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Can we Predict Inflation in Tunisia?
an Analysis Following an Unobserved Components Model

By Bechir FRIDHI

University of Carthage, Tunisia

Abstract- Empirical analysis on the prediction of inflation is becoming more and focus on advanced economies. At least three factors explain this. First, the predominance of agriculture in developing countries makes it dependent inflation climatic conditions of economic activity (eg, Phillips curve). Then, the limits on the quality and frequency data are often limiting factors. Finally, emerging markets are likely to suffer sudden crises and reversals of macroeconomics variables and it is therefore difficult to identify an economic regularity. However, a growing body of research has begun to analyze the inflation forecasts in emerging and developing leading indicators for inflation.

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Can we Predict Inflation in Tunisia? *An Analysis Following an Unobserved Components Model*

Peut-on prévoir l'inflation en Tunisie ? *Une étude suivant un modèle à composantes inobservables*

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Abstract- Empirical analysis on the prediction of inflation is becoming more and focus on advanced economies. At least three factors explain this. First, the predominance of agriculture in developing countries makes it dependent inflation climatic conditions of economic activity (eg, Phillips curve). Then, the limits on the quality and frequency data are often limiting factors. Finally, emerging markets are likely to suffer sudden crises and reversals of macroeconomics variables and it is therefore difficult to identify an economic regularity. However, a growing body of research has begun to analyze the inflation forecasts in emerging and developing leading indicators for inflation.

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Résumé: Les études empiriques sur la prévision de l'inflation sont de plus en plus nombreuses et portent principalement sur les économies avancées. Au moins trois facteurs expliquent cela. Tout d'abord, la prédominance de l'agriculture dans les pays émergents rend l'inflation plus dépendante des conditions climatiques que de l'activité économique (par exemple, courbe de Phillips). Ensuite, les limites quant à la qualité et la fréquence des données sont souvent des facteurs contraignants. Enfin, les marchés émergents sont susceptibles de subir des crises soudaines et des renversements de variables macro- économiques et il est donc difficile de dégager une régularité économique. Toutefois, un nombre croissant d'études a commencé à analyser les prévisions d'inflation dans les pays émergents et à élaborer des indicateurs avancés pour l'inflation.

Mots clés : prévision de l'inflation, courbe de phillips, régularité économique, inflation sous- jacente.

I. Introduction

Forecast inflation will become an essential task for the Central Bank of Tunisia (BCT) due to delays in the transmission of monetary policy on the economy, particularly on inflation. Thus, to be able to react in time, the BCT will base its monetary policy decisions not on past inflation but inflation expectations, the accuracy of these forecasts are an essential element of the inflation targeting framework. For example, it will determine the magnitude of the deviations permitted in relation to the inflation target and the time required returning inflation to the midpoint of the target range. To forecast inflation in Tunisia, it is essential to understand the dynamics and explore ways of underlying calculations of inflation. Studies in this area report several technical preconditions for inflation targeting, including:

- i) Institutional independence: Within a framework of inflation targeting, the primary objective of monetary policy is that of low inflation.
- ii) A healthy financial system: To reduce the risk of conflict with financial stabilization objectives and ensure the efficient transmission of monetary policy, the banking system must be strong and well developed capital markets.
- iii) Good infrastructure and analysis capabilities: The statistical requirements for inflation targeting are more stringent than for other regimes and monetary authorities must have a well- developed ability to forecast inflation.

Tunisia has taken important steps to establish a framework for targeting inflation, especially in regard to i) and ii). The amendment last year to the law governing the BCT strengthened the independence of the central bank and defined price stability as the primary objective of monetary policy. To boost the financial system, the authorities have recently adopted a number of measures to improve the credit culture, promoting good governance and strengthening the legal framework for banks. However, a reliable methodology for forecasting inflation is not yet available. The present work aims to: analyze trends in inflation in Tunisia, to calculate underlying inflation measures and to develop a simple framework for forecasting inflation.

II. The Specific Targeting Rules

The concept of targeting rule returns to [L. Svensson (1998)]. It consists in setting the interest rate in order to obtain the variable targeting criteria. A concrete example of targeting rules would be that of the

Author: Enseignant chercheur à la Faculté des Sciences Economiques et de Gestion de Nabeul (Université de Carthage, Tunisie).
Membre du Laboratoire de Recherche : Intégration Economique Internationale(L.I.E.I) (Université Tunis El-Manar, Tunisie).
e-mail: bechir.fridhi@gmail.com

Bank of England which has made a simple rule targeting of adjusting the interest rate in order to bring the inflation forecasts, with the two- year horizon in the target range.

This rule, both simple and operational, is not necessarily optimal. According Svensson, a targeting rule is optimal if the marginal substitution rate (TMS) and the incremental rate of transformation (TMT) between the target variables are equal.

Svensson illustrated the optimal targeting rules from a simple example, formulated a relationship of supply (Phillips Curve) and demand relationship (IS curve):

$$\Pi_{t+r,t} = \Pi_{t+r+1,t} + \alpha_x x_{t+r,t} + \alpha_z z_{t+r,t}$$
$$avec\ x_{t+r,t} = \beta(i_{t+r,t} - \Pi_{t+r+1,t}) + \beta_z z_{t+r,t} \quad (1)$$

$\Pi_{t+r+1,t}$ and $x_{t+r,t}$: expectations of inflation and output performed $t+r+1$ $\text{in}t, \alpha_x$ and β_x : positive constants, α_z and β_z : Suitable dimensional vectors.

$z_{t+r,t}$: Column vector representing the "deviation", ie the difference between the real model and the simplified version of the New Keynesian model. The values of these deviations are determined by the "judgments" of monetary authorities.

The identification of the optimal targeting rule requires the specification of the (TMT) and (TMS) that of between forecasts targeted variables and establish the condition of their equality.

This condition, identified by Svensson, is of the following form:

$$\Pi_{t+r,t} - \Pi^* = \frac{-\lambda}{\alpha_x}(x_{t+r,t} - x_{t+r-1,t}) \quad (2)$$

In this example, the targeting rule, called "targeting the forecast of inflation" (inflation- forecast targeting) is based on the following steps:

- Define deviations, $z^t \equiv \sum_{r=0}^{\infty} z_{t+r,t}$ by judgments;
- Prepare forecasts of inflation and output, $\Pi^t \equiv \sum_{r=1}^{\infty} \Pi_{t^+r,t}$,
- $x^t \equiv \sum_{r=0}^{\infty} x_{t+r,t}$ Who determine the targeting rule (2) and the supply relationship;
- Identify interest rates,
- $i_t \equiv \sum_{r=0} i_{t+r,t}$ Who determine demand relationship;
- Announcer Forecasts of inflation and output and adjust the interest rate accordingly.

This approach avoids the specification of a reaction function which is always complicated, since it is to specify how the monetary authorities should respond optimally to deviations that are determined only by judgments.

The advantage of targeting rules as specified (2) is to be empirically verifiable by publishing forecasts targeted variables. Its main drawback is, cons, related to the need to identify a precise way the (TMT) between the target variables, which is not always obvious to all models of the relationship of supply.

III. Targeting Inflation Forecasts

The major difficulty in the implementation of an inflation targeting regime is related to the inability of the Central Bank to fully control inflation. This imperfection is due to uncertainty about the monetary transmission mechanisms and deadlines that are attached to; Also the influence of factors other than monetary policy actions. From then on, it would be useful to anticipate well in advance, the evolution of inflation. The for ecasts on the level of inflation can be used as effective intermediate objectives of monetary policy.

[King (1994)], which was the first to evoke the idea of using inflation forecasts as an intermediate target, he argued his idea by the need to take account of a period of time between the handling of interest rates and the expected effects on the level of inflation.

According to Svensson, the implementation of a policy based on targeting inflation forecasts may be considered according to a specific rule, as defined in the example (2). Just, indeed, to impose restrictions $\lambda = 0$ in order to move to a strict regime of inflation targeting in which the specific rule targeting becomes:

$$\Pi_{t+r,t} = \Pi^* \quad (3)$$

r : Minimum horizon assignment of the rate of inflation.

This is to establish the conditions of interest rates in order to obtain estimates of the rate of inflation in a given horizon (shortest horizon for which the rate of inflation may be affected), which will within the target range.

IV. Unde Rlying Inflation as an Estimator of Overall Inflation

The inflation is a new concept in the literature. It was introduced in the early 1970. However, it has been formally identified for the first time by [Echstein (1981)] in the early 1980s.

There is still no consensus on the concept of core inflation in relation to divergences on the basis of inflation in the recent economic theory.

Echstein (1981) developed an econometric model of the US economy. In this model, the inflation rate is divided into three components, namely:

underlying inflation, inflation linked to the supply shocks and inflation driven by demand.

According to [Roger (1998)] if the aggregate supply curves in the short term is given by:

$$\Pi_t = \Pi_t^{LT} + g(x_{t-1}) + v_t \quad (4)$$

Where:

Π_t : Global Inflation rate applying on the date t ;

Π_t^{LT} : Long-term inflation rate;

Π_t^{CT} : Short-term inflation rate;

Π_t^{SJ} : Inflation rate underlying;

x_{t-1} : An indicator of excess supply or aggregate demand;

v_t : A measure of inflationary pressures due to temporary supply shocks.

Then the inflation proposed by Echstein, is defined as:

$$\Pi_t^{CT} = \Pi_t - g(x_{t-1}) - v_t = \Pi_t^{LT} \quad (5)$$

While underlying inflation, Π_t^{SJ} is given by $\Pi_t^{SJ} =. g(x_{t-1}) + v_t$. Under this definition, transient movements have no effect on core inflation. Therefore, the latter should not be cyclic.

[Quah and Vahey (1995)] for their part, explain the long-term verticality of the Phillips curve, generally accepted in economic theory, and identify the underlying inflation as " component of the observed inflation has no impact in the medium term and long term on actual production "

The observed inflation and divided into two parts, one respecting the long-run neutrality (underlying inflation), the other not (non-underlying inflation).

These authors estimated the inflatio n using a structural vector autoregression model (SVAR) combining inflation and output. They assume that the observed changes in the measurement of inflation is caused by two types of disturbances are not correlated. The first of these disturbances has no impact on production in the medium or long term. The second has unlimited effects observed inflation and production but does not influence on core inflation.

According to [Roger (1998)], the definition of [Q uah and Vahey (1995) of the underlying inflation is characterized by:

$$\Pi_t^{CT} = \Pi_t - v_t = \Pi_t^{LT} + g\ x_{t-1} \quad (6)$$

While short-term inflation is defined as: $\Pi_t^{CT} = v_t$

V. The Inflation: Theoretical Basis and Practical

Unfortunately, the concept of core inflation is rarely defined with precision and calculation methods remain to multiple and varied day. Overall, there are three methods to calculate: for econometric modeling, exclusion and more recently by estimating a structural vector autoregression (VAR Structural).

A first step is to break down the inflation rate into a trend component and a cyclical component, or by the filter [Hodrick and Prescott (1980)] or by use of different decomposition techniques available. A second method proceeds by elimination of components deemed too volatile in the price index, particularly sensitive to external shocks or economic policy.

Our study focuses on the exclusion in the first stage food and energy because the exclusion of these two categories of products is due to high price volatility, dominated by fluctuations in supply on which the monetary policy has no influence. In a second step we will exclude the price index for consumer eight components likely to be the source of large changes in relative prices or exposed to significant supply shocks.

VI. Estimation and Forecasting of Inflation in Tunisia

The data used in our econometric study come from the databases of IFS (Intenational Financial Statistics) of the IMF. We consider the following sets of Tunisian quarterly basis over the period from the first quarter 1994 to fourth quarter 2014, the index of consumer prices (IPC), the index of industrial production (IPI), the real exchange rate (TCR) , money supply (M1) and money supply (M2). All series are seasonally adjusted except the exchange rate. All variables are expressed in logarithms.

The study charts and correlogram shows that all autocorrelations and partial autocorrelations concerned first series are significantly different from zero and slowly declining. This is indicative of non-stationary series. It is then necessary to verify this intuition by applying statistical tests of stationarity.

In what follows, we will initially estimate the trend and the cycle of the price index for consumption from various decomposition methods tend cycle.

Among these methods we are interested in unobserved component models proposed by [Harvey (2001)].

Within the framework of these models, the study series can be decomposed additively into a trend T_t, cycle C_t and irregular component ε_t . These are the "trend+ cycle" model which is based on an independent formulation of the trend and the cycle. Each of these components is then subject to a separate estimate.

$$Y_t = T_t + C_t + \varepsilon_t$$
$$T_t = T_{t-1} + \beta_{t-1} + \eta_t \quad (7)$$
$$\beta_t = \beta_{t-1} + \xi_t$$

The irregular component ε_t is a white noise.

The stochastic nature of the trend is determined by the variance of the innovations of the level (σ_η^2) and slope (σ_ξ^2) of the trend. When these are both zero ($\sigma_\eta^2 = \sigma_\xi^2 = 0$), we obtain a deterministic trend. When only the variance of the innovations of the level ($\sigma_\eta^2 = 0$) is set equal to zero, a random walk is obtained with drift. In the case where only the variance of the innovations acting on the slope (σ_ξ^2) is zero, we obtain a smooth trend "Slowly Moving Smooth Trend".

The results of the estimation of unobserved component models on the quarterly change in the price index for the Tunisian consumption are presented in the following table:

Table 1 : Statistical Quality Diagnostics

	$\sigma_\eta^2 = 0$ et $\sigma_\xi^2 = 0$	$\sigma_\eta^2 \neq 0$ et $\sigma_\xi^2 = 0$	$\sigma_\eta^2 = 0$ et $\sigma_\xi^2 \neq 0$
$\sqrt{PEV}$(Standard deviation of the forecast error)	1.625	0.241	0.238
N(Normality statistics)	7.670**	4.482	1.019
$H(h)$[Statistical heteroscedasticity]	6.646**	1.131	1.043
$Q(p,q)$[Statistical correlation]	10.620**	24.09**	10.710**
R_D^2(Correlation coefficient)	-0.440	0.004	0.032

Source: *Estimates of the Author*
*Note: Unsatisfactory tests the null hypothesis are indicated by ** at the 5% level.*
The standard deviations were multiplied by 100.

To improve predictions, we need additional information. To do this, we must make use of other economic indicators. The estimated model is defined from the following equation:

$$IPC_t = \alpha \ L \ IPC_t^{LT} + \beta \ L \ Y_t + \delta \ L \ Z_t + \varepsilon_t$$

The latter is similar to a reduced form of the Phillips curve. The index of consumer prices depends on its long-term IPC^{LT}, component of the output gap Y_t, and the index of industria l prices IPI_t.

The different statistics from the estimated model are shown in the following table:

Table 2 : Decomposition trend-cycle

	IPC	*IPI*
Diagnostics		
$\sqrt{PEV}$(Standard deviation of the forecast error)	0.238	2.867
N(Normality statistics)	1.019	8.003
$H(h)$[Statistical heteroscedasticity]	1.043	0.540

$Q(p,q)$ *[Statistical correlation]*	10.610**	18.200**
R_D^2 *(Correlation coefficient)*	0.031	0.295
Parameters		
σ_δ *(Standard deviation of the irregular component)*	0.000	2.349
$\sigma_{\tilde{n}}$ *(Standard deviation of the innovations of the trend)*	0.000	0.000
σ_ε *(standard deviation of innovations on the slope of the trend)*	0.044	0.162
Cycle		
Frequency	0.006	0.300
cycle period in years	83.325	1.744

Source: *Estimates of the Author*
*Note: Unsatisfactory tests the null hypothesis are indicated by ** at the 5% level.*
The standard deviations were multiplied by 100.

The empirical results obtained by different methods showed that there are as many differences as similarities between the different estimates of trend and cyclical components.

The unobserved components model Harvey has enabled us to provide the underlying price trend in Tunisia. It presents oriented upward trend and should continue to be in the future.

In a multivariable universe, the joint use of the index of consumer prices and industrial production index in an unobserved components model allowed us to highlight the dynamic interrelationships between these variables.

VII. Conclusion

Unlike other monetary policy regimes, that of inflation targeting assigns fundamental importance forecast, including that of the evolution of inflation which is the main intermediate target of monetary policy. Indeed, when the monetary authorities detect a deviation from the expected level of inflation relative to the target, they employ the necessary actions to eliminate this deviation. It should be noted that the consideration of inflation as the main objective for the Central Bank reduced significantly, the role of other formal intermediate targets, such as the exchange rate or monetary aggregates, since in case of conflict, it is the objective related to the level of inflation prevail. That said, monetary authorities considering aimed at targeting regime explicit inflation, should develop econometric models for their work to support forecasting. This step is particularly important because of the role of forecasts in choosing the timing of the company corrective action.

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