

TAYLOR RULE IN THE CONTEXT OF INFLATION TARGETING: THE CASE OF TUNISIA

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ABSTRACT

The aim of this paper is to determine the optimal Taylor-type rule and the appropriate variables for the Tunisian economy in its conduct of the economic policy. Our starting point is the traditional Taylor rule. The results of the estimation of the reaction function in its static version confirm the hypothesis that Tunisia has been leading an efficient policy to control its inflation. Based on Akaike and Schwarz criteria, the results indicate that the static model better represents the reaction function of the Reserve Bank of Tunisia.

Keywords: Inflation targeting, Taylor rule in static versions, Taylor rule in dynamic versions, Tunisia.

JEL Classification: E52, E58, C32.

1. INTRODUCTION

The inflation targeting is a monetary policy whose main objective is controlling inflation. The origin of inflation is attributed to the excess of liquidity. If the currency in circulation increases, economic agents increase their demand for goods and services. If this increase is not accompanied by an increase in production, then prices are expected to rise. Thus, many studies have targeted the aim of price stabilization. Most of these studies have focused on the exchange rate. Indeed, between the end of the Second World War and the early '70s, the fixed exchange rate system established by Britton Woods (1944-1977) was the anchor of price stability in the world. After the collapse of the system between 1971 and 1973, some countries, including the developing nations, have continued to pursue a fixed rate. They are used to control inflation by pegging their currency to the currency of other countries with low inflation. However this policy presents some difficulties: It has, indeed, become more difficult to meet the conditions necessary to maintain a fixed exchange rate because of the growth of the instability of capital flows in recent years, as evidenced by the currency crises of the 90s. On the one hand, this strategy limits the ability of the central bank's reaction to shocks. On the other hand, other countries, mainly most industrialized ones have adopted a flexible exchange rate.

The Taylor rule can be used for the evaluation of monetary policy and the subsequent determination of future policies. It shows a higher rate when inflation is above its target level and

a decrease in a recession period. Thus, the transparency of the inflation targeting framework encourages efficiency and gives scope for monetary policy to act in a broad sense. Similarly, it should also be noted that the success of the strategy of inflation targeting depends significantly on the degree of independence of the central bank in the conduct of monetary policy. This does not mean complete autonomy (tools and targets), because the monetary authorities must be able to deal freely with instruments to achieve the objectives.

Thus, based on this information, we will try to determine the nature of the rule that reflects the behavior of the Central Bank of Tunisia when targeting inflation during the period from January 2006 to December 2012. In other words, the objective of this work is to determine whether the central bank of Tunisia has taken into account the fluctuations of the exchange rate while driving its policy of inflation targeting. To achieve our objective we consider Taylor's estimated reaction functions for several reasons. On the one hand, these functions include the monetary policy instrument of the central bank. On the other hand, in the context of macroeconomic models, reaction functions are important elements to evaluate the policies of central banks and the effects of economic shocks.

The strategy of inflation targeting requires the presence of a stable relation between inflation and monetary policy instruments. Monetary authorities should be able to specify the dynamics of inflation and generate forecasts relevant enough to be useful in the decision process. They must also have effective instruments to influence macroeconomic variables. However, the reference value of the inflation targeting is a very important indicator of the inflation targeting strategy. To determine the proper inflation targeting, monetary authorities should first determine price stability. [Debelle \(1997\)](#) suggests a low inflation rate greater than zero, as the inflation targeting ensures price stability. [Mishkin \(2001\)](#), also considers an inflation rate between 0 and 3% is preferable. Other economists add that the inflation targeting of 2% is quite logical as all countries that have published inflation targets have opted for slightly higher rates to reflect zero bias measurement contained in inflation as measured by the price index for consumption.

2. THE CHALLENGES OF MONETARY POLICY IN TUNISIA

Since 1987, the Tunisian monetary authorities have implemented a policy to ensure the requirements of economic growth and inflation control. Tunisia has created this policy under a 'financial sector reform'. This reform has changed both the regulatory framework for internal financial activities and the conduct of monetary policy ([Hergli and Belhaeth, 1993; 1995](#)). In 1988, the reform of the financial system began with the liberalization of interest rates and the gradual elimination of controls on the volume and composition of credits.

Liberalization of interest rates did not cause fluctuations and was steady. The main aim of the authorities was to replace direct instruments and discretionary interventions in the money market, as it adopted a targeting of broad money (M3) that is the operational target of the central bank. In 2010, the Board of Directors of the Central Bank decided to pursue the adoption of a monetary policy to keep the rate of interest of the BCT unchanged, and to continue monitoring inflation while ensuring adequate financing of the international economic situation and its potential impact on the national economy as well as the balance of payments in particular.

To determine the optimal rule employed by the Tunisian Central Bank in its conduct of economy, we start with the traditional Taylor rule as a reference point. That is: the rate of interest, current inflation, inflation gap, and gap production. Annual data of Tunisia during the period from 1987 to 2007 are used in this instance.

The equation of our starting rule will be:

$$R_t = R^* + \pi_t + \alpha(\pi_t - \pi_t^*) + \beta(y_t - y_t^*) + u_t \tag{1}$$

From the above, we analyse if the Taylor rule explains the traditional policy of the Central Bank of Tunisia and whether it should adopt other rules. That is to say, if we conclude that the model representing the traditional Taylor rule is not too explanatory (R^2 is low), we proceed to estimate other Taylor-type models (reaction functions of the central bank). We try to estimate two types of Taylor function reactions; one under a static version and the other in a dynamic version. The latter version allows us to introduce the smoothing term or partial adjustment of interest rates and to verify if the Central Bank of Tunisia gradually adjusts its interest rates in order to maintain credibility in its policy.

We will then compare these two alternatives using the Akaike and Schwarz criteria in order to identify the best model that better represents the economic situation.

The dynamic rule is given by:

$$R_t = \rho R_{t-1} + (1 - \rho)[R^* + \pi_t + \alpha(\pi_t - \pi_t^*) + \beta(y_t - y_t^*)] + u_t \tag{2}$$

where ρ is the coefficient of partial adjustment of the real interest rate. In this context, the reaction function is based on the current data on inflation and output gap. It is described in terms of partial adjustment of interest rates. We will also consider the Taylor rule under a Forward-Looking scenario. In other words, we replace the data of current inflation and output current by their forecasts. In this case, the rule is:

$$i_t = \rho i_{t-1} + (1 - \rho)[\alpha E(\pi_t) + \beta(y_t - \bar{y})] + \varepsilon_t \tag{3}$$

We will adopt the Taylor rule that better reflects the behavior of the Central Bank of Tunisia. Further, we test a new hypothesis to check whether the central bank has taken into account the fluctuations of the exchange rate. We draw upon Lubik and Schorfeide who consider the role of the exchange rate in monetary policy conducted by the New Zealand, Australia, England and Canada. In this case the rule is given by:

$$R_t = \rho R_{t-1} + (1 - \rho)[\alpha(\pi_{t+1}) + \beta(y - y^*)] + u_t \tag{4}$$

where the variables are: the interest rate (money market), the gross domestic product, the real effective exchange rate, index of consumer prices, inflation target, and the rate of inflation.

In addition to the above, other variables are constructed such as the interest rate balance, the production gap and inflation. The data are taken from the database of the Institute of International Monetary Fund (IMF).

3. EMPIRICAL APPLICATION AND RESULTS

3.1 Preliminary Specifications and Tests of the Taylor Rule for Tunisia

The goal is to present a strategy relevant to Tunisian monetary system to cope with various international changes. A policy based on a strong and stable financial system. The interest rate is deemed to be the favored instrument for the conduct of monetary policy under a flexible exchange rate. In this context, we follow Roffia approach to the euro area. As before, the aim is to determine the method of conducting the monetary and economic policy to achieve price stability and therefore successful policy of inflation targeting. This is given by:

$$i_t = \pi_t + \bar{r} + \alpha(\pi_t - \bar{\pi}) + \beta(y_t - \bar{y}) \quad (5)$$

Where:

i_t is the money market rate, π_t is the current inflation rate, \bar{r} is the real interest rate balance,

$\bar{\pi}$ is the inflation target, and $(y_t - \bar{y})$ measures the average change in the index of industrial production.

The estimation result of the above rule is described in the table below:

Table-1. Estimation Result

Variable	Coefficient	t-Statistic
CONS	1.493294	25.09009
INFL	-10.21376	-10.72837
OUT	0.228288	1.862456

The Durbin Watson (DW) is 0.66, indicating the presence of autocorrelation of the residuals. We note that this is a positive autocorrelation. Therefore, we turn to the estimation by instrumental variables or GMM. Based on White heteroscedasticity test, we noticed that the errors are heteroscedastic: F-tabulated = 8.48 > F-calculated = 0.036. Once we corrected for the heteroskedasticity and autocorrelation of the residuals, we verified the the stationarity of residuals of the estimation¹.

The results of the estimation of the traditional Taylor rule in Tunisia (Table 2) leads to the following coefficients: -8.84 for the inflation gap, CONS = TIR_{req} + inf. These coefficients are statistically significant. Similarly, the output gap is statistically significant, but it acts negatively on the average money market. We note that Tunisia gives importance to inflation and the output gap. This implies that the interest of Tunisia is oriented towards price stability and the stability of economic activity. The adjustment coefficient R² = 0.56 indicates that it is necessary to involve other functions, i.e., reaction functions. The purpose of these functions (Taylor-type reactions) is to determine the optimal rule for the central bank of Tunisia.

¹ Detailed tables are available from the authors.

Table-2. The results of the estimation of the traditional Taylor rule

Variable	Coefficient	t-Statistic
CONS	1.365616	241.9170
INFL	-8.844284	-121.4075
OUT	-0.555806	-31.15929

The transition to the estimated reaction functions of the Taylor type is due to several reasons. On the one hand, these functions predict the change in the monetary policy instrument of the central bank. On the other hand, in the context of macroeconomic models, the functions of the reactions are important elements to assess the policies of central banks and the effects of economic shocks. Thus, several studies have estimated different specifications of reaction functions: static reaction function (without partial adjustment of the interest rate) and functions including dynamic partial adjustment of the interest rate based on current data and inflation the output gap.

3.2 Estimation of the Static Response Function

To estimate the reaction function in its static version we adopt Roffia's approach given by

$$TMM_t = a_0 + a_\pi \pi_t + a_y y_g + \varepsilon_t \quad (6)$$

Our estimates using raw data are reported in Table 1. To improve the results, we resort to GMM and IV. The results of GMM estimation are in Table 3.

Table-3. Estimation of the static response function by the method of GMM

Variable	Coefficient	t-Statistic
C	19.81406	3.195585
TMM(-1)	0.629389	5.406392
LINF	-3.899408	-3.190473
OUT	0.139637	1.897399

According to the result of the estimation of the reaction function we can conclude that the weight given to inflation is ≤ 1 . In fact, according to Roffia, "A parameter of inflation greater than 1 implies that the interest rate of short-term should increase when the inflation rate increases, this exerts a stabilizing effect on inflation." The coefficient of the output gap is significant at 5%. These results confirm that the main objective of the Central Bank of Tunisia is controlling the price level. This impacts negatively the TMM.

3.3. Estimation of the Dynamic Response Function

The objective of this section is to determine whether the central bank of Tunisia adopts a partial adjustment of the interest rate or not. That is to say, we will introduce in the previous specification an additional variable, ie., the interest rate lagged by one period. Hence, the reaction function (dynamic) with smoothing interest rate is written as:

$$R_t = \rho R_{t-1} + (1 - \rho) \left[R_t^* + \pi_t + \alpha (\pi - \pi^*) + \beta (y - y^*) \right] + u_t \quad (7)$$

Smoothing assumes that the central bank tends to smooth changes in interest rates to avoid rate instability and ensure credibility of monetary policy. The reaction function is then described in terms of partial adjustment of interest rates. It adjusts in each period, the weighted average interest rate and the desired rate of interest during the previous period.

To estimate this reaction function, we draw upon Roffia and Mayes et al. by writing the equation in terms of feasible variables as follows:

$$TMM_t = a_0 + \rho TMM_{t-1} + a_\pi \pi_t + a_y y_g + u_t \quad (8)$$

The results are included in Tables 4 and 5.

Table-4. Estimation of the dynamic response function

Variable	Coefficient	t-Statistic
C	19.81406	3.195585
TMM(-1)	0.629389	5.406392
LINF	-3.899408	-3.190473
OUT	0.139637	1.897399

By deduction, the other coefficients are:

Table-5. Estimation of the other coefficients of the equation

it= 0.629	aπ = -3.899	ay = 0.139
it = 0.77	α= -10.509	β=0.374

The coefficient of the output gap (0.139) is statistically significant and acts positively on monetary policy. This suggests that the actual production plays a role in monetary policy considerations. The coefficient of inflation is -3.899 and it is statistically significant. The effect of the output gap is higher than that of inflation. The adjustment parameter is also significant ($= 0.629$). We note an improvement in R^2 from 0.486 to 0.949; and in $\overline{R^2} = 0.422$ to $\overline{R^2} = 0.941$. This may be due to the addition of the lagged interest rate. The criterion of maximizing R^2 is to retain the model with the highest R^2 , yet the disadvantage of this test is not to arbitrate between the loss of degrees of freedom of the model and the resulting adjustment. Therefore, we must recourse to criteria Akaike or Schwarz to compare models involving different numbers of variables. We retain the model that minimizes the Akaike or Schwarz function². According to the calculated measures of Akaike and Schwarz, we note that the static model minimizes these two functions. Thus, the static model best represents the reaction function of the Reserve Bank of Tunisia. The high significance of the coefficients of inflation and the current output gap leads us to examine other variables in this function. We will consider the effect of exchange rate below.

² Detailed tables are available from the authors.

3.4 The Effect of Exchange Rate in Taylor Rule

The objective of this study is to determine whether the instrument of monetary policy should be based on the fluctuations in the exchange rate, or whether it is sufficient to act on domestic indicators such as inflation and real output. In this context, we consider an indirect effect: the existence of indirect effect of the exchange rate channel, if monetary policy does not respond directly to fluctuations in exchange rates. This indirect effect has advantages in comparison with the direct effect because it results in unpredictable fluctuations in interest rates.

We will estimate the Taylor rule with inflation expectations and examine the effect of exchange rate changes on economic policy. We follow Lubik and even Shorfheide, but in a static state, as given below:

$$tmr_t = a_0 + \alpha\pi_t + \beta y_g + \delta e_t + \varepsilon_t \quad (9)$$

We use an IV technique wherein the instrumental variables are : $\text{inf}(-1)$, $\text{inf}(-2)$, $\text{outputgap}(-1)$, $\text{outputgap}(-2)$, $\text{TCER}(-1)$, and $\text{TCER}(-2)$. The results are in Table 6.

Table-6. Taylor rule with the real effective exchange rate.

Variable	Coefficient	t-Statistic
C	154.3414	7.647477
LINF	-16.54711	-12.03806
OUT	-0.451944	-2.333771
LTCER	-15.63123	-5.156314

Based on the estimation results, we note that the coefficient of the real effective exchange rate is (-15.631) and is highly significant. Thus, we can conclude that the exchange rate variable influences the conduct of monetary policy of the central bank of Tunisia. In addition, the TCER variable provides additional information on the pace of inflation and output. Finally, the measures of AIC and SC (= 3.197 and 3.394, respectively) indicate the choice of model. Based on these measures the optimal model again is the static version of the Taylor rule.

4. CONCLUSIONS

We have focused our research on determining the optimal Taylor-type rule and variables that must appear in the rule in the case of the Tunisian economy in the conduct of its economic policy. The estimates are based on static and dynamic responses functions. They are presented as important elements in assessing the policies of central banks and the effects of economic shocks. The results of the estimation of the reaction function in its static version confirm the hypothesis that Tunisia leads a policy of controlling inflation. The calculated measures of Akaike and Schwarz criteria show that the static model better represents the reaction function of the Reserve Bank of Tunisia.

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