeneity concept plays a fundamental role in this context; indeed, the failure to reject the *weak exogeneity* of the variable B (the monetary base is weakly exogenous) implies that the null hypothesis H<sub>02</sub>: “M2 doesn’t Granger-cause B in the long run”, cannot be rejected. Conversely, if the *weak exogeneity* of B is rejected by the data, then it can be thought that the same null hypothesis should be rejected. The results reported (see table 3) indicate that B is weakly exogenous with respect to the long run parameter; indeed, the null H<sub>WE(b)</sub>:  $\lambda_2=0$  (p-value=77%) cannot be rejected; therefore, one can conclude that the hypothesis H<sub>02</sub> is a likely hypothesis. On the other hand, the data rejected the *weak exogeneity* of M2; the null H<sub>WE(m)</sub>:  $\lambda_1=0$  (p-value=0%) is rejected, pointing out by the way that the hypothesis H<sub>01</sub>: “B doesn’t Granger-cause M2 in the long run” is unlikely and consequently should be rejected.

This latter finding is not surprising, conversely it was expected: seeing that on the one hand, it was found that M2 doesn’t Granger cause B, and that on the other hand, M2 and B are cointegrated, then one can easily expect that, B Granger-causes M2. Granger(1988) proved

<sup>16</sup> BJ(2) is the Jarque-Bera test (see Jarque-Bera,1980) for normality which is asymptotically distributed as  $\chi^2(2)$ . Q(4) is the Ljung-Box statistic of lag order 4; it is distributed as  $\chi^2(4)$ . When choosing the lag length, we based our decision on the Akaike final prediction (FPE) criterion and selected k=1; this value of the lag length left the residuals approximately normally independently and identically distributed (niid) for the two equations; the BJ test fails indeed to reject the null hypothesis that the error terms (for the two equations) are normally distributed. Likewise, the Q(4) statistics accept the null of no autocorrelation at the conventional risk level of 5%.

that when two variables are cointegrated, there should be a causality relationship between them at least in one direction. The most importing question for us now is the following: to what extent do the dynamics of M2 depend on those of B? In other words, to what extent is M2 controllable via B and how can we measure the statistical adequacy between these two variables?

According to the above estimations results, Eq.(9) could be used in order to forecast the dynamics of M2 conditional on those of B. Nevertheless, one cannot pretend that M2 is controllable. A (state) variable may be deemed more controllable than another variable if two conditions are gathered. First, the state variable has to exhibit the highest correlation with the control variable<sup>17</sup>; second, the CBT should not lack tools to control the behavior of the state variable with the supposed control variable (for instance in the case at hand, B is the control variable and M2 is the state variable). In other words, the movements of the state variable have to be more closely associated with similar changes in the policy instrument (the variable B). On the empirical front, Eq.(9) implies that growth in the base money explains about 70% of the total variations in the M2 growth. Besides, the degree of responsiveness of the M2 aggregate to the changes in the monetary base (elasticity) is moderate: every 10% increase in the growth rate of the monetary base leads to a almost 0.65% increase in the growth of the money stock.

Table 3: *Long-run Exogeneity Test.*

Null hypothesis	LR ( $\lambda_i=0$ )	P-value	Decision	Conclusion
$H_{WE(m)} : \lambda_1=0$	10.88	0%	Reject H0	M2 is not WE
$H_{WE(b)} : \lambda_2=0$	0.08	77%	Do not reject H0	B is WE

*Note* : WE signifies weakly exogenous. The null hypothesis is rejected at a risk of  $\rho\%$  if the reported *p-value* is lower than  $\rho$ .

On the whole, the direction of the long run causality and the high value of the adjusted  $R^2$  highlight the explanatory power of the money base with regards to M2 aggregate. More precisely, evidence from cointegration between M2 and B implies that there is a strong long run relationship binding the two variables, a finding that supports the controllability of the monetary base in the long run. There is much to be ignored, so it would seem, from being able to explain movements in the level of, and the changes to M2. These results suggest that the control of the base may provide sufficient information about the M2 aggregate to permit them to be utilized within their cointegrating and ECM/causality equation in the conduct of economic policy.

In the light of these findings, one can conclude that Eq.(9) could be used for inference about the supply of money. It could be also utilized to forecast the dynamics of M2 supply. It appears also that a base regime would be a feasible operating regime for the control of the money supply in Tunisia. As a consequence, Eq.(9) could be used, by the CBT, to derive a volume of the injection of the high-powered money consistent with the target monetary aggregate. Nevertheless, the CBT should be careful when using such equation since the

<sup>17</sup> The correlation is measured by the adjusted  $R^2$  statistics, which measures the fraction of the variation in M2 that can be accounted for by variations on money growth. For instance, an adjusted  $R^2$  of 1 means that monetary base (B) accounts for all of the variation in M2 while an adjusted  $R^2$  of 0 says that B accounts for none of the variation in M2.

magnitude of the coefficient of  $\Delta b_{t-1}$  is moderate and may weakens the effectiveness of that equation. Besides, one objection that has been raised against a reserve targeting regime, where interest rates are fully endogenous, is the risk of excessive volatility of interest rates (Treichel, 1993).

## 6.2. The Money-Inflation Relationship

Since the intermediate target should, among other things, be ultimately related to the final target in the long run. Thus, in order to check if the intermediary target is linked to the price variable, cointegration aspect should be emphasized. We start by analyzing the potentially long run equilibrium relationship between these two variables. According to table 2 (Panel B), the data suggest that there is a long run relationship between money and prices, which means that there is a causality relationship between these variables, at least in one direction (Granger, 1988). On the other hand, the results of the table 4 indicate that the null hypothesis that money supply does not Granger-cause prices could not be rejected at the conventional risk level of 5% (p-value=5.4%); more interestingly, in the short-run, the data fail to reject the same null hypothesis (p-value=12.8%). These findings confirm our initial presumption that the growth rate M2 has no impact on inflation, especially because of the low rates of inflation. More surprising, the reverse null hypotheses that prices do not Granger-cause money supply in the long run as well as in the short-run are rejected (all the p-values are less than 5%, see the second row of table 4) casting doubts on the empirical relevance of the main monetarist hypothesis, namely the inflation is monetary phenomenon. The money supply-prices relationship could not even be considered as a looser relationship; in addition, the M2 aggregate cannot be used as a causal variable in achieving the ultimate policy objective; the growth in money supply stock is far from being reliably linked, in the long run, to the policy maker's goal of price stability. On the whole, the above results suggest that money supply growth has no significant impact upon inflation; as a consequence, reductions in the excessive M2 growth could not be considered as appropriate anti-inflation policies in Tunisia.

These results do not tell us anything about the presence of any reliable linkage between money and prices in the short-run. To address this possibility, we resorted to the VECM model since the presence of the cointegration requires the estimation of such model: the results are<sup>18</sup>:

$$\Delta \hat{p}_t = -0.0002 \hat{z}_{t-1} + 0.269 \Delta p_{t-1} - 0.103 \Delta p_{t-2} + 0.034 \Delta m_{t-1} + 0.08 \Delta m_{t-2} \quad (11)$$

(-1.919)                      (1.755)                      (-0.727)                      (0.816)                      (2.345)

adj R<sup>2</sup>=0.345                      BJ(2) = 2.01                      Q(4) = 3.457

$$\Delta \hat{m}_t = -0.0004 \hat{z}_{t-1} - 1.388 \Delta p_{t-1} + 1.083 \Delta p_{t-2} - 0.043 \Delta m_{t-1} + 0.452 \Delta m_{t-2} \quad (12)$$

(-2.252)                      (-4.852)                      (2.186)                      (-0.273)                      (2.947)

adj R<sup>2</sup>=0.10                      BJ(2) = 3.175                      Q(4) = 4.191

If we admit that the statistical reliability is measured by the size and significance of the adjusted R<sup>2</sup>, then it can be hardly argued that growth in M2 provides a sensitive reliable link between money stock and the policy maker's goal of price stability in the short run. The inflation model (Eq.(11)) representing the monetary aggregate exhibits, indeed, a moderate

<sup>18</sup> The lag length k=2 is enough; it ensures that the errors are white noise and small enough to allow estimation. It should be noted also that since our objective is to test Granger-causality, the apparently non-significant terms were not dropped.

adjusted  $R^2$ . But, in all cases, before getting carried away with this apparently interesting finding, it should be noted that the coefficients on ECM terms (associated with Eq.(11) and Eq.(12)) are statistically significant and have theoretically correct (negative) signs. Nevertheless, they have very weak magnitudes; for instance, if we consider the feedback coefficient of the inflation model (Eq.(11)), one can conclude that only 0.02% of any disequilibrium, between actual inflation and the long run inflation in any quarter, is made up within the next quarter. This reflects the presumption that the linkage between money and prices is weak and that actual inflation does not adjust instantaneously to its long run determinant. Moreover, in the short-run, it appears from Eq.(11) that the growth rate of M2 has no impact on inflation (p-value=12.8%, see table 4, column 2).

Table 4: *P-values of Granger-causality and Long run Exogeneity Tests.*

Eq.(i)	$H_{Eqi,0}^{LR}$ or $H_{WE}$	$H_{Eqi,0}^A$	$H_{Eqi,0}^{LR} \cap H_{Eqi,0}^A$
Eq.(11)	$\{\lambda_1=0\}$ 5.4%	$\{\phi_{1i}=0\}$ 12.8%	$\{\lambda_1=0\} \cap \{\phi_{1i}=0\}$ 1%
Eq.(12)	$\{\lambda_2=0\}$ 2.4%	$\{\phi_{2i}=0\}$ 12.8%	$\{\lambda_2=0\} \cap \{\phi_{2i}=0\}$ 0%

Note : The null hypothesis is rejected at a risk of  $\rho\%$  if the reported p-value is lower than  $\rho$ .

Overall, the empirical results point out that the growth in M2 stock is far from being reliably linked to the policy maker's goal of price stability in the short run (as measured from the ECM) as well as in the long run (as seen from cointegration and Granger-causality tests). Thus, any restrictive monetary policy would be fruitless to bring in their effects on inflation. Better still, our findings do not provide any testimony in support of the policy usefulness of M2 aggregate in Tunisia. Therefore, controlling the growth of money supply doesn't seem necessary to stave off inflation at least in the long run horizon.

### 6.3. Announcements and the Expectations Assessment

The main conclusion that one can draw from the above empirical results is that money-prices linkage is very weak. An obvious and a logical consequence of such finding is the fact that the CBT's monetary targets will not anchor inflation expectations. In the light of this information and knowing that that the bank is still following up the same strategy, one would wonder, if the CBT could be transparent and credible. In principal, if the central bank is credible, economic agents would rely on the information published on the monetary targets when forming their expectations about the future dynamics of prices. The question that one should ask is the following: How can we know whether the agents account for the announcements of CBT? To answer this question, we elaborate two models; in the first one (called  $M_{CBT}$ ), we suppose that agents take into account the Bank's announcements and in the second one (that we called  $M_{PUBLIC}$ ), we assume that they do not. But before elaborating these models, we should have at one's disposal the following variables:  $m_t$ ,  $m_t^T$ ,  $\tilde{m}_t$  and  $\tilde{m}_t^T$ . The first variable is the log of the stock money; the second one is the log of money target stock. In principal, these variables are computed as quarterly average but when they bring the tilde symbol this signifies that they were generated from the last month of the quarter. Therefore, the most up-to-date information on target deviations is obviously the deviation from the last month of the current quarter namely  $(\tilde{m}_t - \tilde{m}_t^T)$ . Once all these series were computed, one will be able to formulate the model  $M_{CBT}$  based on monetary target information as:

$$\hat{m}_t = \alpha + m_t^T + \beta(\tilde{m}_{t-1} - \tilde{m}_{t-1}^T) \quad (13)$$

The estimating Eq.(13), gives the following results:

$$\hat{m}_t = 0.02 + m_t^T + 0.941 (\tilde{m}_{t-1} - \tilde{m}_{t-1}^T) \quad (14)$$

(0.661)            (13.709)

The implications that can be drawn from the above results are the following: first, the  $\alpha$ -parameter is not statistically significant which points out that monetary target variable is an unbiased predictor of the money supply when the one period lagged deviation is taken into account. Second, the  $\beta$ -estimate points out that, on average, 94 percent of a quarter's target deviation is carried over during the next quarter.

The next step consists of recouring to the Box Jenkins methodology in order to elaborate a forecasting model for the intermediary target M2. During the identification stage, we carried out a lot of time series forecasting models, but two of them seemed the most suitable: ARIMA(0,1,1) and ARIMA(0,1,0). These two specifications were estimated and only the results concerning the preferred model (that we call  $M_{PUBLIC}$ ) are reported:

$$\Delta \hat{m}_t = 0.023 + 0.303 \varepsilon_{t-1} \quad (15)$$

(3.17)    (1.91)

$$R^2=0.993 \quad DW = 1.85 \quad Q(4)=6.75$$

The diagnostic checking shows that the residuals are not different from white noise series. The Durbin-Watson and the Q-statistics for four lags point out that there is no significant autocorrelation in the residual from this equation. The constant indicates that, on average, the money stock grows about 2.3 percent per quarter during the estimation period. The significantly positive parameter of the lagged error term indicates that a deviation of money from mean growth rate typically gives rise to a deviation of the same sign and of roughly a third (about 30 percent) of the size in the following quarter.

Finally, we compared the expectation model ( $M_{CBT}$ ) to the preferred one chosen in the second step according to the RMSE and MAE statistics in an out-of-sample experiment. The comparison exercise will have in principal two issues: if ( $M_{CBT}$ ) is preferred to ( $M_{PUBLIC}$ ), then it will be said that the CBT succeeded in orienting the public's expectations; otherwise, one can conclude that the Bank failed.

Table 5: *Results of out-of-sample forecasting*

Model	RMSE	MAE
$M_{PUBLIC}$	0.041	0.037
$M_{CBT}$	0.049	0.046

It was found (see table 5) that according to the one-step-ahead predictions results  $M_{PUBLIC}$  performs a robust forecasting; its accuracy is greater than the  $M_{CBT}$ . The conclusion to be drawn from these findings is strong: the BCT failed to guide the public's expectations. The reasons that explain this failure are advanced in the next section.

## 7. Main findings, Policy Implications and Concluding Remarks

The paper's results showed that the preferred monetary aggregate has not the good characteristics. While it is seen that it is controllable in the long run, the data at hand indicated that M2 stock is not perfectly controllable in the short-run. The lack of controllability may indicate that the M2 aggregate does not provide clear signals about the intentions of the policy makers and thereby makes it harder to hold them accountable.

Another finding of this paper concerns the money-prices relationships. It is shown that the M2 aggregate is still far from being reliably linked to the policy maker's goal of price stability in the short-run (as measured from the ECM) as well as in the long run (as seen from cointegration and Granger-causality tests). The low inflation environment could explain this lack of reliability; indeed, if inflation falls to single digit levels, as is the case for Tunisia, money growth rates are indeed likely to lose informational content and become less useful indicators of monetary policy, as occurred in many industrial countries. Thus, restrictive monetary policy would be somewhat fruitless to bring in their effects on inflation.

It is found also that the official target announcements did not provide optimal guidance to the public regarding the future course of the money supply. More precisely, our results showed that the preferred model (according to the RMSE criterion) among many time series models does not rely on the target announcements. We do believe that the CBT failure to guide the public expectations is mainly due to the fact that the monetary target announcements do not happen usually at the right time. Actually, instead of happening at the end of year  $t$  for the year  $t+1$ , they are rather announced (published) at the end of the second quarter of the year  $t+1$  (for the same year).

The CBT did not announce its targets for M2 (money stock) at the right time because it was highly aware of the uncertainties surrounding not only the demand for this aggregate but also about the real sphere of the economy. It should be noted, indeed, that the main sources of uncertainties in Tunisia result from demand and supply shocks of goods and services. The country has known, since the beginning of the 1990's, many events that confirmed this claim: the Gulf war which has had as a consequence a serious decline of the exports growth and tourists receipts in 1991; the dryness of 1993,1994, 1999 and 2000 which gave rise to an important fall in cereal harvests. These uncertainties prevented the CBT from being transparent. The CBT, as usual, felt it had to drive itself back against revising the monetary growth targets in the course of the year in the light of the developments in economy situation. In these circumstances, the transparency will impair seriously the central bank credibility; on the other hand, the opaqueness (with regard to the targets announcements) will guarantee a minimum of credibility.

One should wonder how the CBT succeeded in mastering and reducing the inflation rates despite its lack of transparency, its failure to guide the economy expectations and the breakdown of the money-price relationship.

Actually, these apparent contradictory findings are not surprising. It is true that the main preconditions of the MTS were not met; but this did not prevent the CBT from reaching its goals of containing inflation and stabilizing the financial system. Being aware of the inadequacy of the MTS to the country's economic reality, the CBT has skillfully looked for mastering inflation by means of its discretionary tools and till now, it did not fail in this mission. The Tunisian monetary policy, although being discretionary, seemed effective in

reducing the inflation rates. This could be due to the following reasons: Prices are still administrated at end-2001 despite the ongoing liberalization process. For instance, the prices of the petroleum, water, electricity, telephone, public transportation and basic commodities, are still controlled. Moreover, intermediation margins on some food products (cereals, fruits, and vegetables) are still regulated. In all, about 20 percent of prices at the retail level (*making up a third of the CPI basket*) are still administered. The limited flexibility not only in prices but also in wages contributed to prevent any wage-prices and spiral from occurring as a result of demand shocks. Besides, the prudent macroeconomic policy mix, followed by the authorities, helped the CBT to reach good performances. Also, the careful use of the constant real exchange rate rule helped a lot, along with the absence of significant shocks during the period, the CBT in the achievement of the positive outcomes.

In sum, we cannot argue that the CBT pursued any regime belonging to the MTS: it did not announce its monetary targets for M2 at the beginning of the year because it is not aware of the uncertainties surrounding the real economic situation, nor is it accountable for meeting its targets. Instead, the CBT used the information contained in M2 aggregate as well as in other aggregates to guide the setting of its policy instruments. On the whole, our findings do not provide any testimony in support of the usefulness of M2 aggregate in Tunisian MTS. Furthermore, the CBT is far from being carrying out a MTS. The CBT that was regarded by IMF and AMF, as a monetary targeter, should instead be seen as having followed a discretionary monetary policy with a focus on price stability. Such an approach presents two main caveats: the first one is that it depends too much on the preferences, skills and credibility of the individuals running the CBT; the second one is that it does not lend itself to make monetary policy transparent and accountable.

The policy implications to be drawn from the findings of this paper seem to be important for the future. If the CBT is willing to carry out a monetary rule (a MTS or even an inflation targeting strategy), the framework for implementing monetary policy should be defined more precisely. For instance, to better control the monetary supply process, the CBT must be aware that policies that improve and strengthen the financial and monetary markets should be pursued. It should be also aware that the weakness of the banking system almost brought down its monetary strategy. Consequently, further efforts should be done in order to improve the present situation of the banking system. Globally, the Tunisian financial system is in need of further reforms and Tunisia is about to reach that objective especially when it comes to achieve the dual objective of price stability and financial development.

Also, a strong coordination between the treasury and CBT has to be made out; and on the other hand, a sound information system ought to be made up inside the CBT itself. Of particular importance is the need for an (macro-) econometric model that allows the CBT to forecast the key variables and to simulate a lot of scenarios; this will be of a great help to the monetary authority since it helps predicting the nominal GDP growth, and consequently, the required quantity of money supply to be announced without compromising the central bank credibility.

As to the choice of the proper intermediate target, we do believe that CBT should look for an alternative intermediary aggregate by studying the relevance of other aggregates such as M3, M4, or a modified measure of M2 or even a monetary index. Better still, in order to improve the accuracy of its MTS, the CBT ought to define monetary growth targets in a more convenient way. For instance, it could derive target ranges for the growth of the money supply from a money demand function. If the new aggregate is found to be hardly controllable, the

CBT could introduce some modifications when formulating the targets: instead of announcing a single value target, the central bank should announce a target corridor, say of 2 to 5 percent, which can be interpreted as a 95 percent confidence interval. By the same way, in so doing the CBT could gain greater discretion to respond to extraneous developments. Furthermore, these measures would undoubtedly enhance the credibility and accountability. Lastly, The CBT should clarify its mission and precise its objectives and when they conflict, the bank should state clearly how it would classify them.

We do believe, finally, that in the case of Tunisia the transparency measures must be taken with great cautions and gradually along with the development of the financial market as well as with the skillfulness of the bank itself. Transparency actions are, in fact, numerous. If we translate this concept into a continuous attempt to describe and clarify the main characteristics of the strategy and operating procedures and the motivation behind policy decisions, then it would be useful if and only if the above recommendations will be implemented. Otherwise, the opaqueness would be more useful.

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