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Abstract:
The aim of this paper is to provide a credible measure of inflation. This credibility is of great importance for successful inflation targeting regime. This paper proposes a technique to solve a conceptual disparity between inflation phenomenon and its measurement. For this, we proposed an alternative measure called core inflation, defined as the inflation component that has no real impact on long-term production. Evaluation of core inflation was obtained using a VAR system under the assumption that variations in the extent of inflation are affected by two types of shock. The first type has no impact on real output in the long term, while the second can have this effect. This approach is a reconstruction of the approach of Quah and Vahey (1995) in the case of the Tunisian economy. The study concluded that the administered prices constitute a major obstacle to measure, interpret and forecast inflation. Central Bank of Tunisia has no control over a third of the CPI basket. This feature of the Tunisian economy is simply a sign of weakness of the economic system and the need for monetary authorities to continue its efforts to liberalize prices.
Keywords: *monetary policy in Tunisia, Inflation, core inflation, VAR.*

Introduction

The concept of core inflation has played an important role in the decisions of responsible monetary policy in recent years. However, despite the centrality of this concept, there is still no consensus on the best measure of core inflation. The most widely adopted approach is the exclusion of certain categories of price inflation rate as a whole. It reflects the origin of the concept of core inflation during the turbulent 1970s. However, more recently, many economists are trying to set a robust measure of core inflation.

Core inflation has become in recent years the most important subject of study for central banks of various countries. In fact, many of them are given as central or even ultimate objective of reducing inflation and achieving price stability. However, government policies other than monetary policy can play an important role in maintaining this goal. But the central bank sees its role as crucial when it admits that inflation can persist for a long time if it is tolerated by the monetary policy. It is important, then, that it should follow closely the evolution of the inflation rate.

However, monetary policy affects inflation indirectly: it is the total nominal spending and hence the pressures of demand relative to productive capacity of the economy, through the rate interest and exchange rate. As this process takes some time, we can not expect that monetary policy neutralizes the effect of unexpected changes in prices in the short term. The targets are made in the majority of cases based on the price index (CPI) as a whole. However, several central banks have indicated that, for practical reasons, the index of consumer prices, excluding the volatile components that are usually food and energy could better help overcome inflation. Indeed, it is difficult to address short-term fluctuations in the CPI due to fluctuations in the prices of food and energy. The exclusion of these two actually reduces the volatility of the price index for consumption items. So when bad weather conditions cause a significant reduction in the supply of fruits and vegetables, prices tend to fluctuate sharply upward. This is usually temporary and prices return later to a more or less similar to the previous level. It is therefore not a long-term inflation, but rather temporary and transitory phenomenon. It would be desirable to base monetary policy decisions on this type of phenomenon. This makes it easier to read the movements of the index of consumer prices when some of the more volatile components are excluded.

The question that many economists ask is: a measure such as the CPI excluding food and energy is a good indicator of core inflation? The newer approaches have two key traits in common. First, they take a statistical approach to the problem rather than behaviorist measuring prices. Second, they rely on an alternative concept of inflation, as opposed to the traditional micro-economic cost, and as a guiding theory. We examine in this paper, with a critical eye, several approaches to measuring core inflation.

Section 1. The concept of core inflation

The core inflation should reflect what is fundamental in price movements and remove temporary fluctuations that have no long-term impact on prices. The phenomenon of core inflation should have a persistent character. Otherwise, the analysis of inflation would eventually not make much sense. These factors should explain the behavior of inflation in the long term. Roger uses economic theory to explain the business concept of core inflation. As he pointed out, it does not necessarily translate to the movement of consumer prices. However, it helps to understand what is happening.

In an economic climate where there are no disturbances in relative prices due to supply or consumer preferences, most companies increase their prices based on either their estimate of what will be the general rate of inflation or are the general rate of increase in their production costs. By aggregating all these estimates, we get what we might call the core inflation. Obviously, companies make mistakes estimating price movements and some dispersion of different expectations of inflation is expected. However, the estimate should be unbiased and there is not, at first glance, the reason why these errors are asymmetric. In addition, if a disturbance affects relative prices, that is to say, the price of a good or service becomes more or less expensive relative to other prices, a company will have to choose between raising prices immediately in the event of an increase or wait until that had been expected to do. If there are costs associated with an immediate increase in prices, the company will increase its prices only if the disturbance is strong enough caliber. According to Roger (1997) most companies increase their prices according general inflation. Only companies that deal with large perturbations will tend to increase their prices beyond their estimate of the general rate of inflation.

Core inflation tends to be defined by the method used to construct a practical measure rather than the measure tries to capture. However, all practical efforts to measure core inflation can be seen as an attempt to quantify one of the two following general concepts, a concept states that the core penny as the most persistent component of measured inflation. The second concept designs core inflation as a general component of measured inflation. In both designs, however, core inflation is generally associated with expectations and components of the demand pressure of measured inflation and excludes impact of the provision.

1.1 The core inflation as persistent inflation

Convenient starting point of the theory of inflation is the definition of Milton Friedman states that inflation is a "... steady and sustained increase in the" general price level. "Friedman highlights the distinction" ... between stable inflation, and a discontinuous inflation caused by the crisis. "The importance of this distinction, according to Friedman, is that stable or persistent component of inflation tends to be incorporated into the expectations. However, irregular or transitory inflation will be much less benign, precisely because it is easily anticipated.

Similarly, Laidler and Parkin define inflation as "... a process of continuous price increases, or a continuous decrease of the value of money"

A core inflation design is based on the distinction between stable and persistent character of measured inflation, and intermittent or transient inflation. The definition of core inflation as the persistent element is reflected in a common tendency to define the core inflation trend and inflation as essentially synonymous, or highlight a distinction between price shocks (with only a temporary impact on measured inflation) and shocks more persistent inflation.

According to the design core inflation as the persistent element in inflation, Quah and Vahey (1995, p. 1130) define core inflation as "... a component of measured inflation that n ' no way to have an impact on long-term production. " This definition excludes the impact of supply shocks can have a permanent impact on the price level, but no lasting impact on the inflation rate. In addition, the definition of Quah and Vahey includes the cyclical movements in inflation associated with excessive demand pressures.

In other words, if the short-term aggregate supply curve is given by:

$\pi_t = \pi_t^{LR} + g(x_{t-1}) + v_t$

Where:

π_t The rate of overall inflation in period t

π_t^{LR} The rate of long-term inflation or inflation trend

x_{t-1} Measuring the pressure of the excess of the cyclic request

v_t A measure of transient disturbance in inflation

While the definition of Quah and Vahey of core inflation can be characterized as follows:

$\pi_t^{sj} = (\pi_t - v_t) = \pi_t^{LR} + g(x_{t-1})$

The definition of Quah and Vahey core inflation differs somewhat from the original forward by Eckstein (1981) definition. Indeed, Eckstein has defined core inflation as "... an increase in the cost of factors of production."

The major difference with the definition of Quah and Vahey is that Eckstein explicitly sets aside the cyclical influences on inflation. So in terms of the first equations defining Eckstein becomes:

$\pi_t^{sj} = (\pi_t - g(x_{t-1}) - v_t) = \pi_t^{LR} =$ Inflation rate of long-term

The definitions of Quah and Vahey and Eckstein have quite different implications for the properties of the core inflation and not core. Indeed, for Quah and Vahey, the difference between

core inflation and headline inflation core is essentially the difference between the expected inflation rate and the unanticipated. In principle, changes in the core inflation should not have a low correlation, while core inflation is clearly cyclical. For cons, the definition of Eckstein says that core inflation should not present a cyclical trend, unless expectations of long-term inflation are highly adaptive, and that core inflation will not distinctly cyclical.

In such circumstances, the choice of the definition of core inflation should reflect the horizon set by those responsible for monetary policy if they operate on a medium-term policy to the position, then the definition of Quah and Vahey is most appropriate. But if the policy horizon is longer, then the definition of Eckstein might be more relevant. In both definitions, however, the disturbances have only a transitory impact on inflation, usually associated with supply problems are not included in the definition of core inflation.

In principle, therefore, the rate of core inflation whatsoever in the Eckstein and Quah and Vahey version should have more persistence or less variability than the standard inflation rate or the rate of inflation in whole. On other hand, the supply shocks can have a transitory impact on inflation following the monetary policy regime adopted. Indeed, in a regime of inflation targeting, the central bank can restore the level of the original price because the consequences of supply shocks are temporary, but it must act to prevent any lasting impact on the rate of inflation. Other monetary policy regimes, however, the impact of a supply shock on inflation may be more persistent.

1.2 Inflation as generalized core inflation

An alternative design of core inflation based on the general price movements reflected in the definition of Arthur Okun inflation as "... a state of generalized increase in prices". The measured inflation is seen as widespread component associated with expected inflation and monetary expansion, plus a component representing a change in the relative price response to supply shocks. The relative price shocks are identified as 'noise' of a transitory and negligible impact on price developments. In fact, many central bankers tend to speak of core inflation in such terms, defining core inflation as a whole to the exclusion of a variety of items whose price movements is considered likely to distort or obscure the more general trend of other prizes.

It should be noted that if changes in relative prices are basically temporary (seasonal influences on food prices) or continuous (as a result of technology innovations), the impact on the rate of inflation measured should be temporary valid unless the change in inflation rather than a change in the price level that occurs monetary policy shocks. Therefore, the relative price shocks should be typically associated with transient changes in inflation, while the common general part should have a tendency to be more persistent.

The idea that changes caused by supply shocks relative prices can alter the rate of inflation as a whole has been controversial for as long as the aggregate price measures existed. This idea was basically established in the quantitative theory. In this context, it is assumed that, unless there is a monetary arrangement, increasing some relative prices should be offset with respect to its impact on the general price level, a reduction in other relative prices. If not, it must reflect a non-transitory inflation and thus be a component of core inflation. However, for three reasons, the relative price changes may affect, in reality, the aggregate inflation rate.

Premium on board, as Keynes noted "changes in relative prices can, of course, partially affect price indices, which represent changes in the price of some particular classes, for example, the cost index welfare of the classes of workers. " Thus, there is no reason to say that changes in relative prices must be neutral as all the indices produced by statistical agencies Prices may be designed as partial indices relative to the aggregate price in the quantity theory.

Second, even if there was no problem of incomplete coverage when calculating the price index, measuring the appropriate price should be considered substitutable products in shopping. Thus, the failure to account for such substitution effects is a key reason for the overall price index is affected by changes in relative prices.

Third, the price can not be completely flexible in the short term. In particular, if there are costs associated with the adjustment of nominal prices, while changes in relative prices can not cancel their effect on the general price level. The increase in the general level of prices generally, in this case, does not require a monetary adjustment. Indeed, it could be associated with a reduction in the production or a change in the velocity of circulation of money.

A second major objection to the identification of core inflation with changes in general prices is that it implicitly assumes that movements in relative prices stem from supply shocks, while it is possible that changes in core inflation problems could be responsible for changes in relative prices. In this case, a perfect distinction can not be made between the movements of generalized prices and those of relative prices. However, the real question is not whether the relative price movements are only caused by supply shocks, or only by demand shocks, but if supply shocks are predominant influence on changes of relative prices.

Implicitly, the defenders of core inflation, as the general inflation stipulate that supply shocks are the most important source of changes in relative prices. In this case, the core inflation design as general inflation is defined as the persistent inflation. Currently the difference in conceptual approaches core inflation does not show a big difference. However, the main difference lies in the choice of the appropriate approach to measuring core inflation.

1.3 Indicator of current and future trends in inflation

Monetary authorities supervise and direct a wide range of data on the state of the economy and especially, the changes in the rate of inflation. And if policymakers are considering action on inflation, they convey a range of information in the economy by incorporating them into the decisions of monetary policy. However, monetary policy affects inflation with a variable offset, which causes the central bank to monitor future changes in the inflation rate. In this context, the core inflation measures can improve the analysis of monetary policy by providing a means by which the monetary authority can separate the short-term variations in the data it's supposed to be persistent trend. In addition, this type of measure can minimize the effects of signals that can fool the decisions of the various economic agents about trends in inflation in the short and long term.

In addition, the core inflation can be a useful tool for judging the effectiveness of various earlier decisions makers' orientation of monetary policy and that, through the analysis of temporary changes in inflation. It can be also an understandable indicator of the public can help in the process and the responsibility of the monetary authorities. In this context, measures of core inflation can act as an indicator in communication and transparency of decisions in the conduct of monetary policy. Thus, the monetary authorities can clarify for the various economic stakeholders, their choice of intervention or non-intervention following the variations in the rate of inflation. Its use can also make the public understand that the makers have preferred to react due to changes in the persistent inflation and not those that look to be transient or temporary.

Section 2. Usefulness of core inflation

Most central banks, especially those who have defined an explicit inflation target should monitor inflationary trends both, cyclical and long term. However, central banks need to distinguish between the transient and persistent inflation, or generalized inflation and inflation relative prices. The usefulness of core inflation is that it has two distinct uses to achieve the goals of

monetary policy. The first role is to formulate monetary policy. The second is to increase the accountability of the central bank. These uses shall also identify to a large extent, the desirable properties of a measure of core inflation.

2.1. Core inflation: instrument formulation of monetary policy

The ability of a central bank to achieve its objectives depends largely on his understanding of the economy. An important key issues involved in almost any attempt to model the macroeconomic operation is the Associate program offers short-term. However, the estimate of the program is complicated by the problem of distinguishing between changes in production on the one hand and inflation on the other. This problem is a consequence of changes in the program of aggregate demand as opposed to changes in the program provides comprehensive. If the two programs can not be distinguished effectively, then it is possible that the estimate is biased and inefficient. One of the standard methods to solve this problem is to include other variables, or special relative prices (the relative price of oil, for example) in the estimated equation. In principle, a measure of core inflation should allow a quantitative assessment of the size of transitory shocks on inflation. By including the estimated offering program, the extent of supply shocks on the implicit prices in the difference between the inflation measure as a whole and that the core inflation, the offer can be best identified. This should improve the estimation parameters which allow a responsible and credible monetary policy.

An obvious question in this context is necessary; why central banks should distinguish the difference between transients and that in persistent inflation or between supply shocks and demand affecting the measurement of the rate of inflation. Thus, in case of demand shocks, the actions of monetary policy to counteract the inflationary or deflationary consequences will tend to bring the deviation of actual output around its potential level.

However, in case of supply shocks, the actions of the monetary policy to counteract the impact on the general price level will tend to accentuate the effects of shocks on output and producing a conflict between short-term inflation targeted by the central bank and production targets. For Haldane and Salmon (1995), this problem with inflation targeting, including the impact of supply shocks is a reason why the rules of GDP growth and inflation are frequently advocated as preferable to targeting strict inflation as a basis for the conduct of monetary policy. An attractive property of nominal income or the rate of growth of nominal GDP is that the monetary authorities are not obliged to counter supply shocks since the effects on prices and production tends to offset each other.

From this perspective, a regime of inflation targeting in which the focus is a measure of core inflation, excluding or minimizing the impact of supply shocks, can be seen as the most appropriate adjustments of monetary policy similar to those that would occur under a regime of targeting a nominal level of production. More specifically, the fact that monetary policy is based on the development of core inflation should not prevent the achievement of the inflation target, but it must allow the inflation target to be accomplished with less variability in production and in the instruments of monetary policy.

In this context, it should be noted that the new Keynesian macroeconomic model implies no arbitration between the long-term level of output and inflation, but accept arbitration between long-term variability of production and variability of inflation. This arbitration arises from the existence of the effects of supply shocks on output and inflation. A result that should be followed is that some models suggest that central banks should formulate generally, policies to minimize the variance of output around its trend, even if their ultimate goal only for the inflation rate. However, as noted Goodfriend and King (1997, p.276), if the central bank's policy focuses on a

measure of core inflation, then the arbitration between the New Keynesian output variability and variability of inflation disappears. Otherwise, if the monetary policy objective to minimize the variability of core inflation, it will also minimize the variability of production.

2.2 The core inflation: a viable target for monetary policy

While changes in prices of non-monetary assigns origins can be excluded, the core inflation that results could be regarded as a measure of inflation is the result of decisions in the conduct of monetary policy. Therefore, some measures of core inflation could be considered more controllable by monetary authorities that the inflation rate published and assigns as the basis for calculating the price index for aggregate consumption. Thus, this relationship seems more reasonable to suggest that core inflation may be a logical and appropriate that aggregate target for monetary policy.

Given that monetary authorities of Tunisia considering the adoption of inflation targeting regime, the use of a target for inflation implies that the monetary authority must accept responsibility for ex-post inflation. It is required to set a target inflation which he is an ex-ante control rates. This option only sets and increases the responsibility of the Central Bank of Tunisia as the main guarantor of monetary policy. The core inflation may be, then, a suitable tool as a direct target or an intermediate target for monetary policy.

Thus, the use of a core measure of inflation, as an official target focuses public attention on the persistent part in the movement of inflation. This is very important because the success of inflation targeting was established largely through the anchoring of inflation expectations will be incorporated into the decisions and contracts. Through this approach the monetary authorities consider reducing the degree of transmission of inflation variability, with the characteristic of temporary shocks, expectations of inflation in the public eye.

2.3 Transparency and accountability of monetary policy

The common feature of all inflation targeting regime is an explicit emphasis on the transparency of monetary policy and responsibility. Although these two characteristics are not essential features for such a system, they are seen as useful. The basic idea is that the credibility of the central bank should increase if monetary policy actions are clearly and directly related to the inflation target. The most important element of this is that it should help to keep the central bank external pressures to pursue other goals. Under a regime of inflation targeting, the responsibility of monetary authorities essentially requires the central bank to provide at least an explanation of the deviations of inflation from its target. These deviations may occur for a variety of reasons, and the core mission is to distinguish between deviations that result from unexpected shocks or those resulting from errors in judgment makers of monetary policy. In other words, the central bank must also indicate what adjustments of monetary policy will be required to correct any deviation from the preset inflation target, or to keep inflation within the range tolerated.

A measure of core inflation has two valuable roles to support the accountability and credibility of monetary policy. The first role is that such a measure can be very helpful in explaining deviations of inflation from the target as a result of supply shocks. In other words, if a deviation occurs due to a supply shock, then a measure of inflation that identifies such shocks can help to avoid wrong interpretation of public economic agents. This will minimize the risk of supply shock through the anticipation of inflation.

Second, a measure of core inflation can also play a useful role in improving the accountability of monetary authorities regarding their future decisions. And that, to minimize any confusion in situations where supply shocks can give wrong directions to the inflation trend. For

example, an adverse supply shock may mask a falling trend in core inflation. In such circumstances, the most appropriate action for monetary policy can be a relief from the position of the policy. However, if the official inflation rate increased as a result of supply shocks, a relief by the central bank could be misinterpreted as an inability of the central bank to ensure the preset target inflation. By being able to have a measure of core inflation, which reflects the decrease in the inflation rate, the central bank would find it easier to adjust the position of its policy in the proper direction without damaging its credibility.

2.4 The choice of the price index

Among the major problems that the Central Bank must resolve is the choice of the appropriate price index. Theoretically, in an economy with a single unchanging property or property that the relative price compared to other products is all set individual prices rise or fall with the same rate. In this case there would be no ambiguity regarding the definition of inflation. However, in an economy with a multitude of products with varying relative prices, each property will be valued at its own rate of change of the price. A price index aggregates the prices of different products in a single number which defines the rate of change in the overall rate of inflation. Typically, a price index is defined as the price of a representative basket of goods consumed by a typical consumer, so that the rate of inflation described how the price of the basket changes over time. There are so many, and different overall inflation as products that are included in the basket and on the weights.

The choice of the basket and weights depends on the purpose for which the index will be used. For example, a reason to target a low inflation rate to maintain the real value of the currency as its value to consumers, and thus eliminate the need for indexing from the tax system. This is one reason why most countries that have adopted inflation targeting regime specifies the target for inflation based on the index of consumer prices that take into account only price changes consumer goods and services prices rather than spending the whole economy. This is also the reason why the discussion in this work is limited to measures of core inflation based on the consumer price index for consumption. The choice of the index of consumer prices index as operating monetary policy rather than the price index of production was based on the judgment that the consumer inflation gives a very rough idea of the evolution the cost of living, and this is increasingly the basis for discussing the various economic agents closed their contracts also the determination of the personal tax system. In addition, the index of consumer prices and their evolution over time is often the basis for the formation of inflation expectations will be incorporated in household decisions and contracts.

However, the index of consumer prices may not be the best measure of inflation. Excluding food and energy in a kind of measure of core inflation, for example, was not motivated by a belief that changes in the prices of these products are not relevant, but rather that changes in the relative prices of food and energy are typically transient and do not occur in cases of decisions of monetary policy. It then follows that the key distinction between the question of the appropriate index to use and how to define and measure core inflation is to know what the effect of monetary policy maker is interested in the first case while in the second it is an attempt to differentiate between persistent and transient causes of price changes.

Section 3: Determination of core inflation in the VAR modeling

3.1. The theoretical foundations of the VAR model

The describe how changes in certain key variables empirical study of monetary transmission mechanism aims, namely political instruments or variables intermediate transmission, affect nominal and real variables which are the main objectives of the monetary authorities. Since the implementation of the VAR methodology to the study of monetary transmission in the United States by Sims 1981, 1982 and improved by Litterman and Weiss 1984, VAR models have become a standard empirical tool in this context. In addition to their relative simplicity, the attractiveness of VAR models comes from the number of economic benefits. First, compared to models of simultaneous equations reduced form VAR models impose a priori some restrictions, such as the exclusion of potential explanatory variables or restrictions on the structure of the lags to make the identification. Since economic theory and rarely well defined when we suggest exogenous stringent assumptions of the approach of VAR models has the advantage of taking into account historical data. Second, the extent and nature of the unrestricted lag structure levels of VAR models provide a better guarantee against number of econometric problems, including false correlations and cointegration problems. Third, despite the intensity of the structure of the lags, the restricted nature of the variables used allows efficient estimation over short periods. This could cause a number of advantages for the study of the mechanisms of transmission, since it could make more reliable estimation results in the prediction of situations where the core economic structure has changed significantly in the past. Fourth, VAR models focus in the impact of a policy by examining the effect of a shock to the random policy variable rather than part of its predictable component. This is in contrast with the models of forms reduced scale, with political variables are treated as exogenous, in such models, a policy shock is defined by explicitly focusing on the random component of a policy variable. Finally, VAR models not only provide an estimate of the coefficients of the effects of monetary policy innovations, but also the confidence intervals around these estimates, allowing a better assessment of the likely effect of these innovations. Essentially, VAR models attempt to explain a set of variables in terms of lags of all the variables considered.

VAR is a representation in which k variables are considered $y_{1,t}, y_{2,t} \ldots y_{k,t}$ each variable is a function of its own past values and those of other variables. The representation of the VAR model with k variables and p lags noted VAR p is written in the following matrix form:

$$Y_t = A_0 + \sum_{i=1}^{p} A_i Y_{t-i} + \mu_t \qquad (1)$$

With:

$$Y_t = \begin{bmatrix} y_{1,t} \\ y_{2,t} \\ . \\ . \\ . \\ y_{k,t} \end{bmatrix} \qquad A_i = \begin{bmatrix} a_{1p}^1 & a_{1p}^2 & . & a_{1p}^K \\ a_{2p}^1 & a_{2p}^2 & . & a_{2p}^K \\ . & . & . & . \\ . & . & . & . \\ a_{Kp}^1 & a_{Kp}^2 & . & a_{Kp}^K \end{bmatrix} \qquad A_0 = \begin{bmatrix} a_1^0 \\ a_2^0 \\ . \\ . \\ a_K^0 \end{bmatrix} \qquad \mu_t = \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ . \\ . \\ \mu_{kt} \end{bmatrix}$$

$\sum \mu = E(\mu_t \mu_t')$ Dimension of the matrix (k, k) covariance error variances there. This matrix is unknown. This representation can be written using the lag operator (L):

$(I - A_1L - A_2L^2 - \ldots - A_pL^p)Y_t = A_0 + \mu_t$

$A(L)\ Y_t = A_0 + \mu_t$

Once the representation of the model clarified, it should study the properties of different sets used.

Indeed, the parameters of the VAR process can only be estimated on stationary time series (without seasonality and without trends). Thus, after studies of the characteristics of series or series are stationary transformations by difference, prior to the estimation of the parameters in the case of a stochastic trend, or it is possible to add a trend component in the VAR specification in If a deterministic trend. To test the stationary of the selected series, we use the Dickey-Fuller. These tests not only detect the existence of a trend (unit root test) but also to determine the right way to stationary. Models as a basis for the construction of these tests are three. The principle of the test is simple: if the hypothesis H0: $\Phi_1 = 1$ is retained in one of these three models, the process is not stationary.

(1) $x_t = \Phi_1 x_{t-1} + \varepsilon_t$

(2) $x_t = \Phi_1 x_{t-1} + \beta + \varepsilon_t$

(3) $x_t = \Phi_1 x_{t-1} + bt + c + \varepsilon_t$

If H0 is true, the chronic x_t is not stationary, whatever the model chosen. The general principles of the test are:

Φ_1 It is estimated by ordinary least squares noted $\hat{\Phi}_1$ for three models. The estimated coefficients and standard deviations of the model by OLS provide $t_{\hat{\Phi}_1}$ which is analogous to the Student statistic (ratio of the coefficient to its standard deviation). If $t_{\hat{\Phi}_1} > t_{tabulé}$ then we accept the hypothesis H0, there is a unit root process is not stationary and vice versa.

Then the system (1) can be estimated by ordinary least squares (OLS) independently of each other.

The estimated VAR is;

$Y_t = \hat{A}_0 + \hat{A}_1 Y_{t-1} + \ldots + \hat{A}_p Y_{t-p} + e_t$

e_t : Vector of (k, k) of the estimation residuals ($e_{1,t}$, $e_{2,t}$,… $e_{k,t}$) and we note: $\sum_e$ variance covariance matrix estimated model residuals.

Thus, the estimated coefficients of the matrix (A_p), are obtained, these estimates are used to construct estimates of μ_t which is the vector of residuals or innovations.

The VAR model therefore seeks to investigate the impact of changes in the elements of the vector of residuals and all system variables. However, it is generally recognized that the structural form of the model can not be assessed without taking into account some additional information. It is therefore useful to identify some restrictions especially those that facilitate the estimation of the parameters of the matrix A_0.

First, we typically use a vector orthogonal components of the estimated components and knowledge, a vector where the elements are uncorrelated had this restriction has a number of advantages. The orthogonal innovations are by definition uncorrelated, this will be useful to calculate the variances of linear combinations of these innovations us. In addition, if the elements of the orthogonal matrix A_0 are determined, we can highlight the features of impulse responses.

To achieve this orthogonal decomposition of the error vector e_t, Cholesky decomposition is used. This method is to assume that the matrix A_p is lowering triangular, so we impose a strictly contemporary recursive structure to the system. However, this approach requires that we put the system variables in a fixed order, where the first variable responds only to its own shocks. The second variable meets the pulses of the first variable and its own shock and so on. We note here that the assumed recursive structure could conceivably cause problems correlation, however, can be solved by extensions of the VAR model.

3.1.1. Determination of the number of lags

To determine the number of lags (p) of a VAR model, two criteria can be used to know the Akaike criterion (AIC) and Schwarz criterion (SC). The selection procedure in the order of the representation is to estimate all VARs with an order from 0 to h (h being the maximum allowable lag in economic theory).

The AIC function (p) and SC (p) are calculated as follows;

$$\text{AIC (p)} = \log(\det|\textstyle\sum_e|) + \dfrac{2k^2 p}{n}$$

$$\text{SC (p)} = \log(\det|\textstyle\sum_e|) + \dfrac{k^2 p \log(n)}{n}$$

K, number of system variables
n, number of observations
p, number of lags
$\sum_e$ Covariance matrix of variances of model residuals
Lag (p) that minimize AIC and SC criteria is used.

3.1.2. Dynamics VAR and shock analysis

To measure the impact on the values present a variation of innovations (or shocks), representation (VMA) (∞) of the VAR (p) model is used stationary. This representation is given by:

$$Y_t = \eta_t + \sum_{i=0}^{\infty} M_i \mu_{t-i}$$

In this form, matrix M appears as "a multiplier effect", that is to say that it is through this matrix that a shock is reflected throughout the process. Variation at a given time (t) of μ_t affects all subsequent values Y_t.

Then, from the VAR (p) representation estimated we interpret pulse functions summarizing the impact on μ_t and their impact on Y_t

3.1.3. Variance decomposition

This method is advocated by Sims (1980). It is a statistical method to impose the N (N-1) / 2 additional constraints. To enforce these constraints, Sims proposes to use as transition matrix P Cholesky decomposition of the variance-covariance matrix of innovations. Cholesky decomposition which allows the covariance matrix error variances and forecasting and identifies

variances within each of the variables is used. Then simply bring each of these variances to the total variance for the relative weight percentage.

3.2. Application: Calculation of core inflation: the case of Tunisia

To highlight the core inflation, in the case of Tunisia, we will use the structural VAR methodology. This choice is dictated by the interest of this type of modeling after criticism of Sims. According to him, economic theory is sometimes unable to identify large structural models. Thus, this work is based primarily on the study of Blanchard and Quah (1989). They have advanced a technique to distinguish the impact of supply and demand shocks from the structural VAR. According to their hypothesis, the supply shocks affect the long-term production while demand shocks are no long-term impact.

The methodology used in our analysis comes from the work of Blanchard and Quah (1989). It is therefore a bivariate VAR including two endogenous variables namely, the growth rate y_t monthly index of industrial production (IIP) and the change in the inflation rate (π_t). The estimation period is extended from January 1990 to December 2011. The data series are based on the statistics of the National Statistics Institute NSI, the Central Bank of Tunisia and the IMF's International Financial Statistics. According to this methodology, the shocks are distinguished in two types: the first is associated with core inflation, which is kind of money while the second is a real shock acting on the long-term production. Therefore, the main criterion in the specification of the model is the assumption of long-run neutrality of monetary shock on output.

Thus, we use the VAR model with (p) order written in the following structural form:

$$A(L)X_t = \varepsilon_t \qquad (1)$$

$$Var(\varepsilon) = \sum_{\varepsilon} \quad and\ A(L) = \sum_{j=0}^{p} A_j L^j$$

The VAR (1) can be written in the following Wald representation:

$$X(t) = B(0)\varepsilon_t + B(1)\varepsilon_{t-1} + \cdots$$

$$= \sum_{j=0}^{\infty} B_j \varepsilon_{t-j} \qquad (2)$$

We suppose, $B(L) = \sum_{j=0}^{\infty} B_j L^j$

Then, $(t) = B(L)\varepsilon_t \qquad (3)$

The bivariate mobile form can be written as follows:

$$\Delta y_t = \sum_{j=0}^{\infty} \alpha_{11}^j L^j\ \varepsilon_{1t} + \sum_{j=0}^{\infty} \alpha_{12}^j L^j\ \varepsilon_{2t} \quad \Delta\pi_t = \sum_{j=0}^{\infty} \alpha_{21}^j L^j\ \varepsilon_{1t} + \sum_{j=0}^{\infty} \alpha_{22}^j L^j\ \varepsilon_{2t} \quad (4)$$

With;

ε_{1t}; represents the real shock

ε_{2t}; represents the monetary shock

α_{12}^j; is the effect of ε_{2t} on Δy_tafter (j) times, but what we want is the effect of the monetary shock on y at any level and not in first differences. So if α_{12}^j is the effect of ε_{2t} onΔy_t then $\sum_{j=0}^{\infty} \alpha_{12}^j$ will be the effect of ε_{2t} on any long-term level of$y$.

After defining the structural VAR model, look for errors from the structural innovations of the reduced form of the VAR model and that, since ε_t can not be directly observable.

However, the reduced form of the VAR model is:

$$X(t) = D(L)X(t) + \eta_t \qquad (5)$$

With, V(η_t)= Ω ; $D(L) = \sum_{j=1}^{p} D_j L^j$; $X(t) = \begin{pmatrix} \Delta y_t \\ \Delta\pi_t \end{pmatrix}$ $and\ D_i = A_0^{-1} A_i$

And the representation MA(∞) can be written as follows:

$$X(t) = \eta_t + \varphi(1)\eta_{t-1} + \cdots + \sum_{j=0}^{\infty} \varphi(j)\eta_{t-j} \quad (6)$$

$$X(t) = \varphi(L)\eta_t \quad (7)$$

$$with\ \mathrm{V}(\eta_t) = \Omega \ \text{and}\ \varphi(L) = \sum_j^{\infty} L^j$$

(2) and (6) provides:

$$\eta_t = B(0)\,\varepsilon_t \quad (8)$$

$$\Omega = B(0)\sum_{\varepsilon} B'(0) \quad (9)$$

So, to determine ε_t simply know $B(0)$ as $\eta_t$can be obtained from the standard VAR. In addition, equations (3), (7) and (8) gives:

$$B(L) = \varphi(L)B(0) \quad (10)$$

Thus, the whole problem is whether $B(0)$ is identifiable as $\varphi(L)$ can be derived from standard VAR so we can find $B(L)$ thereafter.

3.2.1. Constraint identification

At this stage, the goal is whether it is possible to find the desired information in the standard VAR model. This is not possible unless we put restrictions in the original system. The latter has more parameters than the standard form. Indeed, our structural VAR model has $n^2 + n(np+1) + n(n+1)/2$ parameters as follows;

n^2, the matrix of contemporary variables

n , the vector constants

n^2p , the p matrices associated with lagged variables

$n(n+1)/2$, the variance-covariance matrix

However, in the VAR model in its reduced form, the matrix of contemporary variables disappears. It then we need n^2constraints identified. All the diagonal elements of the matrix of contemporary variables are equal to unity, and then we win n parameters. There is yet $n^2 - n$. In addition, the variance-covariance matrix of the shocks is assumed to be orthogonal. We've therefore, $n(n-1)/2$ less. It then remains yet, $n^2 - n - n(n-1)/2$.

In addition, in a VAR with two variables, $n(n-1)/2$ =1 this constraint is given by the long-term restriction which states that according to economic theory, the monetary shock will have no effect on long-term production. This cancels the upper right of the long-term impact matrix side. Blanchard and Quah (1989) assume standardize the matrix $\sum_{\varepsilon}$ par the identity matrix I. which gives $\Omega = B(0)B'(0)$

To determine the matrix B(0) Blanchard and Quah (1989) suggest the following steps, if we denote by P the unique triangular matrix obtained by Cholesky factorization of Ω, then any matrix B (0) such that $B(0)B'(0) = \Omega$ is an orthonormal transformation of P. In addition, the long-term restriction on the top right of the matrix $\sum_{j=0}^{\infty} \varphi_j B(0)$ is zero and orthogonal restriction gives us a unique way the following transformation

$$B(1) = \varphi(1)B(0)$$

If we consider more than the demand shock has no long-term effect on production, then B (1) is lower triangular and is a factor of the matrix $(1)\ \Omega\,\varphi'(1)$. Posing F= $B(1)$= $\varphi(1)B(0)$ we have: FF'= $\varphi(1)\ \Omega\,\varphi'^{(1)}$ therefore:

$$B(0) = \varphi'(1)F$$

The structural VAR (1) may be as follows:

$$\begin{pmatrix}\Delta y_t \\ \Delta \pi_t\end{pmatrix} = \begin{pmatrix}\mu_1 \\ \mu_2\end{pmatrix} + \begin{pmatrix}B_{11}(L) & B_{21}(L) \\ B_{12}(L) & B_{22}(L)\end{pmatrix} \begin{pmatrix}\varepsilon_{1t} \\ \varepsilon_{2t}\end{pmatrix}$$

With;

$$B_{ij}(L) = \sum_{s=0}^{\infty} B_{ij,s} L^s$$

Thus, the increase in inflation can be written as follows:

$$\Delta\pi_t = \mu_2 + B_{21}(L)\varepsilon_{1t} + B_{22}(L)\varepsilon_{2t}$$

As we define ε_{2t} one of two shocks satisfying the constraint of long-run neutrality, it follows that the increase in core inflation $\Delta\pi_t^{sj}$ is:

$$\Delta\pi_t^{sj} = \mu_2 + B_{22}(L)\varepsilon_{2t}$$

In addition, by projecting to horizon s we have:

$$\Delta\pi_0^{sj} = \mu_{2,0} + B_{22,o}(L)\varepsilon_{2,0}$$

$$\Delta\pi_1^{sj} = \mu_{2,1} + B_{22,o}(L)\varepsilon_{2,0} + B_{22,1}(L)\varepsilon_{2,1}$$

This allows us to reconstruct the historical evolution of inflation canceling $\varepsilon_{1,s}$.

3.2.2. Analysis of variance decomposition

With variance decomposition we try to Calculate for each of the innovations it's contributing to the variance in the percentage. Cholesky decomposition which allows the covariance matrix error variances and forecasting and identifies variances within each of the variables is used. Then simply bring each of these variances to the total variance for the relative weight percentage.

Table 1: Variance decomposition of inflation

Variance Decomposition of D(INF):

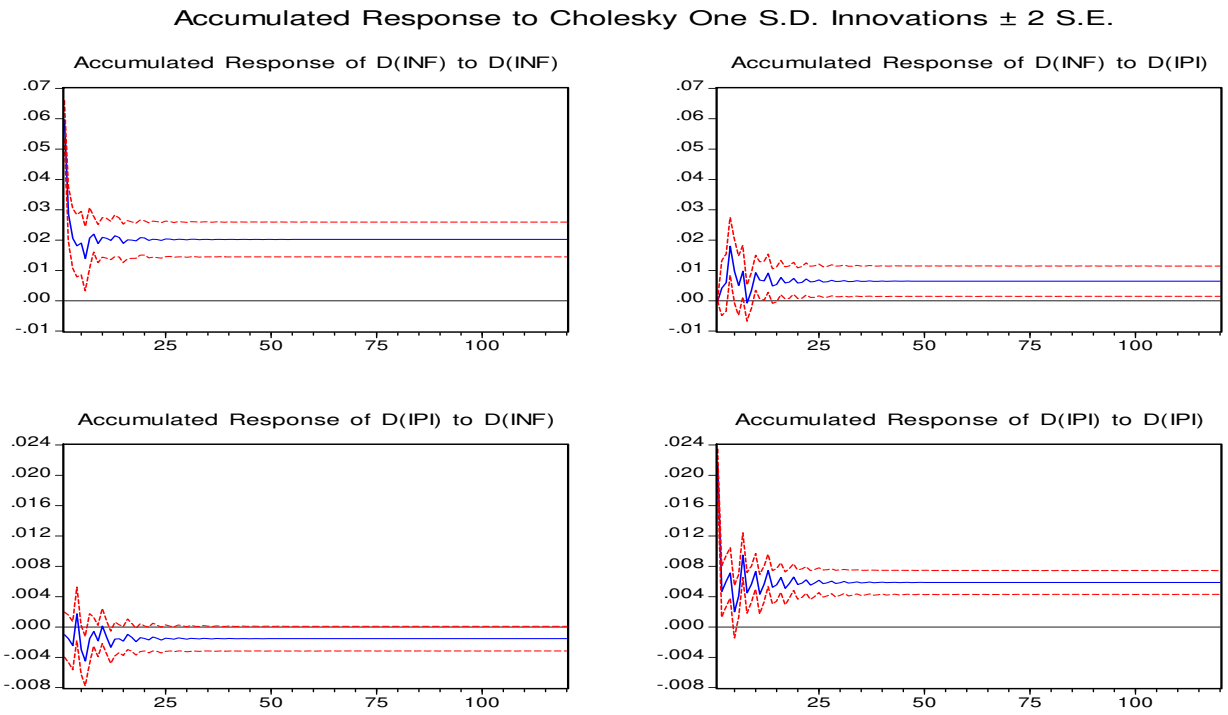
Period	S.E.	D(INF)	D(IPI)
1	0.061573	100.0000	0.000000
2	0.069604	99.61573	0.384268
3	0.070105	99.55265	0.447348
4	0.071240	96.53355	3.466450
5	0.071762	95.15294	4.847058
10	0.073915	91.40803	8.591975
20	0.074297	90.65351	9.346495
50	0.074333	90.59144	9.408558
100	0.074333	90.59142	9.408583
150	0.074333	90.59142	9.408583

For Tunisia's case, we calculated for each series the proportion of variance due to the monetary shock. The variance decomposition of the forecast error shows that the monetary shock has no remarkable influence or even negligible on production since, over a period of 1 to 150, it show that less than 10% of the forecast error of production and almost all of the variance of inflation is explained by the monetary shock ε_{2t} noted here. This result is consistent with the constraint of

retaining identification which states the neutrality of a monetary shock on output in the long term.

3.2.3. Analysis of pulse functions

Figure 1: The impulse functions



The figure above shows the response functions are presented on a time horizon of 120 periods. All shocks are standardized at a value of 1%. So, the vertical axis represents the approximate percentage change in each variable as impulse response of 1% of the other variable. To begin with, we are interested in the response of inflation following a shock of one standard deviation on ε_{1t} and ε_{2t}.

Regarding inflation, we note that the monetary shock has a permanent and significant effect which is consistent with economic theory. Indeed, this component is supposed to control the evolution of the long-term inflation. The effect levels off after one to two years.

Regarding the impact of real ε_{1t} shock on inflation, we note that this impact is slightly positive, which may seem paradoxical, but according Jacquinot (1998) this close to zero impact is not statistically significant. This leads us to accept the hypothesis that the impact is not statistically different from zero. Thus, ε_{1t} shock has no significant long-term effect on inflation. This result allows us to distinguish the long-term effect of ε_{1t} on output and shocks ε_{2t} on inflation.

Regarding production, ε_{2t}shock has not an effect significantly different from zero. This is consistent with the constraint of neutrality monetary shock on output in the long term. The return to equilibrium is fast enough after a year).

In summary, the analysis of the impulse responses confirms the results obtained with the decomposition of the variance of the forecast error.

Figure 2: Core and observed inflation

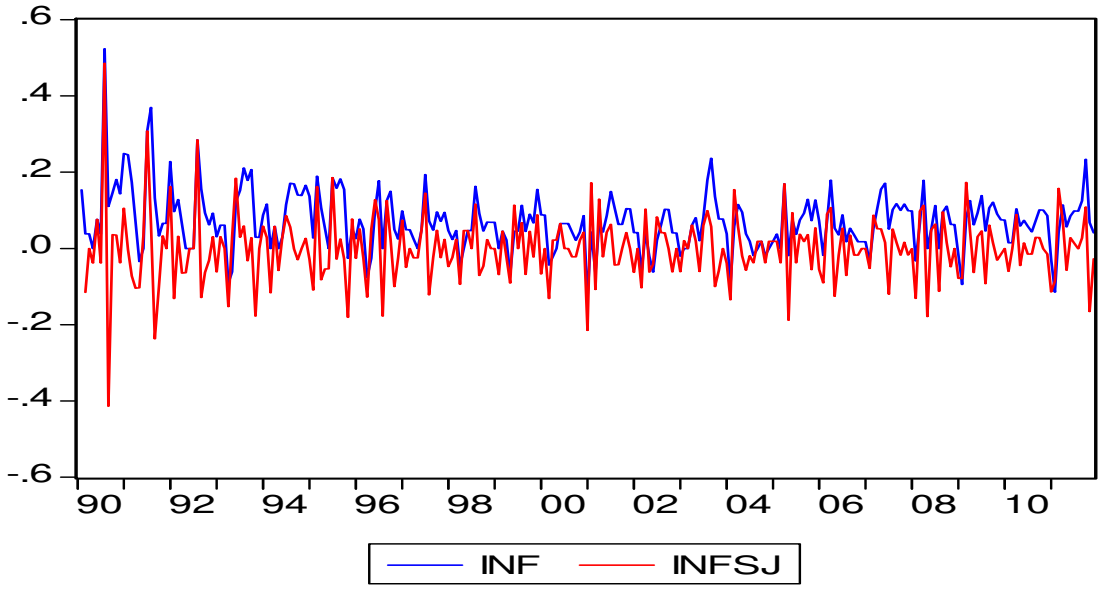


Figure 2 shows the observed inflation and core inflation. We remark first sight generally changes quite similar. This is not surprising since the core inflation is none other than the trend "heavy" of inflation. In addition, it is more often than actual inflation exceeds the core inflation during periods of increased demand and inversely during recessions expected. These observations can be explained by nominal rigidities also more than 32% of the index of consumer prices is administered by the authorities. Therefore, the results for the calculation of the inflation rate in Tunisia remain subject to several critics and liberalization of prices should be further strengthened in order to draw more credible conclusions about the analysis of inflation, its causes and consequences of economic activity in Tunisia. It should be noted at this point that there are other methods for assessing core inflation such as the method of exclusion. This method proposes to exclude the most volatile components of the index of consumer prices.

Conclusion

In this paper, our goal was to provide a credible measure of inflation. This credibility is of great importance for successful inflation targeting regime. Thus, we propose a technique to solve a conceptual disparity between the inflation phenomenon and its measurement. We discussed the standard approaches in the literature about the extent of inflation have some limitations. For this, we proposed an alternative measure called core inflation, defined as the inflation component that has no real impact on long-term production. Indeed, if changes in prices assigns monetary origins can not be excluded, the core inflation that results could be regarded as a measure of inflation is the result of decisions in the conduct of monetary policy. Therefore, some measures of core inflation could be considered more controllable by monetary authorities that the inflation rate published and assigns as the basis for calculating the price index for aggregate consumption. Thus, this relationship seems more reasonable to suggest that core inflation may be a logical and appropriate that aggregate target for monetary policy.

Our evaluation of the core inflation was obtained using a VAR system under the assumption that variations in the extent of inflation are affected by two types of shock. The first type has no impact on real output in the long term, while the second can have this effect. This approach is a reconstruction of the approach of Quah and Vahey (1995) in the case of the

Tunisian economy. The first point we learned from this investigation is that the administered prices constitute a major obstacle to the implementation of a tool for measuring, interpreting and forecasting inflation. BCT has no control over a third of the CPI basket. This is an obstacle to forecast inflation of Tunisia was found, moreover, that core inflation and headline inflation developments generally quite close. We think that this observation is the result of the large share of administered prices and nominal rigidities. This feature of the Tunisian economy is simply a sign of weakness of the economic system and the need for monetary authorities to continue its efforts to liberalize prices.

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