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The NAIRU in Tunisia: Determinants, measurement and policy implications

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Abstract - This paper develops a model to determine the Non-Accelerating Inflation Rate of Unemployment (NAIRU) in Tunisia, i,e, the rate of unemployment at which inflation stabilizes in the absence of any wage-price adjustments. Using data for the period 1970-2016, the NAIRU in Tunisia appears to exhibit two characteristics: (1) it not only stands at a relatively high level but is above an actual unemployment rate that has been persistently high, and (2) it is sensitive to changes in average wages, the effective unemployment rate and the terms of trade, but insensitive to changes in labor productivity. Addressing the problem of relatively high unemployment in Tunisia, would therefore call for a major refocus of the country's economic policies towards measures that raise the level of factor productivity in the various economic sectors along with macroeconomic policies aimed at controlling inflationary pressures.

JEL Classification
D24, E31, E52, J21

Key-words
NAIRU in Tunisia
Unemployment determinants
Labor productivity
Inflation
Macroeconomic policies

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INTRODUCTION

The Non-Accelerating Inflation Rate of Unemployment (NAIRU) is the rate of unemployment at which inflation stabilizes in the absence of any wage-price adjustments. Thus the deviation of the actual unemployment rate form NAIRU signals a desired change in economic policy which, in turn, would depend on whether the NAIRU is lower or higher than the actual unemployment rate.

An effective unemployment rate lower than the NAIRU, indicates a tightening labor market with companies facing increasingly tighter recruiting conditions of skilled workers thereby resulting in higher wages and consequently rising producer and consumer price which calls for counter inflationary measures. On the other hand, as pointed out by neo-Keynesian analysis, when the unemployment rate is higher than the NAIRU, it is possible to implement an expansionary monetary policy without risking inflationary pressures. But any attempt to bring the unemployment rate below the NAIRU threshold by fiscal and monetary "stimulus" policies would be futile in that it only increases the rate of inflation without reducing unemployment. Indeed, as the NAIRU reflects the structural level of the unemployment rate that results from the prevailing fiscal, legislative and regulatory framework, countries with a high NAIRU are urged to undertake structural economic reforms that would sustainably reduce their structural unemployment. For a recent analysis of the relationship between unemployment and inflation see Gordon (2013) and Watson (2014).

1. ESTIMATION METHODS OF THE NAIRU

Being unobservable the NAIRU needs to be estimated for policy analysis. The estimation methods used in the literature can be divided into three categories: structural, statistical and reduced-form methods (Gianella et al., 2008). A brief review of each follows setting the stage for the reduced form method this paper employs to estimate the NAIRU for Tunisia.

1.1. The structural method

It consists of a system of equations that can explain wage and price setting behavior. The empirical literature distinguishes between two approaches. The first specifies wage and price equations in levels as in Layard et al. (1991), Cotis et al. (1996), L'Horty and Thibault (1998), Mc Morrow and Roegers (1999) Phelps (2000) and Chagny et al. (2002). The second uses a rather ad hoc system, which represents the determination of wages by a Phillips curve incorporating expectations and prices by a margin above unit labor costs as in Englander and Los (1983).

Using the different specifications above, the level of equilibrium unemployment is calculated by adopting the assumptions of stable inflation, and of the compatibility of the decisions of companies' profit margins with workers real wages.

The structural approach, however, faces the problem of quantifying institutional variables such as unemployment compensation procedures, legislation, unionization, etc. As reported by Blanchard and Wolfers (1999), Broersma et al. (2000), the omission of these variables would undermine the explanatory power of the model, particularly in the presence of interaction between institutional factors and macroeconomic shocks in determining the structural unemployment rate.

To compensate for lack of quantifiable institutional measures, increasingly studies have pooled information of national origin to estimate wage and price behavior by reduced form equations.

1.2. The statistical methods

They are entirely focused on the actual unemployment rate, which they split into trend (NAIRU) and cyclical (cyclical unemployment) components. The underlying assumption is that in the absence of a long-term trade-off between inflation and unemployment, the latter should, on average, fluctuate near the NAIRU. In other words, the self-balancing forces at work in the economy are strong enough to bring unemployment back to its trend level.

Statistical methods make it possible to identify these two components either on the basis of filtering techniques, the most used being the HP filter (Hodrick and Prescott, 1997) and the bandpass filter (Baxter & King, 1995), or methods implying that unemployment tends to follow a random walk (Watson, 1986). But they suffer from several practical disadvantages:

- The estimated indicators are often not sufficiently correlated with inflation and difficult to extrapolate, even in the short term.
- These indicators tend to lose statistical validity at the end of the sample, which is the most interesting period for economic policy; nevertheless, it is often possible to mitigate this problem by adding at the end of the sample of data a few years of forecasts, a commonly followed practice.
- Most filters behave like simple moving averages and therefore give poor results in the event of a sudden and substantial change in the unemployment rate.
- It is often impossible to assess the degree of precision of the results. As a result, recent studies that estimate NAIRUs rarely use these methods, resorting instead to more efficient ones.

1.3. The reduced-form methods

To calculate the NAIRU, studies have opted for the Phillips curve method incorporating inflation expectations. This method, which is part of a long-standing empirical tradition, has the main advantage of being directly related to the NAIRU definition. In addition, its simplicity and transparency make it compatible with several other models that are related to the structural method.

As in the statistical approach, some identification assumptions are necessary before estimating the NAIRU by the reduced-form method. Fortin (1989), Fuhrer (1995), Estrella and Mishkin (1998) hypothesized that the NAIRU remains stable over time. For the analysis of periods up to thirty years, this assumption may be valid if the observed unemployment rate hovers around a stable average, as in the case of the United States since the sixties.

However, this is clearly not the case for countries in the European Union where the unemployment rate has been on an upward trend since the end of the 1970s. Under these conditions, a constant rate is unlikely to give a meaningful estimate as indicated by Setterfield et al. (1998).

One of the first attempts to estimate time-varying NAIRUs was made by Elmeskov (1993) and then taken up by the OECD. For the most part, this method deduces NAIRU movements from changes in wage inflation, based on the concept of an underlying Phillips curve.

In a related work, Bell and Blanchflower (2018) show that the Phillips curve in Britain is flat and conclude that the British NAIRU is declining with an anticipated fall in the underemployment rate to below 3%, against 4.9% in 2017 which, as a consequence, renders the attainment full employment in the United Kingdom a difficult task.

The reduced-form method is relatively simple and gives plausible and up-to-date indicators. Nevertheless, it could be improved in different ways:

- The concept could be better defined and based in principle on a short-term notion of NAIRU, but this characteristic is weakened by a smoothing over time (which brings it closer to the notion of "unskilled" NAIRU);
- The Phillips-curve relationship could be enriched by introducing additional explanatory variables that strengthen the link with inflation (Holden and Nymoen, 1998).

More sophisticated estimation methods further contribute to these improvements. Indeed, the Kalman filter has been used in several studies, most of which have been applied in the United States and have simultaneously estimated the NAIRU and the Phillips curve and measured the statistical uncertainty of the NAIRU (Gordon, 1997, 1998 ; King et al., 1995 ; Staiger et al., 1997).

In brief, the reduced form filtering techniques have several advantages. First, they give NAIRU estimates in direct relation to inflation. Second, the fully specified Phillips curve makes it possible to distinguish between long term and short-term NAIRU[1] within the same framework (Ball and Mankiw, 2002). Third, these indicators can be easily obtained in a timely and consistent manner.

Although the reduced-form filtering methods have certain shortcomings, they bring improvements compared to the other methods, particularly as regards the real-time estimation of the NAIRU.

However, in the Tunisian context, it is not possible to apply these filtering methods because of the unavailability of quarterly or half-yearly data concerning the main variables, in particular the actual unemployment rate, the nominal wage and the labor productivity.

The alternative we have chosen is to apply the reduced-form method to estimate an augmented Phillips curve that is as stable as possible and that takes into account the socio-institutional context of Tunisia, particularly with regard to the wage determination process.

The structural unemployment rate, reflecting persistent long-term unemployment, has been the subject of divergent explanations. In the classical tradition, the real business cycle ascribes the persistence of a high unemployment rate to the effects of supply shocks that affect productivity and lead to a fairly stable natural rate of unemployment

Keynesian explanations of the persistence of unemployment are based on a rejection of the natural rate as a single rate of unemployment and argue for the existence of a hysteresis effect. This hypothesis, first proposed by Gregory (1986) then formalized by Blanchard and Summer (1986), predicts that long-term and prolonged unemployment, whatever its causes, could lead to a reduction in the effective supply associated with the factors production and an increase in the NAIRU.

An alternative explanation of the persistence of unemployment is that proposed by Giavazzi and Wyplosz (1985). It is based on the logic of a very slow adjustment of the economy to its stationary state rather than an adjustment in accordance with conventional assumptions of the natural rate which postulate that in the absence of economic shocks and cycles, wages tend towards a level of equilibrium that equates supply and demand in the labor market. One of the main causes of this slowness could be nominal wage rigidity.

This paper aims primarily to determine the level of NAIRU in Tunisia by developing a model based on Taheri (2000) that identifies different sources of unemployment, and considers the effects of the natural unemployment rate on the choice of economic policies, hysteresis and the weak adjustment process of the

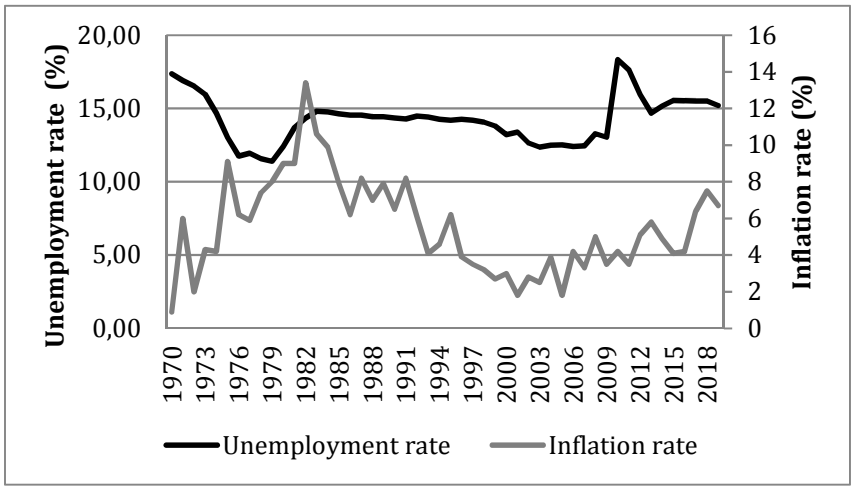
[1] The short-term NAIRU is volatile, influenced by temporary factors that alter short-term inflation, such as oil and other price fluctuations. The Long-term is more stable being determined independently of such factors.

employment market especially after the uprising where the unemployment rate is very high, especially among graduates. This paper is organized as follows: section 1discusses the Tunisian socio-economic and institutional context. The second section is devoted to the presentation of the data and methodology employed to elaborate the model used to estimate the NAIRU. The third section presents the model used for the determination of the NAIRU in Tunisia; Finally, the section 4 puts forward concluding observations followed by policy recommendations.

2. TUNISIAN SOCIO-ECONOMIC AND INSTITUTIONAL CONTEXT

Since the uprising, Tunisia has been facing consecutive vulnerabilities and an increasingly unsustainable political-economic situation. Indeed, the twin unemployment/inflation problem caused an increase in the public debt which reached 69.7% of GDP at the end of 2017 and 72% at the end of 2018, against 40.7% at end 2010 thus creating strong pressures on the national currency. Indicators of the labor market easing or tightening such as the unemployment and inflation rates are important elements in assessing the Tunisian Central Bank's monetary policy in its attempt to bring about the desired national economic adjustment.

Figure 1. Evolution of unemployment and inflation rates in Tunisia (en %) (1970-2019)



Source: National Institute of Statistics database (The nation's accounts, and Statistical yearbooks of Tunisia).

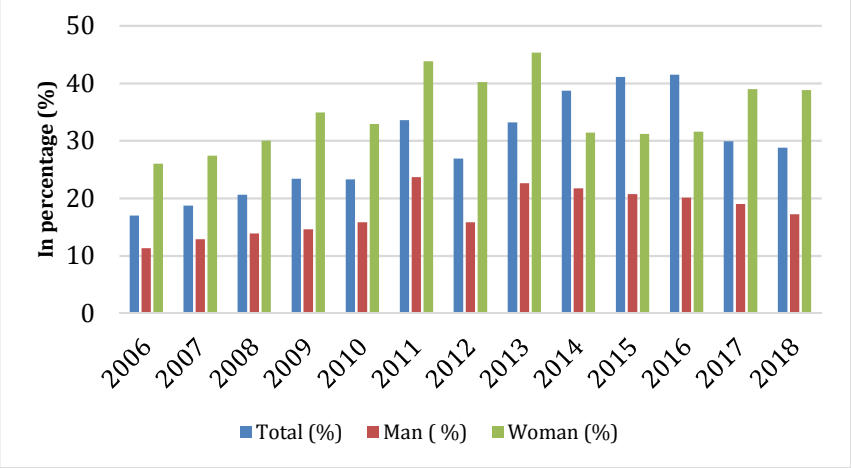
Figure 1 indicate the evolution of the Tunisia unemployment and inflation rates over the period 1970 and 2019. It should be noted that, while in the period 1970-1983, there was an inverse relationship between unemployment and inflation, in accordance with the Phillips curve, in the following period 1984-2019, it was no longer the case: Inflation and unemployment rates have evolved concomitantly, both showing declining trends during the period 1984-2003 (result of the price stabilization policy adopted by the government in 1982), followed by an upward trend since then. The jump of the unemployment rate in 2011 to over 18 percent from 13 percent the year before is due to the socio-economic turmoil that accompanied the uprising with a consequent loss of jobs. The subsequent decline to a range of 15.8 percent in 2012-19 is partly due to a governmental policy of creating,

mainly in 2011 and 2012, new jobs in the public sector[2] to ensure political stability and not to any significant economic growth whose rate after the uprising is yet to recover to its pre-2011 levels. A contributing factor to the decreasing rate of unemployment is Tunisia's demographic transition.

In recent years (i.e. a lower fertility rate) that has resulted in a declining rate of population growth and hence in the numbers of new jobseekers. It remains though that the government's employment policy resulted in an increased wage bill without any accompanying increases in productivity, which, in turn, has tended to sustain inflationary pressures.

Significantly, since 2006 the rate of unemployment of university graduates has been at levels higher than the national average, ranging after 2011 between 27 and 32 percent (Fig 2). Equally, unemployment among female graduates has been much higher than male graduates, averaging in the period 2012 -2017, 34% and 20% respectively. This confirms a remaining bias in the labor market against female employment, the personal status code adopted in 1956 that gave Tunisian women equal rights with men notwithstanding[3].

Figure 2. Unemployment rate of graduates by sex 2006-2018



Source: Ministry of professional Training and Employment and National Institute of Statistics database (Employment and unemployment indicators).

The inflation trend since 2000 (Fig.1), has been rising averaging in 2000-2010 about 3.1 percent compared to 10 percent in 2011-2018. The observed decline after 2012 was reversed after 2016 with inflation reaching 7.4% at the end of 2018, fueled by the depreciation of the Tunisian dinar. In the pre uprising period, while monetary policy was oriented towards the support of economic activity, Tunisia managed to keep inflation within acceptable levels thanks to its policy of price administration, which countered the shocks of rising international commodi-

[2]Nearly 59,000 new jobs were created. Law No. 2012-4 of 22 June 2012 provided for derogations, in particular for political prisoners enjoying an amnesty, the wounded of the revolution and members of family or close relatives of martyrs of the revolution

[3]Decree of 13 August 1956, promulgating the Personal Status Code, published in JORT 104 of 28 December 1956.

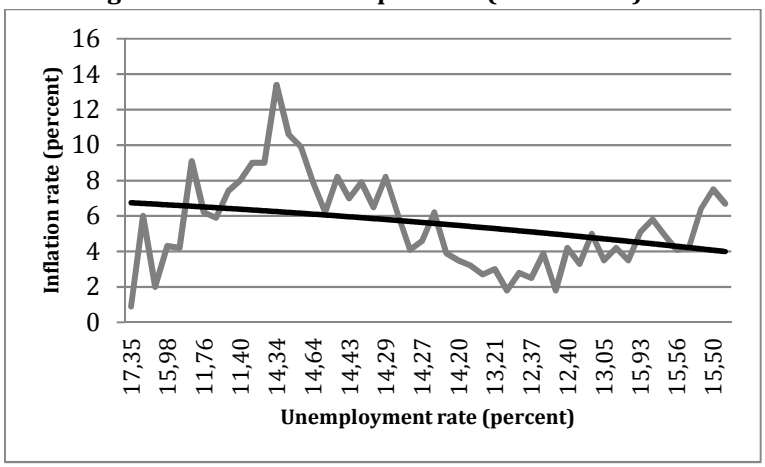
ty and energy prices. In the post-uprising period, however this policy began to be phased out.

The Central Bank has been attempting to counter inflationary pressures of recent years by following a tighter monetary policy through raising interest rates and controlling bank liquidity. But these measures will have a very limited impact on inflation as long as its causes remain beyond the control of the Central Bank: e.g.depreciation of the dinar, a flourishing informal market, and rising demand following increases in the wage bill.

The fear is that in recent years Tunisia has entered a cycle of stagflation. Inappropriate governance combined with various austerity measures taken since 2015 have led to deteriorating macroeconomic conditions. Given the expectations of economic agents in the context of the prevailing economic situation in Tunisia, as things stand, policy makers would not be able to maintain an unemployment rate lower than the natural rate[4] without leading to a rising inflation. Hence for this policy objective to be achieved there is urgent need for institutional reform as well as structural changes in the labor and goods markets

A construction of the Phillips Curve for 1970-2017 (Figure 3) shows it is relatively flat.

Figure 3. Tunisian Phillips curve (1970-2019)



Source: Authors made based on the database of the National Institute of Statistics.

This long-term flattening of the curve can be explained by three factors. First, with the increase in foreign competition, the ability of domestic firms to raise prices in line with rising demand has declined. Second, Tunisia's integration into the WTO and the signing of multilateral and bilateral free trade agreements with its partners have increased trade and investment flows, making the price of goods less sensitive to the pressure of domestic demand. Indeed, in recent years, and especially following the depreciation of the dinar, the relationship between inflation and domestic demand seems to have broken down. The Third factor is the growing incompatibility of the expertise of young graduates with the available job opportunities, where firms are having difficulty recruiting skilled workers.

[4] The natural rate is defined as the level of unemployment towards which the economy converges in the long term in the absence of fluctuations in the economic cycle and structural changes.

In this context we will try to estimate the NAIRU for Tunisia. The gap between the calculated NAIRU and the actual unemployment rate will constitute an indicator for policy makers on the future evolution of the unemployment rate and inflation so that they can adopt appropriate economic policies.

3. DATA SOURCES AND METHODOLOGY

3.1. Data

In our study, we use different sources of data: the population-employment survey conducted by the National Institute of Statistics (NIS) (1980, 1990, 1995, 1997-2011 and 2015), the National Accounts (1983-2018), statistical yearbooks (National Institute of Statistics (NIS) (1970-2018), Employment and unemployment indicators (NIS). Data can be downloaded from the NIS or the Economic Research Forum data portal[5].

3.2. Methodology

It should be noted that several empirical models have been tried to determine the NAIRU in Tunisia. Indeed, in the intermediate approach of estimation of the increased Phillips curve there are no fundamental differences between all the empirical models. All relate wage inflation or price inflation to the unemployment rate and / or its variations (Helali, 2018). The other variables introduced remain dependent on the country's institutional, political and social context. For example, we have tried to apply the Mc Morrow model (1996), which focuses on the famous price-wage loop, but in all its versions it led to a very high NAIRU that exceeds the effective unemployment rate over the entire period. While this possibility is not excluded by in the literature, we preferred to adopt the results provided by the Taheri model. Soussi and El Ouardani (2013) showed that the NAIRU in Tunisia, over the period 1971-2010 was 14.1% and determined particularly by the difference between the apparent productivity and its trend.

Drawing on these varying explanations of the structural unemployment rate we construct a global Taheri based model (2000) to estimate the NAIRU for Tunisia, its determinants and test its empirical results for the period 1970-2016 by introducing two dates (1982 and 2011) as dummy variables.

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The Taheri model has the advantage of not excluding any source of unemployment, it considers the effect of the natural unemployment rate, hysteresis and the weak adjustment process. If all these scenarios are theoretically possible, by taking account of the country's political-social and institutional context, this model allows for the testing of different hypotheses of sources of unemployment. The empirical results will then permit the determination of the most plausible alternative hypothesis.

[5] Can be downloaded from the National Institute of Statistics (www.ins.nat.tn) or from the Economic Research Forum data portal: (www.erfdataportal.com).

The basic equation in the model considers wage inflation caused by a positive gap between the NAIRU and the effective unemployment rate.

The assumption of a natural unemployment rate is represented by the following expression:

$$\Delta w_t = \alpha_1 \Delta w_{t-1} + \alpha_2 (U_t^* - U_t) \quad (1)$$

Lowercase letters indicate the logarithm of the values shown in upper case. With, Δ the difference operator, W the nominal wage, U_t^* the NAIRU, and Ut the unemployment rate observed.

For $\alpha_1 = 1$, we have $\Delta w_t = \Delta w_{t-1} + \alpha_2 (U_t^* - U_t)$ and therefore equation 1 confirms the natural unemployment rate assumption. However, if $0 < \alpha_1 < 1$, equation 1 captures an inflationary inertia.

To be able to identify the effect of hysteresis in the process of unemployment[6], the model assumes that the NAIRU follows a self-regressive behavior:

$$U_t^* = \beta_1 U_{t-1} + \beta_2 Z_t \quad (2)$$

With, Zt: a composite vector containing all the variables (productivity, terms of trade variations, etc.) that can influence the determination of the NAIRU.

If $\beta 1 = 0$, the stationary value of the NAIRU will be independent of the actual current unemployment rate and in this case will be equal to $\overline{U}^* = \beta_2 \overline{Z}$, with $\overline{Z}$ the stationary value of Z. This is the assumption of the natural unemployment rate.

In the case of $\beta_1 = 1$[7], there is a hysteresis effect expressed by a stationary value of the NAIRU, variable and dependent on the trajectory of Zt in time, thus:

$$\overline{U}^* = U_0 + \beta_2 \sum z_t \quad (3)$$

For $0 < \beta_1 < 1$, the NAIRU will be equal to

$$\overline{U}^* = \frac{\beta_2 \overline{Z}}{(1 - \beta_1)}.$$

Here, against the assumption of the natural unemployment rate, the effective unemployment rate will gradually move towards the NAIRU, with a rate of adjustment inversely proportional to β1.

If we substitute equation (2) in (1) and considering $\Delta U_t = U_t - U_{t-1}$, we can write:

$$\begin{aligned} \Delta w_t &= \alpha_1 \Delta w_{t-1} + \alpha_2 (\beta_1 U_{t-1} + \beta_2 Z_t - U_t) \\ &= \alpha_1 \Delta w_{t-1} + \alpha_2 \beta_1 U_{t-1} - \alpha_2 U_t + \alpha_2 \beta_2 Z_t \\ &= \alpha_1 \Delta w_{t-1} - \alpha_2 U_t + \alpha_2 U_{t-1} - \alpha_2 U_{t-1} + \alpha_2 \beta_1 U_{t-1} + \alpha_2 \beta_2 Z_t \\ \Delta w_t &= \alpha_1 \Delta w_{t-1} - \alpha_2 \Delta U_t - \alpha_2 (1 - \beta_1) U_{t-1} + \alpha_2 \beta_2 Z_t \end{aligned} \quad (4)$$

[6] The existence of a hysteresis phenomenon is based on the belief that a period of prolonged unemployment may lead to a weakening of the competitive mechanisms, in particular a decrease in the influence of unemployment on the growth of the real wage and therefore an initially cyclical unemployment can turn into structural unemployment. Econometrically, this phenomenon means that the wage growth rate is no longer sensitive to the level of unemployment but rather to its variation, i.e. to the difference between actual unemployment and a weighted average of past unemployment.

[7] We show below, following econometric estimates that this is the case for the Tunisian NAIRU.

It is according to the value of β_1 in equation (4) that we can distinguish between three alternatives.

First, in the case of the natural unemployment rate, i.e. $\alpha_1 = 1$ and $\beta_1 = 0$ and equation (4) is reduced to:

$$\Delta w_t = \Delta w_{t-1} - \alpha_2 U_1 + \alpha_2 \beta_2 Z_t \quad (5)$$

$$\text{Or} \quad \Delta^2 w_t = -\alpha_2 U_t + \alpha_2 \beta_2 Z_t \quad (6)$$

so, for the natural rate assumption, it is the acceleration (deceleration) of inflation that is influenced by the level of the unemployment rate.

Second, for the case of hysteresis, i.e. $\beta_1 = 1$ and $\alpha_1 \neq 1$, equation (4) is reduced to:

$$\Delta w_t = \propto_1 \Delta w_{t-1} - \propto_2 \Delta U_t + \propto_2 \beta_2 Z_t \quad (7)$$

According to equation (7), in the case of hysteresis, inflation will be influenced only by changes in the rate of unemployment.

Finally, for the case of persistence of the adjustment process, equation 4 provides a simple way to test simultaneously the three hypotheses: natural unemployment rate; hysteresis and persistence of the adjustment process. i.e. $\alpha_1 \neq 1$ and $\beta_1 \neq 0$, $\beta_1 \neq 1$, that is to say: $0 < \propto_1 < 1$ *et* $0 < \beta_1 < 1$.

4. CONSTRUCTION OF THE MODEL FOR TUNISIA

4.1. Explanatory variables of NAIRU in Tunisia

The explanation of the NAIRU in Tunisia pertains to the unemployment/inflation relationship in the period 1970-2016. To analyze empirically equation (4), we integrate in the vector Zt, which groups other than the unemployment rate and its variation, the three variables: terms of trade, labor productivity gain and its trend. Two dummy variables are introduced. It should be noted that the variables are expressed in logarithms of the export and import price indices.

The terms of trade

We designate this variable as *Tech*.

Returning to the variable in the original version of the model developed by Taheri (2000), we find the presence of a delay period which is explained by the introduction of an adaptive anticipation hypothesis on prices. It is also possibly explained by the use of quarterly price index but this is not relevant in the context of this paper as we rely on annual data.[8]

The labor productivity gain

This gain is measured by $PorT_t^* = (\Delta x_t - \Delta x_t^*)$ which is the difference between the growth rate of the actual labor productivity and its estimated trend over time, with x_t and x_t^* respectively being the logarithms of the apparent productivity of work and its trend.

The apparent productivity of the labor factor[9] represents a real indicator of supply shocks; its introduction into the wage equation responds to the foundation

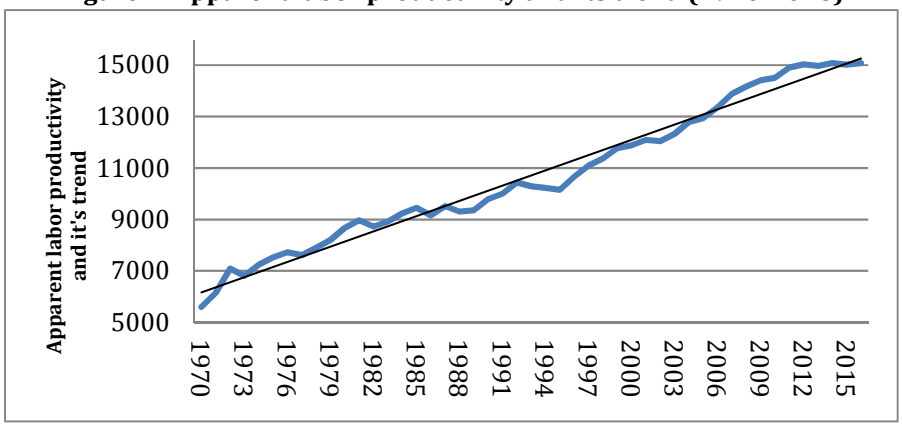
[8] Data on the various annual price indexes for the period 1970 to 2016 are available in the National Institute of Statistics yearbooks.

[9] The Phillips curve literature considers that the term "augmented" is due to the introduction of certain structural variables into the Phillips curve equation, such as labor productivity, terms of trade, incomes compensation, and union negotiations.

of the "increased Phillips curve" (Phan Duc Loic (1971).The net effect of labor productivity on the volume of employment is not obvious[10], but its effect on wages should be positive. In this model, the productivity shock on wages is introduced by considering the gap between the evolution of productivity and that of its trend (Figure 4).

If this difference is positive, it would imply a positive wage shock and vice versa. It is interesting to introduce in the econometric estimates a certain delay in the specification in order to take account of the delay in wage bargaining by the social partners.

Figure 4. Apparent labor productivity and its trend (1970-2016)



Source: Authors estimation based on the database of the National Institute of Statistics.

$$y = 197.65\ x + 5967{,}5$$

The productivity trend (x*) is calculated by determining an equation to the trend curve associated with the evolution of productivity over time. A linear trend curve is associated with $R^2 = 0.979$ and is therefore retained.

The apparent productivity of labor is calculated by relating GDP at constant prices (2005) to the number of employees. Subsequently was transformed into Log and we calculate the first differences to get Δx_t^*. We proceed in the same way for productivity and we get Δx_t.

Dummy variables

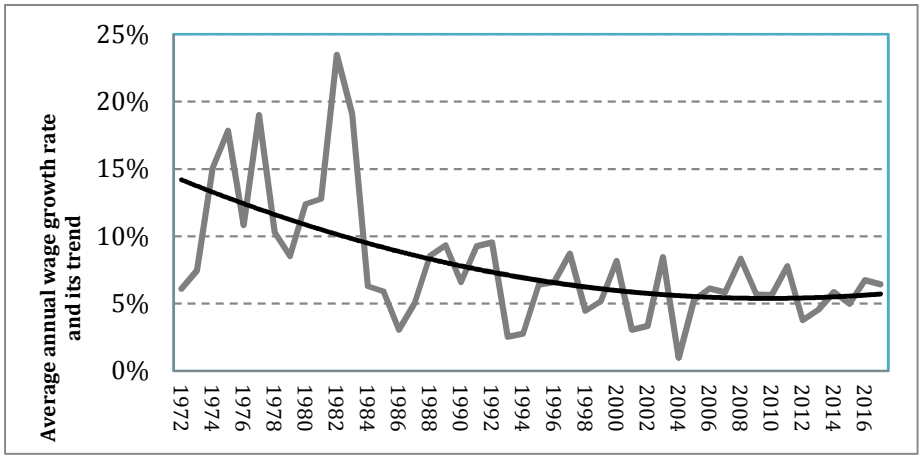
We introduce two dummy variables, the years 1982 and 2011 to consider stylized facts specific to the Tunisian labour market, notably of socio-political origin, which have affected wage bargaining by trade unions, a hysteresis factor usually developed by the "insider-outsider" models Lindbeck and Snower (2002).

Indeed, the reading of events influencing wage bargaining in 1982 shows that there had been very high wage increases (Figure 5) not accompanied by improvements in real labor performance indicators. In fact, with [an increase of more than 24% in the average annual wage, productivity fell by 3.4%].

The year 2011 saw the outbreak of the successful uprising. Since then major difficulties have been affecting the country's productive system and political stability. A major illustration is the question of wages which has been influenced more by social and political than by economic considerations.

[10] According to Okun's law it depends on the gap between productivity and growth.

Figure 5. Average annual wage growth rate and its trend in Tunisia (1972-2016)



Source: National Institute of Statistics data base (National Surveys on Population and Employment).

4.2. Estimation of the wage equation

By incorporating the variables predicted by the econometric model into equation (4), we obtain the following empirical equation:

$$\Delta w_t = C1 + C2\Delta w_{t-1} + C3\Delta U_t + C4U_{t-1} + C5\,\Delta Tech_t + C6PorT_t^* + u_t \qquad (8)$$

Recall that: Δw_t is the nominal wage growth measured by the first difference of the log of the nominal wage between t and t-1; $\Delta Tech_t$ is the difference between the growth rates of the export price index and the import index; $PorT_t^*$ indicates the productivity shock.

In accordance with equation (4) of the theoretical model, the coefficients to be estimated will be interpreted as follows:

$C_2 = \alpha_1$, $C_3 = -\alpha_2$, et $C_4 = -\alpha_2 (1-\beta_1)$

The external terms of trade are included in the Zt vector, which is composed of variables that can influence the NAIRU. The integration of this variable into the vector Zt depends on its determined empirical relevance.

In practical terms, the omission of this variable implies that, in Tunisia, the wage bargaining process is not influenced by the terms of trade variations. At the theoretical level, the disappearance of this variable does not prevent the determination of the NAIRU variable if the productivity variable remains significant.

The omission of the variable ΔU_t amounts to assuming that its coefficient will be zero in the estimated equation. Testing this hypothesis of the nullity of the estimated coefficient in the original model equation, provides a probability of rejecting $C_3 = 0$ at a 50.3% risk of being erroneous based on Chi-square statistics and 51.1% on the Fisher's statistical basis. It follows that $C_3 = 0$ does not pose any empirical problem. However, $C_3 = 0$ results in $-\alpha_2 = 0$ in equation (4) of the theoretical model. Thus, not only will we eliminate ΔUt from the empirical equation but also U_{t-1}. Under these conditions, the estimation of the wage equation does not account for the variable unemployment rate and therefore will not measure the NAIRU. This leads us to say that we must have at least ΔU_t significant to be able to calculate the Tunisian NAIRU.

Before estimations we proceeded to analyzing of the variance covariance matrix to detect the possibility of multicollinearity. As indicated below we see no correlation between the explanatory variables.

Table 1. Variance-covariance matrix

	Ldwt	dUt	Lut	dTECH	PorT
Ldwt	1.0000				
dUt	0.0449	1.0000			
Lut	-0.1107	-0.3300*	1.0000		
dTECH	0.2662	0.0465	-0.1855	1.0000	
PorT	-0.1712	0.0514	-0.2304	0.1720	1.0000

Always to detect the problem of multicollinearity we carried out the "VIF" test, the results of which are in the table below.

The statistic of this test is equal to 1.16 as shown in table 2, much lower than 10 which eliminate any risk of multicollinearity.

Table 2: VIF test

Variable	VIF	1/VIF
Lut	1.23	0.812686
dUt	1.17	0.856927
Ldwt	1.14	0.873751
dTECH	1.13	0.886397
PorT	1.11	0.898226
Mean VIF	1.16	< 10 no-multicollinearity risk

The results of equation (8)'s estimation (Table 3 model (1)), show that this model is not appropriate to the Tunisian context Indeed, the impact of the unemployment variation and unemployment lags, which are the key variables of the model, are not significant although the signs are negative according to the theoretical model**.** Similarly, the impact of productivity's fluctuations is not significant. We must underline the positive and sufficiently significant effect of exchange terms. It appears that in this version the econometric model requires improvements.

- To improve the results of this model in accordance with the theoretical foundations of the basic model, we proceed to introduce Dummy variable for 1982 in model 2 which is statistical significant but all dUt, L.Ut, dTECH and PorT variables are not. We note that 1982, witnessed remarkable increases in wages that were not accompanied by productivity improvements. In fact, simultaneously with an increase of more than 24% of the average annual salary, productivity recorded a fall of 3.4%.
- The year 2011 saw the start of wage negotiations after the revolution regardless of productivity. That is why we introduced Dummy variable in 2011 with1982 in the model. We note that in model 3 introducing only the Dummy variable in 2011 is not statistically significant and does not improve the model. Decidedly we adopt two Dummy variables for 1982 and 2011 in the model 4. As already noted, these two years were marked by two instabilities relating to wage bargaining in Tunisia.

- In the model 4 we concentrate on the productivity effect. It is found that the variable PorT is not significant and with a negative sign contrary to the theoretical basis.
- Consequently, we retain model 6 which delates lagged unemployment Ut-1 (C_4=0) and introduces terms of trade and adopts the two dummy variables for 1982 and 2011.

At results the better model estimating the process of wage determination in Tunisia is formed by the equation (9) and mentioned by Model 6 in the table below.

$$\Delta w_t = C1 + C2\ \Delta w_{t-1} + C3\ \Delta U_t + C5\ \Delta Tech_t + C6\ PorT + C7\ Dummy82 + C8\ Dummy11 + u_t \quad (9)$$

Table 1 summarizes the different tests approved and indicates the adapted specification that corresponds to models from (l) to (6).

Table 3. Results of the estimations for Tunisian context

Explained variable: dwt	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
L.dwt	0.501***	0.434***	0.533***	0.498***	0.440***	0.477***
	(0.145)	(0.129)	(0.152)	(0.128)	(0.130)	(0.108)
dUt	-0.0984	-0.429	-0.871	-2.329**	-1.835	-1.609*
	(0.660)	(0.585)	(1.236)	(1.092)	(1.109)	(0.937)
L.Ut	-0.335	-0.222	-0.467	-0.520	-0.526	
	(0.427)	(0.375)	(0.465)	(0.390)	(0.406)	
dTECH	0.211	0.187	0.240	0.251**		0.250**
	(0.140)	(0.123)	(0.146)	(0.122)		(0.118)
PorT	0.0324	0.0572	-0.0243	-0.0745	0.0196	
	(0.208)	(0.182)	(0.223)	(0.187)	(0.188)	
Dum82		0.136***		0.157***	0.156***	0.156***
		(0.0378)		(0.0379)	(0.0394)	(0.0377)
Dum11			0.0602	0.144**	0.107	0.107*
			(0.0812)	(0.0709)	(0.0713)	(0.0628)
Constant	0.0863	0.0725	0.101	0.106*	0.111*	0.0349***
	(0.0618)	(0.0543)	(0.0654)	(0.0547)	(0.0569)	(0.0105)
Observations	45	45	45	45	45	45
R-squared	0.333	0.502	0.343	0.552	0.501	0.530

**** p<0.01, ** p<0.05, * p<0.1 The omitted variables are non-significant.*

Considering these results, we can note according to the following equation:

$$\Delta w_t = \alpha_1 \Delta w_{t-1} - \alpha_2 \Delta U_t - \alpha_2 (1-\beta_1) U_{t-1} + \alpha_2 \beta_2 Z_t$$

First, $\alpha_1 = C_2 = 0.477$, i.e. less than 1, which indicates that we do not have a fixed natural unemployment rate for the entire period of estimation. And therefore, the NAIRU can change from one period to another regardless of the value of $\alpha_2 = - C_3$. This change can be explained by the economic situation of the Tunisian economy and the applied economic policies.

Second, if the value of α_2 is greater than 1 ($\alpha_2 = 1.609$) this suggests the existence of a hysteresis phenomenon. But the change in the unemployment rate is not significant in the wage equation ($\beta_1 = 1$) and therefore this hysteresis is partial and not total.

Finally, the coefficient associated with the exchange terms $C_5 = 0.250$ (which corresponds to $\alpha_2\beta_2$ of the theoretical model because the variable PorT, is non-significant), which implies that $\beta_2 = 0.155$.

The conclusion that can be drawn from these results is that the Tunisian labor market is characterized by a partial hysteresis and does not allow for a stable natural unemployment rate.

4.3. Determination of NAIRU in Tunisian

As the NAIRU is an unemployment rate calculated from a salary equation based on augmented Phillips curve logic, the estimated equation must be solved by assuming that inflation is stable, i.e. the nominal wage growth rate is fixed. In this case, the unemployment rate will be equivalent to the NAIRU.

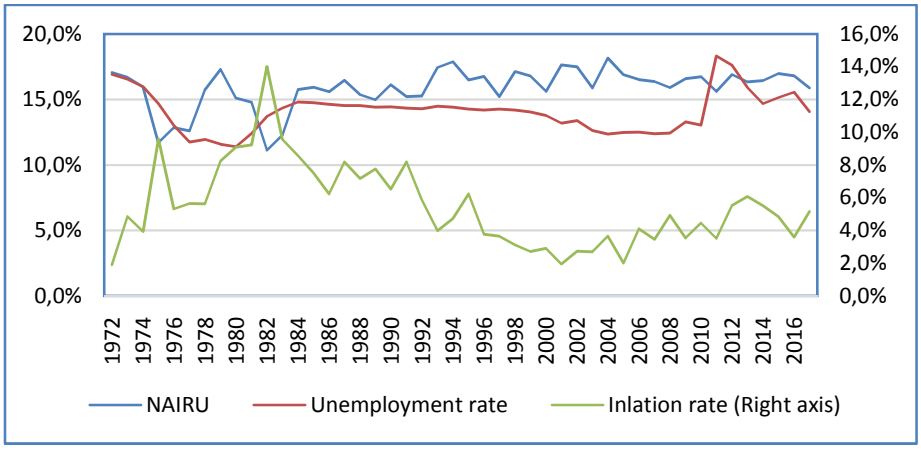
Let $dw_t = dw_{t-1} \Rightarrow U = U^*$ by replacing these two expressions in the estimated equation (9) we will have:

$$U^* = \frac{c(1) - dw_t\big(1 - c(2)\big) + c(5)\Delta Tech_t + C(6)\ PorT + C(7)Dummy\ 82 + \ C(8)Dummy\ 11}{-c(3)}$$

$$U^* = \frac{c(1) - dw_t\big(1 - c(2)\big) + c(5)\Delta Tech_t + c(6)Dum82 + c(7)Dum11}{-c(3)}$$

$$U^* = \frac{0.0349 - dw_t(1 - 0.477) + 0.250\ \Delta Tech_t + 0.156\ Dum82 + 0.107\ Dum11}{1.609}$$

Figure 6. NAIRU, the unemployment rate and inflation and their trends (1970-2016)



This figure shows that over the entire period 1970-2016, the NAIRU was higher than the unemployment rate except for five years (1975, 1982, 1983, 2011 and 2012). Its oscillations in the period 1970-1993 had greater amplitude, with a standard deviation of 2.16, than in the subsequent period 1994-2016 with a standard deviation of only 1.18. A NAIRU averaging 15.9 % against higher than 14.0 % for the actual rate meant that the scope for cyclical policy to reduce unemployment has been very limited in that the cost in terms of inflation would, in most cases, have been very high and remains so.

5. CONCLUSION AND POLICY IMPLICATIONS

NAIRU's empirical estimation bumps against the difficulty of having precise and reliable statistical information. From a methodological approach, the NAIRU is an indicator calculated ex-post, which reduces its effectiveness of forward-looking economic policies. Despite these limits, our estimations for the case of Tunisia

were conclusive and made it possible to calculate a NAIRU which in most cases exceeds the effective unemployment rate.

The results of our estimations have shown that the natural Tunisian unemployment rate is determined by the terms of trade rather than by factor productivity and this can explain the higher value of NAIRU against the effective unemployment rate since 1984, except 2011 and 2012 when there was massive recruitment in the public sector to reduce social tensions after the uprising.

The NAIRU in Tunisia has been and remains above an already relatively high actual unemployment rate, especially for the university graduating students. This calls for a major reorientation in the country's economic and social policies to reduce unemployment and bolster national economic and political stability. Along with macroeconomic policies aimed at controlling inflationary pressures, whatever their causes, the implementation of measures that focus on raising the level of factor productivity in the various economic sectors is urgently needed. This would help break the vicious circle of low cost labor and a low value-added productive system which has come to prevail in Tunisia and open the door for the employment of a growing skilled work force and the resurgence of national economic growth.

With the above in mind we can draw the following policy implications:

1. Tunisia has entered a cycle of stagflation. Governmental policies should, therefore, focus on stimulating supply rather than demand. Specifically, levels of productivity should be raised; quality of institutions improved and exports, allowing the accumulation of human capital, encouraged. Concomitantly it is important to develop the educational system to become better aligned with rapid technological changes thereby enabling it to meet the evolving needs of national economic and social development. This would require a national consensus on the nature of knowledge to be transmitted to form a skilled and creative workforce and by extension the development of quality universities and training centers that, among other things, will serve this purpose.

2. Policies that encourage high-added-value industrialization which the government should have adopted but failed to do so, should be given high priority. This type of industrialization would provide expanding employment opportunities for graduates with higher education and specializations and contribute to the creation of a needed new and development model for Tunisia. Towards attaining this objective, the Government should endeavor to create a business environment that would attract both domestic and foreign private investment to high value industrial ventures. If successful, such policies would lay the foundations for a sustained and balanced national development.

3. Monetary policy should play an active role in promoting the Tunisian manufacturing industry. The Central Bank's interest rate policy should favor capital intensive industries over those that are not, export oriented over home industries, and healthy industries over risk prone or weak industries. On a broader level Tunisian banking regulation needs to be reformed and the banking system modernized with the objective of rendering it more effective in supporting the structural transformation of the private sector.

4. The authorities should adopt a development policy aimed at reducing regional income disparities and social inequalities; this would prepare the least developed regions to benefit from the positive spin-offs of agglomerations and to better integrate into the world economy so that they can develop in a more dynamic and sustainable way, thus promoting job creation.

5. In Tunisia, the partnership between state-sponsored scientific research organizations and the productive sectors could play an important role in helping to

define development objectives and increase productivities, particularly in the scientific field. However, bureaucratic delays have posed obstacles to an effective partnership by causing major interruptions in obtaining timely funding for research and development programs. More specifically, the Ministry of Higher Education and Scientific Research, which is responsible for promoting research, has faced undue delays in providing the necessary funding related to the current public finance management system. Corrective policies are urgently needed to resolve this problem and make this sector more responsive to allow access to high value-added production[11].

REFERENCES

Ball, L., Mankiw, N.G., 2002, The NAIRU in Theory and Practice, *Journal of Economic Perspectives,* 16, 4, 115–136.

Baxter, M., King, R.G., 1995, Measuring Business Cycle Approximate Band-pass Filters of Economic Time Series, *National Bureau of Economic Research Working Papers,* n° 5022.

Bean, C., 1994, European Unemployment : a Survey, *Journal of Economic Literature*, 17, 573-619.

Bell, D.N.F. Blanchflower, D.G., 2018, The Lack of Wage Growth and the Falling NAIRU, *NBER Working Paper* No. 24502.

Beveridge, S., Nelson, R.G., 1981, A New Approach to Decomposition of Economic Times Series Into Permanent and Transitory Components With Particular Attention to Measurement of the ''Business Cycle'', *Journal of Monetary Economics*, 7, 2, 151-174.

Blanchard, O., Wolfers, J., 1999, The Role of Chokes and Institutions in The Rise of European Unemployment, *NBER Working Papers*, n°7282.

Blanchard, O.J., Summer, L.L., 1986, Hysterisis and European the Unemployment Problem, *NBER Macroeconomic Annual (ed)*. S. Fisher, MIT Press, Cambridge, 15-78.

Broersma, L., Koeman, J., Teulings, K., 2000, Labour Supply, the Natural Rate, and the Welfare State in The Netherlands: The Wrong Institutions at The Wrong Point in Time, *Oxford Economic Papers*, 52, 1, 96-118.

Calvo, G., 1983, Staggered Prices in an Utility Maximizing Framework, *Journal of Monetary Economics*, 12, 3, 383-398.

Chagny. O, Reynès, F., Sterdiniak, H., 2002, Le taux de chômage d'équilibre discussion théorique et évaluation empirique, *Revue de l'OFCE*, 81, 205-244.

Cotis, J.P., Meary, R., Sobczak, N., 1996, Le chômage d'équilibre en France : une évaluation, Contribution française à la session du Groupe du travail n° 1 du comité de politique économique de l'OCDE. Publié également dans les *Documents du travail (Working Papers) de la Direction de la Prévision*, n° 96-14.

David N.F., Bell David G. Blanchflower, 2018, The lack of wage growth and the falling NAIRU, *Working Paper 24502 NBER,* Cambridge, MA 02138 April.

Debelle, G., Laxton, D., 1996, Is the Phillips Curve Really a Curve? Some Evidence for Canada, the United Kingdom and the United States, *IMF Working Papers*, n° 96/111.

Elmoskov, J., 1993, High and Persistent Unemployment : Assessment of the Problem and Its Causes, *OECD Working Paper*, n°132.

Englander, A., Los, C.A., 1983, Recovery Without Accelerating Inflation?, Federal Reserve Bank, *Quarterly Review*, 8, 2, 19-28.

[11] In this connection it is worth noting that lack of proper maintenance of major equipment at state laboratories had led to their being underutilized that, in turn, has affected negatively the carrying out of planned research programs.

Estrella, A., Mishkin, F.S., 1998, Rethinking the Role of NAIRU in Monetary Policy: Implications of The Model Formulation and Uncertainty, *NBER Working Papers*, n°6518.

Fabiani, S., Mestre, R., 2000, Alternative Measures of the NAIRU in The Euro Area : Estimates and Assessment, *European Central Bank Working Papers*, n° 17.

Fortain, P., 1989, How Natural is Canada's High Unemployment Rate?, *European Economic Review*, 58, 1-17.

Fuhrer, J.C., 1995, The Phillips Curve is Alive and Well, *New England Economic Review*, The Federal Reserve of Boston, mars/avril, 41-56.

Gianella, C., Koske, I., Rusticelli, E., Chatal, O., 2008. What Drives the NAIRU? Evidence from a Panel of OECD Countries, OECD Economics Department Working Papers 649.

Giavazzi, F., Wyplosz, C., 1985, The Zero Root Problem: a Note on the Dynamic Determination of the Stationary Equilibrium in Linear Models, *Review of Economic Studies*, 52, 353-357.

Gordon R.J., 1997, The Time-Varying NAIRU and its Implications for Economic Policy, *Journal of Economic Perspectives*, 11, 11-32.

Gordon R.J., 1998, Foundations of the Goldilocks Economy: Supply Shocks and the Time-Varying NAIRU, *Brookings Papers on Economic Activity*, 29, 2, 297-346.

Gordon R.J., 2013, The Phillips Curve is Alive and Well: Inflation and the NAIRU During the Slow Recovery, *NBER Working Paper*, 19390.

Gregory, R.G., 1986, Wage Policy and Unemployment in Australia, *Economica*, 53, 53-73.

Helali K., 2018, A new Assessment of the Non-accelerating Inflation Rate of Unemployment and Capacity Utilization in Tunisia, *The Romanian Economic Journal*, Department of International Business and Economics from the Academy of Economic Studies Bucharest, 21(68), 54-77.

Hodrick, R.J., Prescott, E.C., 1997, Post-war US Business Cycles: an Empirical Investigation, *Journal of Money, Credit and Banking*, 29, 1, 1-16.

Holden, S., Nymoen, R., 1998, Measuring Structural Unemployment: is There a Rough and Ready Answer?, OCDE.

King, R.J., Stock, J.H., Watson, M.W. 1995, Temporary instability of the unemployment relationship, *Economic Perspectives of the Federal Reserve Bank of Chicago*, mai/juin, 2-12.

L'Horty, Y., Thibault, F., 1998, Le chômage d'équilibre, de quoi parlons-nous ?, *Revue Française d'Economie*, XIII, 4, 51-81.

Layard, R., Nickell, S., Jackman, R. (eds.), 1991, *Unemployment: Macroeconomic Performance and The Labour Market*, Oxford University Press. Reissue 2005.

Lindbeck A., D.J. Snower, 2002, The Insider-Outsider Theory: a survey, Working, IZA Discussion paper series, No. 534.

Manning, A., 1993, Wage Bargaining and The Phillips Curve: The Identification and Specification of Aggregate Wage Equations, *The Economic Journal*, 100, 416, 98-118.

Mc Morrow, K., 1996, The Wage Formation Process and Labour Market Flexibility in the Community, the US and Japan, *Economic Papers, European Commission Directorat-General for Economic and Financial Affaire*, n° 118.

Mc Morrow K., Roeger W., 1999, The economic consequences of ageing populations, European Economy - Economic Papers 138, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Minocha S., Hristov D., Reynolds M., 2017, From graduate employability to employment: policy and practice in UK higher education, *International Journal of Training and Development*, 21, 3, 235-248.

Nickell, S., 1990, Unemployment: a Survey, *The Economic Journal*, 100, 391-439.

Nickell, S., 1998, Unemployment: Questions and Some Answers, *The Economic Journal*, 108, 802-816.

Nicoletti, G., Scarpetta, S., Bylaud,O., 1999, Summery Indicators of Product Market Regulation With an Extension of Employment Protection Legislation, *Document du travail du département des affaires économiques de l'OCDE,* n°226.

OCDE, 1999, La mise en œuvre de la stratégie de l'OCDE pour l'emploi. Evaluation et performance des politiques, Paris.

Phan Duc Loic, 1971, Un aperçu de la littérature théorique sur la courbe de Phillips, *Revue Economique*, 22-5, 751-791.

Phelps, E.S., 2000, Lessons in Natural-rate Dynamics, *Oxford Economic Papers*, 52, 51-71.

Richardson, P., Boone, L., Giorno, C., Meacci, M., Rae, D., Turner, D., 2000, The Concept Policy Use and Measurement of Structural Unemployment : Estimating a Time Varying NAIRU a Cross 21 OECD Counties, *Economic Department Working Papers*, n°250.

Scacciavillani, F., Swagel, P., 1999, Measures of Potential Output: an Application to Israel, *IMF Working Papers*, n°99/66.

Setterfield, M.A., Gordon, D.V., Osberg, L., 1998, Searching for The Will or The Wisp: an Empirical Study of the NAIRU in Canada, *European Economic Review*, 36, 119-136.

Soussi, M., El Ouardani, H., 2013, Le NAIRU en Tunisie (1970-2010) : Quelles marges pour des politiques conjoncturelles de relance ?, dans J. Auvret-Finck, C. Berthomieu J.-P. Guichard, S. Redzepagic (éds.), *L'Intégration Euro-méditerranéenne en panne*, Edition CEMAFI International.

Staiger, D., Stock, J.H., Watson, M.W., 1997, *How Precise are Estimates of The Natural Rate of Unemployment?*, University of Chicago Press (ed.), Reducing Inflation: Motivation and Strategy.

Taheri, J., 2000, On the Alternative Explanations of Persistence of Unemployment in the OECD Countries , *Applied Economics*, 32, 1051-1057.

Watson, M.W., 1986, Univariate Determining Methods with Stochastic Trends, *Journal of Monetary Economics*, 18, 1, 49-75.

Watson, M.W., 2014, Inflation Persistence, the NAIRU, and the Great Recession, *American Economic Review*, 104, 5, 31-36.

Zouari A., 2018, Pour une refonte des relations tuniso-européennes ou comment permettre à la Tunisie de réussir sa transition économique, Leaders.
http://www.leaders.com.tn/article/25774-abderrazak-zouari-pour-une-refonte-des-relations-tuniso-europeennes-ou-comment-permettre-a-la-tunisie-de-reussir-sa-transition-economique

APPENDIX
Statistics

Year	wt	dwt	Ut	dUt	dIPM	dIPX	dTECH	PorT	Ldwt	Lut
1970	5,835		0,161					-0,114		
1971	5,999	0,165	0,174	0,013	0,003	-0,053	-0,056	-0,056		0,161
1972	6,060	0,061	0,169	-0,005	0,003	0,036	0,034	0,057	-0,104	0,174
1973	6,135	0,074	0,165	-0,004	0,174	0,212	0,038	-0,002	0,014	0,169
1974	6,285	0,151	0,160	-0,006	0,376	0,528	0,151	0,018	0,076	0,165
1975	6,464	0,178	0,147	-0,013	0,048	-0,016	-0,065	0,026	0,028	0,160
1976	6,572	0,108	0,130	-0,017	0,030	-0,107	-0,137	0,043	-0,070	0,147
1977	6,762	0,190	0,118	-0,013	0,059	0,076	0,018	0,024	0,082	0,130
1978	6,865	0,103	0,119	0,002	0,065	0,101	0,036	0,035	-0,087	0,118
1979	6,950	0,085	0,116	-0,004	0,108	0,208	0,101	0,046	-0,017	0,119
1980	7,074	0,124	0,114	-0,002	0,202	0,242	0,040	0,069	0,039	0,116
1981	7,202	0,128	0,124	0,010	0,137	0,165	0,028	0,070	0,004	0,114
1982	7,437	0,235	0,137	0,013	0,089	0,105	0,016	0,023	0,107	0,124
1983	7,628	0,191	0,143	0,006	0,088	0,086	-0,002	0,024	-0,044	0,137
1984	7,691	0,063	0,148	0,005	0,126	0,080	-0,046	0,039	-0,128	0,143
1985	7,750	0,059	0,148	0,000	0,125	0,082	-0,043	0,028	-0,004	0,148
1986	7,780	0,031	0,146	-0,001	0,037	-0,088	-0,125	-0,030	-0,028	0,148
1987	7,831	0,050	0,145	-0,001	0,170	0,144	-0,026	-0,021	0,020	0,146
1988	7,916	0,086	0,145	0,000	0,108	0,085	-0,023	-0,048	0,035	0,145
1989	8,010	0,093	0,144	-0,001	0,148	0,116	-0,031	-0,055	0,008	0,145
1990	8,076	0,066	0,144	0,000	0,077	0,061	-0,016	-0,030	-0,027	0,144
1991	8,168	0,093	0,143	-0,001	0,055	0,037	-0,018	-0,028	0,027	0,144
1992	8,264	0,095	0,143	-0,001	0,045	0,037	-0,008	-0,002	0,003	0,143
1993	8,289	0,025	0,145	0,002	0,075	0,059	-0,015	-0,031	-0,070	0,143
1994	8,317	0,028	0,144	-0,001	0,043	0,061	0,017	-0,048	0,002	0,145
1995	8,381	0,064	0,143	-0,001	0,060	0,064	0,005	-0,072	0,037	0,144
1996	8,447	0,066	0,142	-0,001	0,034	0,059	0,026	-0,044	0,002	0,143

Year	wt	dwt	Ut	dUt	dIPM	dIPX	dTECH	PorT	Ldwt	Lut
1997	8,534	0,087	0,143	0,001	0,068	0,039	-0,029	-0,029	0,021	0,142
1998	8,579	0,045	0,142	-0,001	0,026	0,030	0,004	-0,025	-0,042	0,143
1999	8,630	0,052	0,141	-0,001	0,027	0,024	-0,003	-0,008	0,007	0,142
2000	8,712	0,082	0,138	-0,003	0,087	0,071	-0,016	-0,005	0,030	0,141
2001	8,743	0,031	0,132	-0,006	0,033	0,041	0,008	-0,003	-0,051	0,138
2002	8,776	0,034	0,134	0,002	0,019	0,023	0,004	-0,025	0,003	0,132
2003	8,861	0,085	0,126	-0,007	0,032	0,040	0,008	-0,019	0,051	0,134
2004	8,870	0,010	0,124	-0,003	0,114	0,113	-0,001	0,001	-0,075	0,126
2005	8,923	0,053	0,125	0,001	0,093	0,098	0,005	0,002	0,043	0,124
2006	8,984	0,061	0,125	0,000	0,074	0,073	-0,001	0,019	0,009	0,125
2007	9,043	0,058	0,124	-0,001	0,100	0,083	-0,016	0,031	-0,003	0,125
2008	9,126	0,083	0,124	0,000	0,166	0,174	0,007	0,040	0,025	0,124
2009	9,183	0,057	0,133	0,008	-0,064	-0,069	-0,005	0,044	-0,027	0,124
2010	9,239	0,057	0,130	-0,002	0,061	0,066	0,005	0,038	0,000	0,133
2011	9,317	0,078	0,183	0,053	0,073	0,050	-0,023	0,044	0,021	0,130
2012	9,355	0,038	0,176	-0,007	0,072	0,048	-0,024	0,039	-0,040	0,183
2013	9,401	0,046	0,159	-0,017	0,059	0,016	-0,043	0,021	0,008	0,176
2014	9,459	0,059	0,147	-0,013	0,056	0,046	-0,010	0,014	0,013	0,159
2015	9,509	0,050	0,152	0,005	-0,020	-0,014	0,006	-0,003	-0,009	0,147
2016	9,576	0,067	0,156	0,004	0,024	0,056	0,032	-0,012	0,018	0,152

Le NAIRU en Tunisie : déterminants, mesure et implications politiques

Résumé – Cet article propose un modèle pour déterminer le taux de chômage non accélérateur de l'inflation (NAIRU) en Tunisie, c'est-à-dire le taux de chômage auquel l'inflation se stabilise en l'absence d'ajustement des salaires. En utilisant des données sur la période 1970-2016, le NAIRU en Tunisie semble présenter deux caractéristiques : (1) il se situe à un niveau relativement haut mais il est supérieur au taux de chômage effectif qui a toujours été élevé, (2) il est sensible aux variations des salaires moyens, du taux de chômage effectif et des termes de l'échange, mais insensible aux variations de la productivité du travail. Résoudre le problème du chômage relativement élevé en Tunisie nécessiterait donc un recentrage des politiques économiques vers des mesures qui favoriseraient la productivité des facteurs dans différents secteurs économiques ainsi que des politiques macroéconomiques visant à réduire les pressions inflationnistes.

Mots-Clés
NAIRU en Tunisie
Déterminants du chômage
Productivité du travail
Inflation