

Estimation of the structural unemployment rate in Tunisia

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ABSTRACT

In this paper we checked empirically if the Phillips Curve exists in Tunisia and therefore estimated the structural unemployment rate over the period (1970-2010). The answer of this issues was gradual starting by both theoretical and empirical literature afterwards econometric tools. Our empirical results using the OLS method have clearly revealed the existence of the Phillips curve in Tunisia thus the relationship between inflation and unemployment rate is negative and significant, as well using the maximum likelihood method with the kalaman filter technique, the structural unemployment rate is around 5.41%. Comparing to the reality of the labor market and the unemployment case of Tunisia during the period mentionned above, this result appears quite convincing because in the long run, the unemployed become discouraged diminish their probability of finding a job and stopped pointing into employment agencies.

KEYWORDS : Unemployment – Phillips curve – Inflation– TV-NAIRU – Kalman Filter – State space

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INTRODUCTION

Over the last decades, around the world, one of the most prominent issues appeared in many countries has been the unemployment question. Several countries, suffered on account of the emergence or / and the persistence of this question, regardless of developed or developing countries. Among developing countries we will focus on Tunisia, it seems the most significant example to embody the unemployment issue by way of the most important starting point of tunisian revolution was it the unemployment. This question is perseverance in Tunisia before 70s, the unemployment rate varying at an average rate of 14% inspite of the efforts made by the government in terms of promoting employment. Since this period until nowadays the only remarquable difference is in the unemployment characteristics likewise before 2000 it was unemployed with low education level while after 2000 with higher education. In this context, several economists have been investigated to find solutions, such as Keynes, suggests the government intervention by an expansionary fiscal policy, as well A. Phillips, prove that to reduce unemployment rate, the inflation rate should be increased and inversely, others see the unemployment as a result of the strong position of the insiders over the outsiders. Most of economists confirm that we can reduced unemployment through various measures, but we can not eliminated it, since there is always a natural rate of unemployment or an equilibrium unemployment rate. Also, As it's known and as argued many economists, after long term unemployment spell, the unemployed loss some of their human capital and become less employable and less productive thus the cost of hiring this unemployed kind is very costly. So, the unemployment is a big problem but the stuctural unemployment is the biggest because it could lead to a deepest social problems like the poverty. In this paper we will try to see if Tunisia can faced the unemployment by increasing the inflation rate. So, the main objectives, first is checked the existence of the Phillips Curve in Tunisia, next is estimated the structural unemployment rate following the Gordon (1997,1998) and OECD (2001) methodology.

This paper is organized as follows. The first section reviews some economic history of Tunisia. Section two presents theoretical analysis. Section three lays out the main empirical studies. Section four describes the model specification. Section five checks the empirical analysis.

A brief history

The unemployment issue in Tunisia is persistence, despite of the tremendous efforts employed by the government such as In 1960, after the failure of the socialization experience, Tunisia undertook in the social development process, where the employment component was one of the most important strand in this proces. Also, in mid 1986, Tunisia adopted a structural

adjustment program (SAP) which it aiming at integrating the country into the world economy, preserving the stability of both the Macro-economic framework and the financial balances through the gradual liberalization of the economy accompanied by a drawal State's from both non strategic and competitive activities. Moreover, in the mid 90's, Tunisia's accession to WTO (The World Trade Organization) and became a membership, likewise concluded the partnership with the European Union (EU) regarding the free trade agreements (FTAs), which acceerated the pace of the changes and the structural adjustments in terms of reallocation workers. This opening to the outside has prompted the Tunisian authority to give more attention to the human capital through improving the quality of the workforce. Also, the government has encouraged the private sector through the investment incentives, tax reform, promulgation of the investment code, financial reform..., in order to create employment. Starting in the end of 1990s, economic growth rate soared around six per cent, but the elasticity of employment still unchanged¹. So we can conclude that Tunisian economic can not create enough jobs to absorb the expanding unemployed. As a result, the unemployment is rife in the country, thus the oprising of peoples.

Review of the theoretical literature

Since the advent of capitalism, the unemployment issue has existed. Thus, this problem is not exclusive to developing countries though the kind of unemployment is not uniform across countries. Several **economic schools of thought** have attempted to find a solution for the unemployed. **The traditional approaches**, such as **the classical economics**, who prouve under reasnoble assumptions that there is no unemployment if the wages are flexible both upwards and downwards. So, for them unemployment could only be frictional or voluntary ; whereas for **the Keynesian school**, the employment creation is the duty of the state, therefore the government must be intervened by an expansionary fiscal policy.**The contemporary economists** likewise Phillips (1958), P.Samuelson & R.Solow (1960), Friedman (1967), A.Lindbeck et D.Snower (1989), Carl Shapiro et Joseph Stiglitz (1984). Using different ways, many economists have investigated the unemployment issues, such as Samuelson and Solow (1960), indicate that for decreased the unemployment rate it should be increased the inflation rate, while for M.Friedman this solution is checked only in the short term, While A.Lindbeck et D.Snower (1989) in **the "insiders-outsiders" theory** demonstrated the opposite and explaining why wages do not decrease in the presence of high unemployment by the powerful position of the insiders through the presence of unions.

In this paper, we offer a considerable interest for the economists who's focused on the Phillips Curve, because it is the object of our empirical studies.

¹ Banque mondiale (2004), République tunisienne Stratégie d'emploi, rapport No.25456 - TUN

A. Phillips (1958), an economist New Zealand, established in 1958 for the United States an empirical negative relationship between the unemployment rate (μ) and the nominal wage growth rate (ω) over the period 1861-1957. This relationship is non-linear, stable and inversely proportional, implying that to get a low unemployment rate you have to support a high change of nominal wages or of inflation rate as concluded by Robert Lispey (1960), P.Samuelson & R.Solow (1960). These economists have emphasized that the Phillips Curve is as an economic policy tool, where countries could selected various combinations of unemployment and inflation, they could recorded a low unemployment rate providing that tolerated a high inflation rate and inversely, thus, ensuring the price stability on condition to accept a high unemployment rate. Definitely the phillips curve does not resolve at the same time and satisfactorily the problems of inflation and unemployment, but at least it yields a possibility of choice. Indeed, it is an awkward choice, a trade off between two evils, as noted by G.A.Frois (2005), the possibility of « *(purchasing) a little less unemployment by a little more inflation* » and conversely.

Until the end of the 60s, the trade off between unemployment and inflation is operative, but after this period, precisely during the 70s, it noticed a slowdown in economic activity, an increase in unemployment and inflation through which the inflationary unemployment relationship is unstable: This is called « the stagflation phenomenon », where inflation and unemployment simultaneously increase and this instability was partially explained in the United States by the importance of shocks: the Oil shock (1973- 1974) and the Vietnam War. This shift is inconsistent with the stability assumption of the Phillips curve. The Stagflation has revealed the disappearance of the Phillips curve. So, It was useful to explain both the past existence of the Phillips curve and its disappearance especially in the industrialized countries. How then to reconcile the observed facts with the theory? Part of the answer was advanced by Friedman.

It was M. Friedman in 1967, which would provide the first deemed convincing explanation of the phenomenon of stagflation. He is largely based on **the quantity theory of money (QTM)**, reinterpreted the Phillips relationship so as to support the idea of the trade off by the existence just in short term but it disappears in the long term and that any conjunctural policy fight against the unemployment is doomed to failure.

The most promising starting point of Friedman's explanation is asserted that the Phillips curve is misspecified because economic agents are rational, take into account **real variables** in their economic decisions and not the nominal variables. For this, Friedman added in the Phillips curve an **increased expectations** variable which considers that the workers are rational and interested in the real wages (that we can only anticipated it).

The position of the augmented Phillips curve depends on the expected inflation rate (π^e). (See the diagram below)

The Phillips curve reproduced and plotted in bold corresponds to a null expected inflation rate ($\pi^e = 0$).

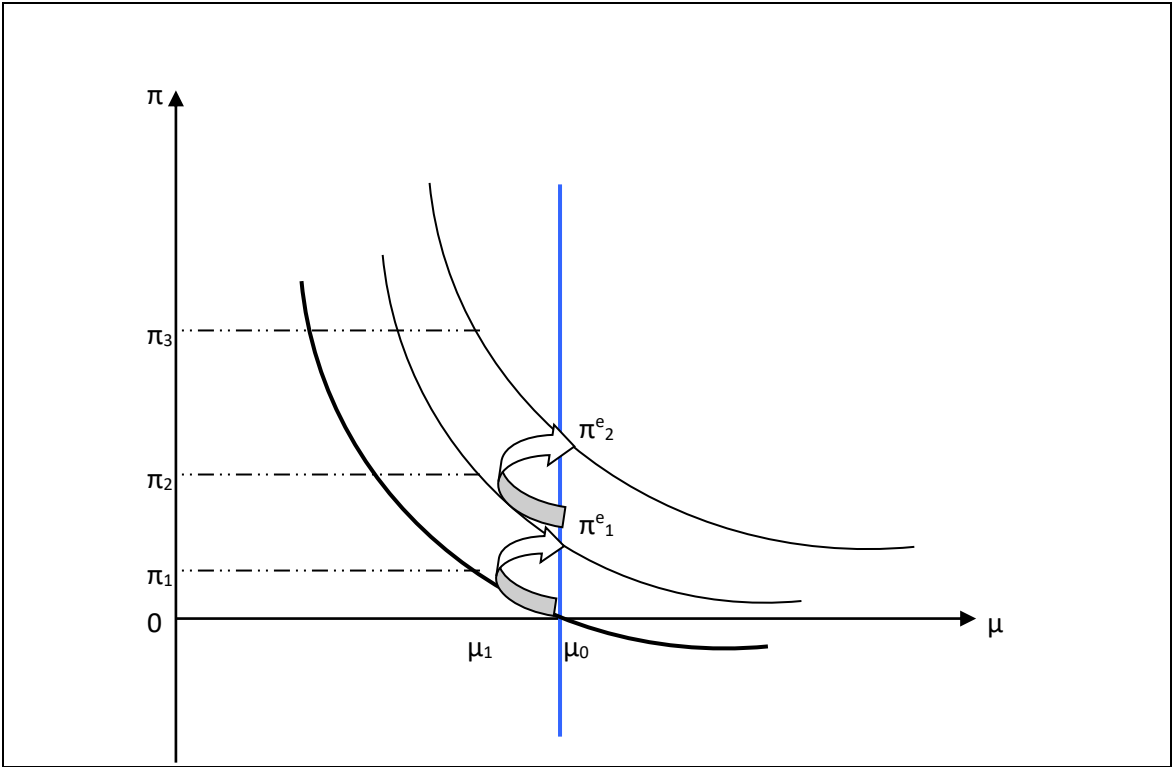
If however (π^e) was greater than zero, the effective inflation rate would be increased for any value of the unemployment rate (μ): This means that the Phillips curve would be located above. Thus, for Friedman, the shape of anticipation is adaptive expectations.

Assuming that the expected inflation rate (π^e) is initially null. And the position of the Phillips curve is given by the bold line.

Assuming that the government seeks to boosting economic activity and to lower unemployment below the (μ_0) level through an expansionary monetary policy.

For the monetarists, financing the budget deficit could not be done without monetary creation, thus for M. Friedman, reviving always has inflationary effects.

Figure - 1 - Acceleration Inflation



With the increase in money supply, The national income increases. The unemployment decreases from μ_0 to μ_1 , The price level is now higher than expected, The real wage appears to be lower than anticipated.

In the next period, nominal wages are negotiated according to the new expected inflation rate which is not null as it was in the initially case, but it could be less than, equal to or above the

inflation rate observed at the previous period (π_1). But according to the anticipation mechanism, the expected inflation rate in the first period (π^e_1) will almost certainly be higher than the rate previously anticipated, which moves the Phillips curve upwards.

In the long run the Phillips curve is a vertical line, so the unemployment rate is not related to the inflation rate. For this reason, the objective of reducing unemployment is harmful and needless because it translates into higher inflation without definitely reduced the natural unemployment rate. **In the short term**, monetary policy can have real effects; but in the long term the dichotomy between real and monetary sphere is reasserted, so the change in the money supply will have only effect on the general price level (GPL). Most economists have argued that inflation is a monetary phenomenon while the unemployment rate is a function of the structural variables, thus there's no inverse relationship between them in the long term but it exists in short term. Over the time, the Phillips curve has undergone several changes. The newest generation appeared and developed in the late 1990s, was it the *reduced Phillips curve* incorporating three major factors : adaptive expectations or inertia, supply shock variables and demand variable calculated by the gap between the observed unemployment rate and the NAIRU (Non Acceleration Inflation Rate of Unemployment). Comparing to the previous Phillips Curve, the substantial difference in the reduced form that has the advantage to include the NAIRU variable that allows to conduct the economic policy in terms of describing the future trends of inflation, the sustainability fiscal positions, the trends in production and employment..., and this reduced form assessed by economists as the most appropriate model to estimate the NAIRU that represents the structural unemployment rate in long term. Actually, the definition of the NAIRU varies between economists, for Edmund Phelps the NAIRU is the natural rate of unemployment, for others the NAIRU is the unemployment rate consistent with stable inflation, some others consider the NAIRU as the structural or equilibrium unemployment rate. So, to end this debate we are following the OECD (2001) concepts in the empirical study, where the NAIRU in short term represents an unemployment rate consistent with stable inflation **while** the NAIRU in long term describes the structural unemployment rate by means of fully adjusted all the influences of economic policies and both temporary and sustainable supply shocks in order to achieve the steady state. In this paper we based on the studies of Elmeskov (1993), Gordon (1997), France bank(2000), OECD (2001), Whose focus on the reduced Phillips Curve.

Review of the empirical literature

Several empirical studies have checked the existence of the Phillips curve, some economists have demonstrated its presence in some countries before and after the 60s while others have proved the opposite. So In this part we will check some many studies that have attempted to study both the augmented and the reduced Phillips Curve. Samuelson and Solow (1960) were the first researchers who supported the Phillips analysis by confirming the negative relationship between unemployment and inflation, for the United States. Later, Phelps (1967) and Friedman (1968) criticized the assumptions of the initial Phillips Curve and mentioned that there is no relationship between unemployment and inflation in the long-term. During this time Lucas (1976), went beyond Phelps and Friedman, he thinks the Phillips curve does not exist under these assumptions, arguing that agents adjusting regularly their behavior for both current and future economic policies through anticipation the impact of both change in currency and prices. He advanced the argument that the inverse relationship between unemployment and inflation can be existed, but providing that policy makers have not created a situation where high inflation will be accompanied by a low unemployment rate. Alogoskoufis and Smith (1991) supported the "Lucas critique" by providing empirical Study for the United States and the Great Britain.

King and Watson (1994), checked the existence of the Phillips curve in the United States by using macroeconomic data. They confirmed also the existence of the inverse relationship between inflation-unemployment during the period examined, also, Reichel (2004), applied the methodology of Cointegration on the empirical study of Phillips Curve for the industrialized countries and argued that the trade off exists in both the United States and Japan, evenly Islam et al. (2011) examined this trade off for Northern Cyprus, also they confirmed the existence of Phillips curve in short and long term.

Table-1- : Summary of the empirical literature focused on the validity of the Phillips curve

Year	Author(s)	Country	Phillips Curve : Validation (+), (-), (?)
1960	Samuelson & Solow	The United States	+
1968	Phelps & Friedman	The European countries & The United States	?
1976	Lucas	The United States	-

1991	Alogoskoufis & Smith	The United States & the United Kingdom	-
1991	Alogoskoufis & Philippopoulos	Greece	-
1994	King & Watson	The United States	+
1999	John Dinardo & Mark P. Moore	9 OECD countries	+
2003	Islam et al.	The United States (1950-1999)	?
2004	Reichel	Japan, The United States	+
2005	Ricardo Llaudes	OECD countries	+
2011	Islam et al.	Northern Cyprus	+
2012	Chaido&MelinaDritsaki	Greece	-
2013	Chaido&MelinaDritsaki	Greece	?

The Central Bank of France (2000), after comparing the models² allow the estimation of the Phillips curve, it described the reduced Philips Curve that assuming a stable relationship between inflation and demand disequilibrium (usually the gap between Unemployment and NAIRU) as the most interesting one to estimate the equilibrium rate of unemployment. It adopts the state-space model using the Kalman filter technique to estimate the TV NAIRU over the period 1986-1999, that it amounts to 10% with an interaval confidence [9%-11%] in 1999.

OECD (2001), to assess the structural unemployment rate for 21 OECD countries over the period 1966-1999. It based on the State-Space model (Kalman filter) and inspired from the Triangle model to estimate the reduced Phillips Curve, the corresponding NAIRU and particularly the TV NAIRU, where the dependent variable is the variation of inflation (based on the private consumption deflator), and as a regressors the delayed inflation, unemployment rate, the gap between the observed unemployment rate and the NAIRU, where the NAIRU is

² The structural model (wage setting-price setting) and the pure statistical model (HP filter)

an unobserved variable, and a temporary variables such as supply shocks (real import prices, real oil prices, productivity growth ...).

Table -2- : TV-NAIRU across countries

Author(s)	Method	Period of Study	Final TV NAIRU (%)
OECD (2000)	Phillips Curve (The Kalman Filter)	1966-1998	10.1
EU Commission (2000)	Phillips Curve (The Kalman Filter)	1990-1999	11.3
Irac (2000)	Phillips Curve (The Kalman Filter)	1970-1999	10 - 11
Laubach (2001)	Phillips Curve (The Kalman Filter)	1971-1998	10.7
FMI (2001)	Phillips Curve (The Kalman Filter)	1964 – 1999	10
Èric.H & Xavier.T (2002)	Phillips Curve (The Kalman Filter)	1978-2000	9.44

Table -3- NAIRU for some countries

Country	Period	NAIRU (%)
United States	1963-1999	5.2
Japan	1963-1999	3.9
Germany	1962-1999	7.8
Greece	1975-1999	7.9
Austria	1966-1999	4.9
New Zealand	1980-1999	5.4

Source : OECD

1- MODEL SPECIFICATION

a. The Phillips curve

In 1958, Alban PHILLIPS established an empirical relationship, nonlinear, and inversely proportional between nominal wage growth rate (ω) and the unemployment rate (μ) for the United States over the period 1861-1957. This relationship appeared contrast, non-linear and stable.

The starting point of the reasoning is the following:

Firms in perfect competition choice the output level and the employment that maximizes its profit.

- (W) is the nominal wage, i.e the price of the labor service.
- The profit (Π) of the company is defined as the difference between business income (PY) and its production cost which depends solely of the labor factor (WL).

The expression of the profit is: $\Pi = PY - WL = Pf(L) - WL = \Pi(L)$

The goal of the company is to maximize $\Pi(L)$ compared to L . This leads to the following condition: $\frac{d\Pi}{dL} = Pf_L(L) - W = 0$ or $f_L(L) = w$ where $w = \frac{W}{P}$ is the real wage $f_L(L) = \frac{df(L)}{dL} = \frac{dY}{dL}$ is the marginal productivity of labor.

So, maximizing profits leads the firms to equal the marginal productivity of labor to the real wage.

Firms will thus strive to employees the quantity of workforce required for the verification of the optimality condition $\frac{W}{P} = f_L(L)$.

In terms of growth rate, this expression is equivalent to $\frac{\Delta P}{P} \cong \frac{\Delta W}{W} - \frac{\Delta f_L(L)}{f_L(L)} \Leftrightarrow \pi = w - \gamma$.

The inflation rate (π) is equal to the rate of change in nominal wages (w) minus the rate of growth in the productivity of labor (γ).

The original empirical model adopted by Philips to assert the negative relationship between nominal wages growth rate and the unemployment rate based on the observation of the United States over the periods (1861-1913) and (1861-1957) is as follows:

$$\omega_t = \alpha + \beta\mu_t + \varepsilon_t \quad (1)$$

Where ω is nominal wage and μ is the unemployment rate.

b. The augmented Phillips Curve

The relationship of A. Phillips has become an instrument of monetary policy after the working of P. SAMUELSON and R. SOLOW which presented in December 1959 at the XII Symposium of the American Economic Association, and published in May 1960 in the American Economic Review.

These economists have modified the original relationship to a relationship between unemployment and inflation which they called *the augmented Phillips curve* that has the same characteristics as the original relationship PHILLIPS.

- Inflation

$$\pi_t = \alpha + \beta\mu_t + \varepsilon_t \quad (2)$$

Where, π is inflation rate.

- Productivity

$$pte = \alpha + \beta\mu_t + \varepsilon_t \quad (3)$$

Where pte is the productivity

c. The reduced Philips Curve

According to Gordon triangle model *the reduced Phillips curve* that can be expressed as follows :

$$\Delta\pi_t = \alpha(L)\Delta\pi_{t-1} - \beta(U_t - U_t^*) - \theta(L)\Delta U_t + \lambda(L)Z_t + \xi_t \quad (4)$$

Where Δ is the first difference operator, π represents inflation, U is the observed unemployment rate, U^* is the NAIRU (Unobserved vector), Z is a vector of supply shocks and $\alpha(L)$, $\theta(L)$ and $\lambda(L)$ are polynomials operators delay.

(ξ) is an error term uncorrelated, with mean zero and σ^2 variance.

The NAIRU varies over time, So it's useful to add a transition equation (State Equation) that shows how it changes.

The state equation :

$$U_t^* = U_{t-1}^* + v_t \quad (5)$$

Where (ξ) and (v) are error terms, intertemporal and uncorrelated, iid with a normal distribution (mean zero and σ^2 variance).

The transition equation (5) describes the variation of the NAIRU variable over time should be combined with the inflation equation (4).

2- Empirical Analysis

Before examining the estimation results it is imperative to check the time series stationarity. To analysis the stationary we focus on the Phillips-Perron Test, Phillips-Perron (1988) propose a non-parametric method to correct the existence of autocorrelation, without adding endogenous delayed as in the method of ADF.

Table -4- Results of PP test

Serie	T-statistic	critical Value	level	Decision	Result
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μ	-3.906201	-3.526609	5%	Rejet H0	Stationary in level
Π	-3.869192	-3.526609	5%	Rejet H0	Stationary in level
ω	-3.480578	-2.938987	5%	Rejet H0	Stationary in level
Pte	-5.820468	-4.205004	1%	Rejet H0	Stationary in level

Details of the Phillips-Perron (PP) test are given in Appendix II.

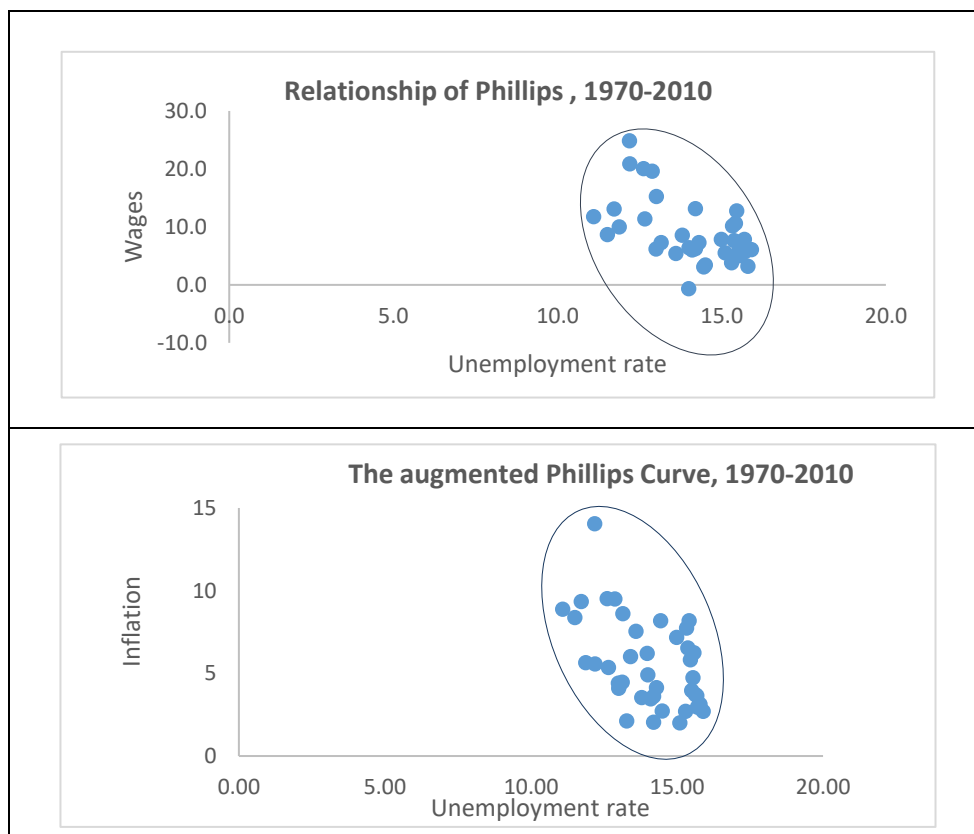
3- Estimation Results

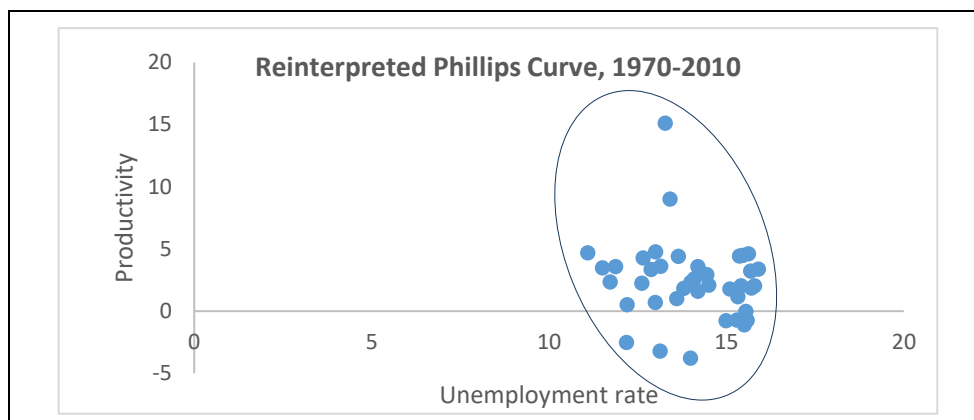
a- The Trade off

The Visual analysis (chart) simultaneously of the correlation between the wage growth rate, inflation rate and productivity growth rate with the unemployment rate are described in the following figures.

The adjustment of the scatter chart obtained through different variables combination with the unemployment rate confirms the existence of the inverse and decreasing relationship between successively the wage growth rate, inflation rate and productivity growth rate, with the unemployment rate.

Graph -1-: Correlation with the Unemployment rate





By using the Eviews 6.0 software, we estimated equations (1), (2) and (3) by the OLS. The results are shown in the following table. Details of the results are attached in appendix.

Table -5- Empirical Results of the Phillips curve

Specification	Equation	Estimation results	
		A	B
(1)	$\omega_t = \alpha + \beta\mu_t + \varepsilon_t$	37.38 (4.95)	-2.02 (-3.80)
(2)	$\pi_t = \alpha + \beta\mu_t + \varepsilon_t$	18.77 (4.74)	-0.94 (-3.37)
(3)	$pte_t = \alpha + \beta\mu_t + \varepsilon_t$	37.83 (5.41)	-2.05 (-4.15)

Source: Our calculations based on output EViews 6.0

The equations (1), (2) and (3) are estimated by the ordinary least squares method (OLS) to check empirically the presence of *the trade off* in Tunisia.

The empirical results clearly confirm the existence of the Phillips curve in Tunisia. So, the inverse correlation between inflation and unemployment rate is possible for the Tunisian authorities: Thus, to fight against the unemployment, the government is required to buy the employment through increasing the inflation rate, more precisely to reduce 1% the unemployment rate authorities should increase prices by 0.94%.

Drawing inspiration from the Quantity Theory of Money (QTM), that expresses there is a direct link between the quantity of money circulating in the economy during a period and the general price level (GPL), So, more the stock money in circulation is greater, more the GPL is higher and therefore inflation.

Similarly for the Tunisian authorities, we can interpret the β coefficient as an elasticity, thus, to fight against unemployment it should be created money supply because

increasing thereof leads to increasing the general price level (GPL) which in turn will act on unemployment. Whence, the issue of inflation targeting.

b- Structural unemployment rate

As previously discussed, we inspire from Gordon (1997,1998) and the OECD (2001) that have adopted the *state space* model by the *maximum likelihood* method using *the Kalman Filter* to estimate the NAIRU and The TV-NAIRU, where the final TV-NAIRU considers as the leading indicator of the structural unemployment rate i.e represents the structural unemployment rate after the fully adjusted of all the influences of the economic policies and both temporary and sustainable supply shocks in order to achieve the steady state.

Specification of our model is described in the following system:

$$\left\{ \begin{array}{l} \text{Signal equation : } \pi_t = \alpha\pi_{t-1} + \gamma\pi_{t-2} + \beta(U_t - U_t^*) + \lambda pte + \xi_t \\ \text{State equation : } U_t^* = U_{t-1}^* + \mathcal{G}_t \end{array} \right.$$

The reduced Phillips curve is represented by the Signal equation while the state equation discribed the changes of the unobserved variable, in our case it is the TV-NAIRU.

Where we denote by:

- π : the inflation rate
- U^* (in the gap between U and U^*) is the trend unemployment rate estimated by the Hodrick Prescott filter
- pte is the productivity rate
- \mathcal{G} and ξ are error terms, uncorrelated, iid with a normal distribution (mean zero and variance σ^2).

The estimation steps are The first step after State Space statement is decribed the both equations signal and state that allowing to estimate the structural unemployment rate (the Final TV NAIRU) and the regressors coefficients of the signal equation by the *maximum likelihood* method using *the Kalman Filter* technique. After that, to predicted the short-term unemployment (the TV NAIRU that varies over time) we use the forecasting option or we make it state series.

Estimation output of the State Space :

Working on the data base over the period (1970-2010), using the *maximum likelihood* method with the *Kalman Filter* technique in the *State Space* model, the empirical result of the system mentioned above shows that 5.41% of the unemployed in Tunisia have not chance to finding an employment. So, the structural unemployment rate (the Final TV NAIRU) we obtained is amounts to about 5.41%.

This empirical result appears quite convincing : In the long run the Tunisian unemployed diminish their employment search intensity, become discouraged and therefore as concluded by Devine and Kiefer (1991) and Schmitt and Wadsworth (1993), their chances of finding a job getting low. Moreover, in the long term the unemployed will seek an employment that certainly does not match its qualifications and they eventually by boycotting the pointing into employment agencies.

A further argument focuses on the companies's behavior literature, such as Blanchard and Diamond (1994), Acemoglu (1995) claimed that companies prefer to employ individuals newly unemployed rather than individuals with longer unemployment spell because over time the long-term unemployed loss part of their human capital (HC) and they become less productive and more costly than those newly unemployed. Thus as a result, they will become less employable.

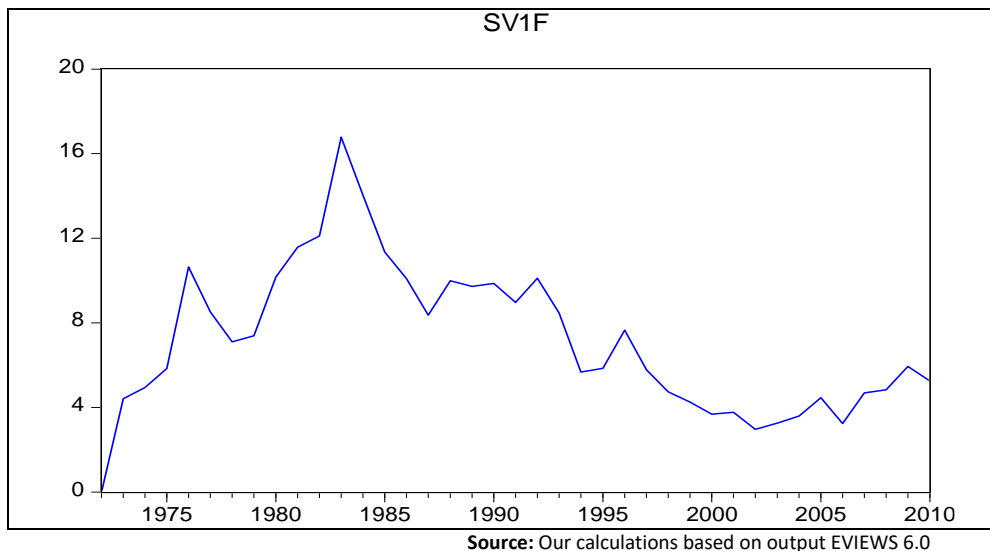
The structural unemployment is a chronic unemployment which reflects a deep and lasting disequilibrium in the labor market and it's very difficult to combat it by the simple mechanisms allocations or ad hoc training. In Tunisia this disequilibrium can be explained by the mismatch between supply and demand in the labor market, employees immobility or the rigidity of social legislation, also, it can be linked to changes in long period occurred in the demographic, economic, social and institutional. Such structural unemployment may be accompanied by other deepest social problems like poverty, exclusion ...

After estimating the structural unemployment rate we will predict the volatility of the Time Varying NAIRU that describes the short-term unemployment.

The initial econometric guess for the state variable represents in the chart below prove that the TV-NAIRU has known two phases :

- Over the period of (1970-1986), especially from the 80s, the TV-NAIRU has experienced remarkable growth. This is can be explained by the difficulties and social tensions observed since 1978 such as the social claiming, UGTT General Strike and the negative growth rates.
- From 1986, the TV-NAIRU was down, this behavior could be explained by the adoption of the SAP and the economic model change in 1986. This is consistent with the structural reforms implemented since 1986, such as the economy liberalization, the state enterprises privatization program where the GDP growth rate reached 5%. Also, the accession to the WTO in 1995 when Tunisia has developed their competitiveness in terms of exported goods and therefore it had freer access to international markets.

Graph -2-TV-NAIRU Estimation (1970-2010)



Conclusion

The unemployment issue is an adged problem dating back to the advent of capitalism. While since the last two decades, this problem has been divided across countries hitting the developing countries more than the developed. Tunisia one of the developing countries that suffered from the persistence of the long term unemployment. In this paper, we try to find a solution for Tunisia by checked if the Phillips curve exists or not, and therefore estimated the structural unemployment rate. The empirical results obtained from database covering 40 years period from 1970 to 2010, yield strong support for the assumptions that an increase in the inflation rate is accompanied by a decrease in the unemployment rate. So, our results have been shown in first step, the existance of the Phillips curve in Tunisia, in the next step, 5.41% of Tunisian unemployed have not chance to find an employment. The monetary authorities should be created money in proportions that can be target inflation, so, at what rate authorities will be required to target inflation ?

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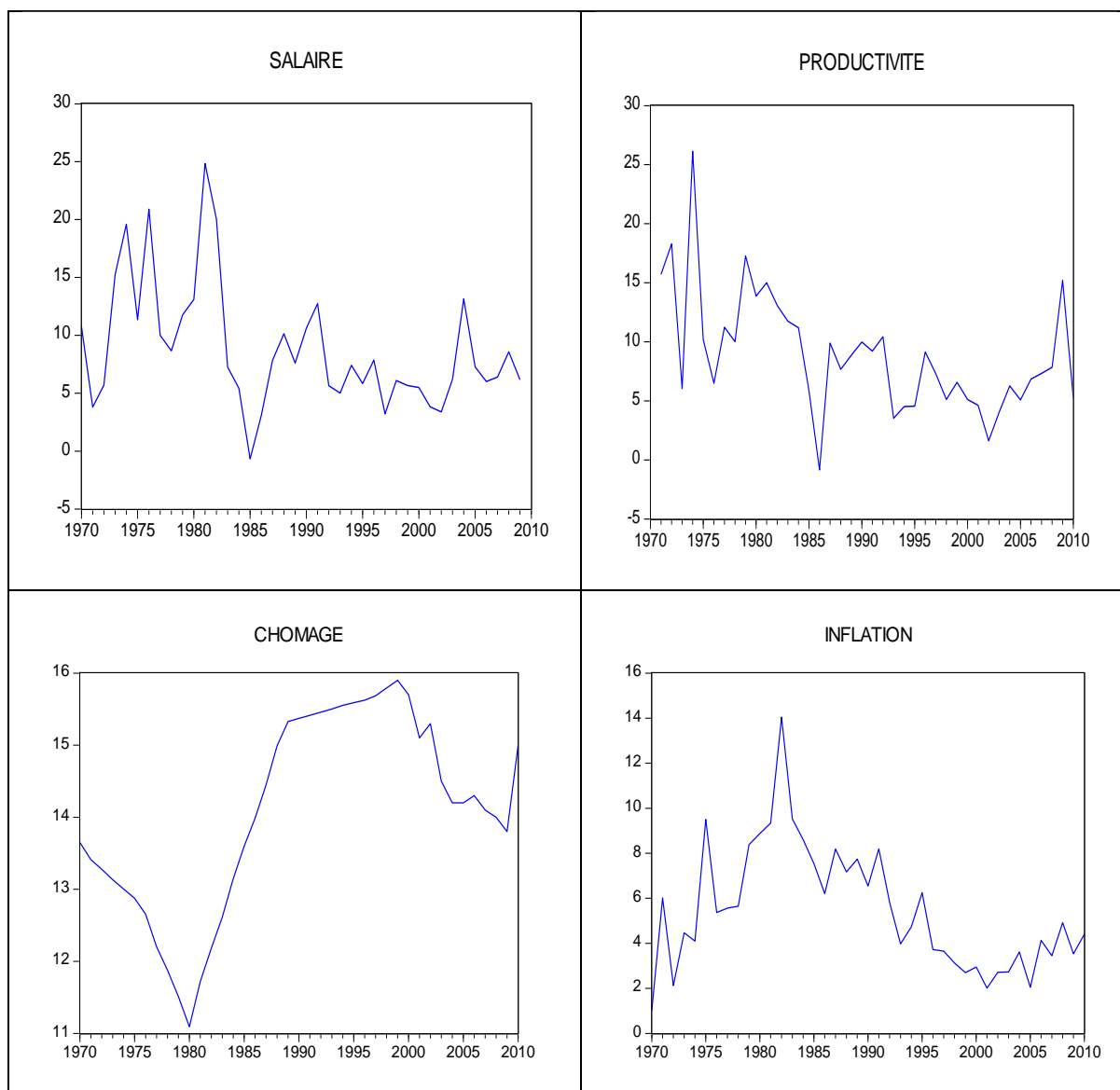
Appendix I

Table : Variables statistical property

	Unemployment	Inflation	Productivity	Wage
Mean	14.05503	5.620894	9.025174	8.774971
Median	14.20000	5.368778	7.834977	7.266636
Maximum	15.90000	14.04263	26.14431	24.83874
Minimum	11.09200	2.007515	0.852534	0.675857
Std. Dev.	1.395329	2.690268	5.116783	5.415744
Skewness	-0.407644	0.828346	1.016797	1.212893
Kurtosis	2.009868	3.584099	4.724292	4.202744
Sum	548.1460	219.2149	351.9818	342.2239

Observations	39	39	39	39
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Figure III- 1: Évolutions des variables (En %, 1970-2010)



Appendix II

a- Data description

The data used in the econometric analysis are : nominal wages, inflation rate, unemployment and productivity rate. These variables cover the period from 1970 to 2010.

- **Nominal wage** : This variable is denoted W . The nominal wage is the remuneration of employees, it consists all payments in cash and in nature (meals and housing) provided to employees in exchange of their services. It also includes government contributions to

social systems such as social security and superannuation. This series is compiled from NST data and is operated as a growth rate. It fluctuated between 24.88% and 0.67%. The average growth rate of around 8.77%. (See appendix)

- **Unemployment rate** : This variable is denoted. The Unemployment rate refers to the portion of the labor force that is unemployed, looking for work and available to hold it. The data are from the World Bank (WBI). The average unemployment rate is around 14%. The highest rate is 15.9% observed in 1999. The minimum rate is 11.09% achieved in 1980.
- **Inflation rate** : This variable is denoted π . Inflation CPI (index of consumer prices) reflects the change in the cost of goods and services basket bought by the average consumer. The contents of this basket could be fixed or variable periodically every year. The Laspeyres index is generally the forum used. This series is taken from the WBI. The average inflation rate over the period 1970-2010 is around 5.62%.
- **Productivity** : The productivity growth rate is measured by the relative variation in labor productivity (TD) for workers, productivity is an indicator for measuring the effectiveness of using capital, i.e it is the value added ratio (quantities produced) and the resources used to obtain it. This is a variable calculated by using the data of both the NSI and WBI.

Before applying the ordinary least squares method (OLS) and reviewing the estimation results it is imperative to examine the stationarity of variables which will carry our regressions.

b- Stationary series

To analysis the stationary we focus on the Phillips-Perron Test, Phillips-Perron (1988) propose a non-parametric method to correct the existence of autocorrelation, without adding endogenous delayed as in the method of ADF.

The stationary test PP and PAC

Test PP	Autocorrélation Partielle (PAC)
NullHypothesis: CHOMAGE has a unit root Exogenous: Constant, Linear Trend Laglength: 2 (Fixed Spectral OLS-detrended AR)	<u><u>PAC</u></u>
	0.156
	-0.174
	-0.338
	-0.233
Phillips-Perron test statistic	-3.906201
	0.0209
Test critical values: 1% level	-4.205004
5% level	-3.526609
10% level	-3.194611
	0.010
	0.058
	-0.249
	0.082
NullHypothesis: INFLATION has a unit root Exogenous: Constant, Linear Trend	<u><u>PAC</u></u>

Laglength: 3 (Fixed Spectral GLS-detrended AR)			0.647
			0.416
			-0.055
			0.097
Phillips-Perron test statistic			-0.133
Test critical values: 1% level			-0.006
5% level			0.175
10% level			-0.255
			-0.240
			-0.260
NullHypothesis: SALAIRE has a unit root			PAC
Exogenous: Constant			
Bandwidth: 2 (Newey-West using Bartlett kernel)			0.513
			-0.098
			-0.045
			-0.081
Phillips-Perron test statistic			0.224
Test critical values: 1% level			0.139
5% level			0.039
10% level			0.085
			-0.174
			-0.055
NullHypothesis: PTE has a unit root			PAC
Exogenous: Constant, Linear Trend			
Bandwidth: 2 (Newey-West using Bartlett kernel)			0.284
			0.280
			0.201
			-0.117
Phillips-Perron test statistic			0.085
Test critical values: 1% level			-0.033
5% level			0.186
10% level			0.199
			0.097
			-0.106

Sspace: UNTITLED
Method: Kalmanfilter
Sample: 1970 2010
Included observations: 41
Valid observations: 39
Convergence achieved after 37 iterations

	Final State	Root MSE	z-Statistic	Prob.
SV1	5.414346	1.756310	3.082796	0.0021
Log likelihood	-78.69540	Akaike info criterion		4.343354
Parameters	6	Schwarz criterion		4.599286
Diffuse priors	0	Hannan-Quinn criter.		4.435180

Source: Our calculations based on output EViews 6.0