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RESEARCH ARTICLE

Equilibrium Exchange Rate Misalignment-A Case Study of Algeria

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ABSTRACT

Is correct imbalance exchange rate of the most important economic policy goals in emerging countries and a core for the development of economic performance and ensuring conditions, where the malfunction rate describes the situation in which the exchange rate in the country away from a long-term level unsustainable for the level of the real exchange rate, and goal basic of this paper is to know the extent of the contribution of the real exchange rate equilibrium in achieving internal and external balances, and that of the underlying output to Algeria. As well as the output rate gap (NAIRU), and in another phase have included stability ratio of external debt to gross domestic product guide, which shows us that the most worthy to adjust the current situation of the Algerian economy, and finally, we have the evaluation analytical model (Williamson), which allows us to estimate the difference between real exchange rate of the dinar Algerian and value price, then extract the periods of imbalance in the real exchange rate,

INTRODUCTION

The exchange rate equilibrium represents a sustainable balance of the balance of payments when the economy is growing at a normal rate, and is therefore the exchange that prevails in a non-dysfunctional economic environment, and according to Edwards (Epstein-Macchiarelli, 2010, p. 35),the exchange rate equilibrium is the ratio of the price of goods interchangeable to the price of non-tradable goods exchange, so that in case of an equilibrium optimal values in the long term for some variables, such as international prices, taxes, trade policy, capital flows, it will lead to an internal and external balance at the same time. Internal balance requires a balance in the production and labor market (a static equilibrium), which is assumed to exist with a non-accelerating inflation rate of unemployment (NAIRU). The external balance requires that the net present value of the current balance be non-negative, after taking into consideration all long-term capital flows (dynamic equilibrium).

Starting in the mid-1980s, new thinking has emerged about the principles of macroeconomic balance, which are being studied within the medium-term economic policy framework. From there, (Konuki, 2008, p. 28) prepared his research under the terms of monetary instability with strong exchange rate fluctuations, where the first two approaches based on specific hypotheses such as The law of one price and price elasticity. However, this approach gives more flexibility in terms of the experimental calculation (OdiaNdongo, 2006, p. 43), in the target zone project, endorsed and supported the exchange rate as reflecting the fundamentals and as the focus of discussions on growth and development strategies as well as in the alphabet of stability and structural adjustment.

In order to strengthen this study and to highlight its scientific status, we have chosen the state of Algeria as a model for research, from which the problematic of research is highlighted as follows:

What is the optimal level of the real exchange rate that allows internal and external balances to be achieved so that it can be used as a reference to the competitiveness of the national economy?

Theoretical framework:

The need for econometric empirical studies linked to international transformations has led economic thinkers to look for approaches that fit the new parameters of the international economy. Starting in the mid-1980s, new thinking has emerged on the principles of macroeconomic balance, the latter studied in the framework of medium-term economic policy, from which Williamson prepared his research under the conditions of monetary instability with strong exchange rate fluctuations.

Equilibrium exchange rate:

The increase in the exchange rate fluctuations has led to the International Monetary Fund's research directed towards determining equilibrium exchange rate models, which offer advantages that illustrate the parameters of situational analysis related to imbalances. The equilibrium exchange rate also provides criteria in the definition of exchange rate policies, and this research has imposed itself as a result of crises that have particularly affected the international monetary system, caused by which were caused by unreal estimation for a group of currencies (Denis-al, 2002), whose goal was to create competitive profits. In addition, microeconomic factors, particularly the effects of the expectations of traders in the exchange market that were introduced with a strong state of certainty in view of the evolution of exchange rates, have led to their volatility, from which the equilibrium exchange rate calculations, if not accurate, lead to the determination of margins dealers at low levels.

In this context, the theory of Williamson in 1983 was formulated, where there were very significant imbalances in currency prices, which led to suggestion of an analytical method to evaluate or estimate the equilibrium exchange areas, which had several advantages in terms of the strategic needs of the most developed countries. From this point of view, the problem in this theory is the ineffectiveness of exchange markets. Imbalances mean that the real exchange rate does not play its role as an indicator in the international market, despite the difficulties in measuring the various fundamentals of the common model; this theory has brought a significant development in the concepts of the exchange rate economy (Benes, 2004).

The basic equilibrium real exchange rate, in this approximation, is compatible with the real exchange rate, which allows the economy to be positioned on the path of latent (absolute) growth or internal balance, and to reach the external balance in the medium term. It has been called basic because it is the exchange level that allows for the international use of resources without compromising the internal balances of economies (Adamu, 2009, p. 66).This rate allows for the detection of deviations compared to the equilibrium position, which (OdiaNdongo, 2006, p. 87)called the basic position and which share the macroeconomic balance of the country.

The equilibrium real exchange rate and Williamson Model:

The Williamson model requires the analysis of two main components: production potential and current account target, and according to this approach, the current account is as follows:

$$NX = f(Y, Y^*, R, g) \quad [1]$$

Where:

NX: Current balance / Y: Internal production /Y^*: Foreign production / R: Real exchange rate / g: External variables / f: nonlinear function

When the economy is centered in its balance, the equation [1] becomes:

$$\widetilde{NX} = f(\widetilde{Y}, \widetilde{Y^*}, \widetilde{R}, g) \quad [2]$$

2.1. Internal Balance:

We find the concept of potential production in the relationship (OKUN), which is calculated by the following equation:

$$\text{Gap d'OKUN} = \text{PIB}_{\text{potentiel}} - \text{PIB}_{\text{effectif}} \quad [3]$$

Since the potential PIB cannot be measured, it must be predetermined as the evaluation methods can be multiple depending on the concept of full employment, some of which are considered the level of employment that corresponds to an unemployment rate approaching zero. In this case, production that shares this level of unemployment is represented by the threshold of internal balance, and there are some methods that consider the unemployment rate to be different from zero, which is called the rate of non-accelerated inflation of unemployment or (NAIRU)unemployment rate. Therefore, the equivalent PIB for this level of unemployment is called the normal PIB. When combining the analysis of the OKUN law with those related to Williamson's approach, it is possible to determine the relationship between the unemployment rate in an economy and its real exchange rate in the medium term, taking into account the functional relationship between growth and the unemployment rate.

In order to solve the problem of determining the potential PIB, the Hodrick-prescott filtering technique is used, which is based on the directional combinations of economic variables, with the elimination of all cyclical or transitional compounds. There are ways that depend on the pace of potential growth, which require the identification of subsidized growth rates in the economy, and allow development without the increase in inflation (Epstein-Macchiarelli, 2010).An example of a Cobb_Douglas production function used to calculate the growth rate, where we get the relationship between the growth rate with employment, and the growth rate of employment, and the rate of economic growth at the pace of technological development in the share of labor in production.

$$y = \lambda + \left(\frac{\beta}{\alpha}\right) \quad [4]$$

whereas:

y: The growth rate of the economy / λ :The growth rate supported by employment

α: Share of labor in production / β: The pace of technological development

The growth rate supported by employment can be divided into two variables: The growth rate of the active population group, and the growth rate of NAIRU.

$$\lambda = \phi + (1 - \text{NAIRU}) = \lambda_{\text{pop}} + \lambda + (1 - \text{NAIRU}) \quad [5]$$

Where:

φ: The growth rate of the active population group

λ:The growth rate of activity rate (Business)

λ_{pop} :The growth rate of the labor-capable population

2.2. External balance:

The differences in growth between the country's economy and the rest of the economies are accompanied by a deterioration in the current account and the latter can be represented as follows:

$$\text{NX} = \phi(\text{PIB} - \text{PIB}^{*}) \quad [6]$$

The introduction of the exchange rate assumes the application of the Marshall-Lerner condition and therefore:

$NX = \psi(R)$ [7]

Where:

ψ:an inverse and increasing function.

According to equation [7] each degradation in (NX) must be accompanied by a real degradation and by applying this equation according to Williamson taking the basic equilibrium real exchange rate FEER as an equilibrium price, we get the following:

$\widetilde{NX} = f(FEER)$ [8]

The problem at this level is the selection of current account ratios used in the identification of FEER, and several solutions have been found, including Williamson's suggestion to set the goal of stability in the ratio of external debt compared to the PIB, and each deficit or surplus calculated by this rule is considered efficient and supported.(Abderrahmane, 1990, p. 26)

Based on the dynamic accounting equation that links current account flows with external debt stocks, we can calculate the equilibrium current balance:

$NX_t = ED_{t-1} - ED_t$ [9]

With:

NX_t : The current account for the period (t)

ED_t: External debt stock for the period (t)

Based on the objective of stabilizing the external debt ratio on PIB, we obtain:

$\frac{ED_t}{PIB_t} = \frac{ED_{t-1}}{PIB_{t-1}} \Rightarrow \widetilde{Ed}_t = \widetilde{Ed}_{t-1}$ [10]

Even though:

d_t: ratio of external debt on PIB in time (t)

$\tilde{d}_t$: ratio of external debt targeting to PIB in time (t)

The development of equations [10]and [11] gives us the following:

$$\frac{NX_t}{PIB_t} = \frac{ED_{t-1}}{PIB_t} - \frac{ED_t}{PIB_t} \ [11-1]$$

$$\frac{NX_t}{PIB_t} = \frac{ED_{t-1}}{PIB_{t-1}} \cdot \frac{PIB_{t-1}}{PIB_t} - \frac{ED_t}{PIB_t} [11-2]$$

Note that:

$$TCNP_t = \frac{PIB_t}{PIB_{t-1}} \ [11-3]$$

Even though:

TCNP: Nominal growth rate of production between (t) and (t-1), and By compensating the equations [11-3]and [10] in the equation [11-2] Assuming that the current account is at the equilibrium level $\widetilde{NX}_t$We obtain the following:

$$\frac{\widetilde{NX}_t}{PIB_t} = Ed_{t-1} \cdot \frac{1}{TCNP_t + 1} - Ed_t \ [11-4]$$

Where in the balance: $\tilde{d}_t = d_{t-1}$

$$\frac{\widetilde{NX}_t}{PIB_t} = Ed_{t-1} \cdot \frac{1}{TCNP_t + 1} - Ed_{t-1}$$
$$\frac{\widetilde{NX}_t}{PIB_t} = Ed_{t-1} \cdot \left[\frac{1}{TCNP_t + 1} - 1\right] \quad [11-5]$$

And finally:

$$\frac{\widetilde{NX}_t}{PIB_t} = -Ed_t \cdot \frac{TCNp_t}{1 + TCNp_t} \quad [11-6]$$

The latter relationship is used to calculate the current balance target.

2.3. Mass of foreign trade elasticities:

The equation [1] assumes that the current account is related to domestic and foreign production, the real exchange rate, and other external variables. The first method for solving the FEER model is based on the direct calculation of the deviation of the current account target as represented in equation [12]:

$$NX - \widetilde{NX} = f(Y\,;Y^*\,;R\,;g) - f\left(\tilde{Y}\,;\tilde{Y}^*\,;\tilde{R}\,;g\right) \quad [12]$$

Where:

f: An undefined linear function.

The current account can be negative or positive; the logarithm cannot be applied for linear conversion of the model, and the use of differential logarithm on the second side of the equation would allow for the following linear relationship:

$$\frac{\partial NX}{Y} = a\frac{\partial Y}{Y} + b\frac{\partial Y^*}{Y^*} + c\frac{\partial R}{R} \quad [13]$$

With: a; b; c: constants

$$\left|\begin{aligned} \partial NX &= NX - \widetilde{NX} \\ \partial Y &= Y - \tilde{Y} \\ \partial Y^* &= Y^* - \tilde{Y}^* \\ \partial R &= R - \tilde{R} \end{aligned}\right.$$

Derivatives represent the deviations of variables from their equilibrium values and the constants a; b; c are the elastic functions of the foreign trademass, a form of a volume-related and price-related matrix, export-related and import-related volumes, as well as domestic and foreign production.The price matrix consists of domestic and foreign price indices and price indices for exports and imports.The deviation of the real exchange rate given its fundamental equilibrium value is calculated by turning the equation [14].

$$\frac{\partial R}{R} = \frac{1}{C}\left[\frac{\partial NX}{Y} + a \cdot \frac{\partial Y}{Y} - b\frac{\partial Y^*}{Y^*}\right] \quad [14]$$

$$\frac{NX}{Y} = \frac{NX}{Y} + a \cdot OG - b \cdot OG^* \quad [15]$$

$OG = \frac{\partial Y}{Y}$: The Local output (production) gap.

$OG^* = \frac{\partial Y^*}{Y^*}$: The foreign output (production) gap.

Finally, the analytical solution of the Williamson model will allow us to obtain the relationship between the deviation of the real exchange rate and the variables: the deviation of the current account with its objectives and domestic and foreign outputs.

$$\frac{\partial R}{R} = \frac{R - \widetilde{R}}{R} = \frac{1}{\gamma}\left[\frac{\partial NX}{Y} + \eta_M \cdot \xi_M^Y \cdot \frac{\partial Y}{Y} - \eta_X \cdot \xi_X^{Y^*} \cdot \frac{\partial Y^*}{Y^*}\right] [16]$$

$$\gamma = \eta_X\left(\beta + (1-\beta)\cdot \xi_M^{e^*}\right) - \eta_M\left(1 - \alpha + (1-\alpha)\cdot \xi_M^{\tilde{e}}\right)[17]$$

Knowing that:

η_X: The rate of export. η_M: The rate of imports.

α:price elasticity of imports at domestic price

B: price elasticity of exports relative to foreign price.

ξ_M^Y: Flexibility of imported volumes with real domestic production.$\xi_X^{Y^*}$: The flexibility of exported volumes with real foreign production.

$\xi_M^{\tilde{e}}$: The flexibility of imported volumes with competitive import.

$\xi_M^{e^*}$: The flexibility of exported volumes with real foreign production.

II. Application of the FEER model to the data of the Algerian economy:

1. Internal balances:

In this component, the latent output of Algeria is estimated during the period (1970-2018), as well as the output gap and the unemployment rate that does not affect inflation (NAIRU). Estimates of the potential output may vary depending on the estimation method used, and from that we have followed a univariate method for estimating the latent output, among which we find a filter (Hodrick-Prescott, HP), and a multivariate method, including the methodology of the production function.

$$Min\sum_{t=1}^{T}(y_t - y_t^*)^2 + \lambda\sum_{2}^{T-1}[(y_{t+1}^* - y_t^*) - (y_t^* - y_{t-1}^*)]^2[18]$$

The parameter (λ) controls the degree of chain initiation (y*), the higher the (λ), the more (y*) is smoothed, while T represents the length of the chain as is the case with similar direction separation methods, the issue of degree of initiation with Hp method The degree of preamble must be determined during the filtering process, depending on the nature of the shocks to which the economy is exposed.If these shocks are basically affecting aggregate demand and supply is largely unaffected, then the underlying output is not close to the data,and this refinement is valid here to a large degree. On the other hand, if there is a high rate of supply shocks, we find that the latent output moves in a way Close to data,and it is correct here to use a lower boot grade (Benes, 2004).

In order to estimate the potential output of the Algerian economy over the period (1970-2022), we will use HP filter technology as it is based on annual GDP observations.

the Algerian economy has been exposed to many structural changes and external shocks that led to a relatively large variation in the output levels.

To estimate the production function, the Cobb-Douglas function is followed, assuming yields remain constant with size. This method is very common in the literature that relies on the underlying growth frequency (Epstein-Macchiarelli, 2010). According to the application of the production function (Cobb-Douglas), the output is a function of labor and capital, in addition to the total productivity of the factors of production (TFP):

$$Y_t = L_t^{\alpha}.K_t^{\beta}[19]$$

Where (y_t) represents output, (L_t) labor, (K_t) capital, while (A_t) represents total productivity of production factors (TFP), and for the assumption of yield stability with volume it adds a condition that the sum of the elasticities of output equals the correct one.

Employment is defined as the number of workers in the economy, while capital is defined as the capital stock consisting of total investments using the permanent stock method, and according to this method the balance of capital is an accumulation of previous investment flows.

$$K_t = I_t + (1 - \phi)K_{t-1}[19]$$

Where K_t represents the capital balance in the period (t), (I_t) the capital flow in the period (t), and (ϕ) represents the annual depreciation rate, and from that the (Nehru-Dhareshwa, 8(1) June1993)method uses the concept of capital balance Initial K (0) in the formation of the capital balance chain:

$$K_t = (1 - \phi)^t . K(0) + \sum_{i=0}^{t-1} I_{t-1} . (1 - \phi)^i [20]$$

Where K (0) expresses the initial capital balance, and following the Nehru- (HocineBenissad, 1994) method, the value of the initial investment is re-estimated by making a linear regression of the investment logarithm over time and the estimated value of the initial investment $\hat{I}(1)$is used in the initial capital account through the following equation:

$$K(0) = \hat{I}(1)/(g + \phi)[21]$$

Where (g) represents the average annual growth rate of the annual output, and it is worth noting that the exponentially smooth investment balance was prepared before the start of the analysis process, and the TFP is calculated as the remaining Solow resulting from the Cobb-Douglas function.Although it is better to improve it by taking the qualitative differences of the components of the factors of production into consideration, using indicators that simulate changes in the components of capital and labor power, then the TFP is derived from the equation [22]: $A_t = Y_t / L_t^{\alpha} . K_t^{1-\alpha}$ [22]

In order to estimate the potential output, it is necessary to obtain the potential values of the inputs. As for the latent use of the capital stock, it is assumed that the existing capital stock will be fully exploited, as this balance can be considered as an indicator of the total energy of the economy (Mise, Kim, & paul, 2003) On the other hand, the trend for the TFP series obtained from equation [6] calculated by HP technology is considered to be the series of possible values for TFP . As for obtaining the possible values of employment, the NAIRU is defined as the unemployment rate at which inflation does not tend to rise or fall, and on this basis the normal rate of latent output corresponds to the NAIRU, from there the NAIRU is obtained by dividing the unemployment rate by using the Kalman filtering into the trend component, which is a standard for measuring the balanced unemployment rate, and a periodic component that is a reference for measuring the unemployment gap (Epstein-Macchiarelli, 2010, p. 69). Next, a model containing the periodic component is estimated by a standard philips trend curve, so the NAIRU can be derived directly from the Philips curve, and thus the latent output estimate can be (Adamu, 2009).

We estimate the Cobb-Douglas production function for Algeria and from it the variables forming this function are as follows: Gross domestic product (PIB): It represents the total production (Y) in the Cobb-Douglas function, the number of workers (EMP), which represents the volume of employment (L) in the Cobb-Douglas model where employment can be measured by the number of workers or hours of work and the latter is more indicative than the first. However, we will limit ourselves to the number of workers instead of working hours due to the absence of statistics of the latter in Algeria, crude accumulation of fixed assets (ABFF):Due to the absence of a statistic (k), proxy variables will be used instead of crude accumulation of fixed assets .By taking the previous variables of Algeria, we can write the Cobb-Douglas function as follows:

$PIB_t = A(EMP)^{\alpha}(ABFF)^{\beta}$[23]

In order to facilitate estimating the parameters of this function, it must first be converted to a linear form, by entering the natural logarithm on both sides of the equation and then adding the random error as follows:

$\mathrm{LPIB_t} = \mathrm{LA} + \alpha\mathrm{L(EMP_t)} + \beta\mathrm{L(ABFF_t)} + \varepsilon_t$[24]

1.1. Model Estimation:

The Cobb-Douglas function takes the form of a multiple regression model, and by using the "OLS" method to estimate the regression equation for the function parameters the results shown in Table (1) are obtained:

Table (01): Estimation of the "Cobb-Douglas" for the Period (1970-2022)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEMP	0.074550	0.189578	0.393241	0.6963
LABFF	0.402822	0.056405	7.141662	0.0000
C	-1.774727	1.193005	-1.487610	0.1451
R-squared	0.761657	Meandependent var		3.739831
Adjusted R-squared	0.749113	S.D. dependent var		0.827822
S.E. of regression	0.414645	Akaike info criterion		1.147565
Sumsquaredresid	6.533345	Schwarz criterion		1.272949
Log likelihood	-20.52509	Hannan-Quinn criter.		1.193223
F-statistic	60.71715	Durbin-Watson stat		0.211866
Prob(F-statistic)	0.000000			

Source: Output Eviews 11

$LPIB = -1.7747 + 0.0745L(EMP) + 0.4028L(ABFF)$

This function can be written in the regular form after removing the logarithm, as follows:

$$PIB = e^{-1.7747}EMP^{0.0745}ABFF^{0.4028}PIB = 0.1695EMP^{0.0745}ABFF^{0.4028}[25]$$

Accordingly, the values of the estimated parameters were as follows:

$A = 0.1695$، $\alpha = 0.0745$، $\beta = 0.4028$

1.2 Statistical and Economic Analysis:

The parameters of the model are significant, and it is clear from the results that work and capital explain (74.91%) of the output, while the remaining percentage (25.09%) refers to (TFP) the overall productivity of factors of production, and therefore the signal of all parameters is positive, and this corresponds to economic theory. However, the flexibility of production to work is rather weak,if the volume of employment increases by (1%), then the production increases by (0.074%), which is a weak amount, as it indicates the weakening of production's impact on employment, while the parameter (β) is economically acceptable, and therefore, the increase in the accumulation size of fixed assets leads to an increase in the production volume. In addition, the value of (α) and (β) can be accepted economically, because their value is between [0.1].In other words, they achieve the hypothesis of diminishing marginal productivity of labor and capital, and in general it can be said that the estimated production function during the period (1970-2017) is a homogeneous function of degree (α + β = 0.47), given the compatibility of the model with economic assumptions and statistical tests that can be relied upon in the interpretation of output changes on the one hand and forecasting on the other.

Calculating the effect of technological development, or so-called total factor productivity (TFP), can be obtained from the "Solow" residues, and thus the HP direction of the resulting time series can be considered the potential "TFP".

The potential output is achieved when all factors of production are fully exploited, and as mentioned, the full exploitation of the existing capital stock is assumed and the potential TFP is equivalent to the HP liquidator in relation to the derived TFP.

Finally, we need to estimate the potential employment rate, in order to calculate this rate, the NAIRU is estimated, and for the purpose of estimating the latter, a method similar to the (Epstein-Macchiarelli, 2010) method is adopted where the unemployment rate (UP_t)was initially dismantled using the Kalman filter method to a direction $\overline{UP}_t$ and the G_t league component:

$$UP_t = \overline{UP}_t + G_t [26]$$

Where the trend follows a linear trend pattern as follows: $\overline{UP}_t = \mu_{t-1} + \overline{UP}_{t-1} + \eta_t$ [27]

From this the direction of unemployment is described by a variable that follows the process of random walking accompanied by an offset, and the offset is allowed to be random,that is $\mu_t = \mu_{t-1} + \varepsilon_t$ it is assumed that η_t is the iid that follows the usual distribution $N(0,0.01)$. This test allows for η_t variation to achieve a desired property which is that the long-term unemployment rate values move smoothly and the periodic component is treated as a variable that follows the static autoregressive model as follows:

$$G_t = \phi G_{t-1} + \phi G_{t-2} + \phi G_{t-2} + \phi G_{t-3} + G_{t-4} + \psi_t [28]$$

The Philips relationship can be expressed as follows:

$$INF_t - INF_t^* = \beta(UP_t - \overline{UP}_t) + \delta z_t + V_t [29]$$

Where INF_t the estimate of the actual inflation rate, while INF_t^* is the expected inflation rate, and z_t is imported inflation to express supply shocks and V_t is the error term, and it is assumed that $INF_t^* = INF_{t-1}$ and therefore $\Delta INF_t = INF_t - INF_t^*$, Then the model becomes as follows:

$$\Delta INF_t = \beta(UP_t - \overline{UP}_t) + \delta Z_t [30]$$

The equation [30] does not indicate the possibility of a sequential correlation in the error term and therefore the autoregressivedescription is used as follows:

$$\Delta INF_t = \beta(UP_t - \overline{UP}_t) + \gamma(L)\Delta INF_{t-1} + \delta(L)Z_t + \varepsilon_t [31]$$

Where (L)represents the delay effect, while $\beta(L)$, $\gamma(L)$, $\beta(L)$ are polynomials for delay periods, while (ε_t)represents the non-sequentially unrelated error term, and the variables used in the estimate are also tested and found to be static.In the estimated model, a regression was performed for the change in the inflation rate by one submission period ΔINF_{t+1} on the periodic component (G_t) under the description mentioned in equation [28], as well as the immediate change in inflation ΔINF_t and with one delay period ΔINF_{t-1} and in an advanced and timely period of imported inflation Z_{t+1} and Z.

And by estimating the autoregressive of ΔINF_t the results were as follows:

$$\Delta INF_{t+1} = -.117G_t + 0.094\Delta INF_t + 1.01\Delta INF_{t-1} + 0.32Z_{t+1} - 1.6Z_t [32]$$

S.E: (0.09) (0.03) (0.039) (0.012) (0.021)

P-Value:[0.24][0.001][0.29][0.064][0.02]Adj.$R^2 = 92.5$

2. External balances:

The evidence of the stability of the external debt ratio on the gross domestic product shows us that it is the most worthy to control the current state of the Algerian economy, so it is one of its external constraints. Note that other movements of capital, private transfers and direct foreign investments are not important, and from it we recall that the evidence of external debt stability on the gross domestic product allows us to follow the following relationship:

$$\frac{\widetilde{NX}_t}{PIB_t} = -Ed_{t-1} \cdot \frac{Tcnp_t}{1 + Tcnp_t}$$

whereas:

$\widetilde{NX}_t$: Target current account for the period (t)

Ed_{t-1}: The ratio of foreign debt stock to gross domestic product (GDP) for the period t-1

Tcnp_t: Nominal production growth rate for the period (t)

The target current balance account of the Algerian economy during the period (1970-2018)

the balance of the target using the following relationship: $\frac{\widetilde{NX}_t}{PIB_t} = -Ed_{t-1} \cdot \frac{Tcnp_t}{1+Tcnp_t}$As the statistics (PIB_t‘$Tcnp_t$‘Ed_t) from (IFS)

Estimating model parameters (Williamson):

The analytical evaluation of the (Williamson) model allows us to estimate the difference between the real exchange rate and its equilibrium value by employing foreign trade parameters. Hence, the general composition of the Williamson model is as follows:

$\frac{\partial q}{q} = \frac{q-\tilde{q}}{q} = \frac{1}{\gamma}\left[\frac{\partial NX}{Y} + \eta_M \cdot \xi_M^Y \cdot \frac{\partial Y}{Y} - \eta_X \cdot \xi_X^{Y^*} \cdot \frac{\partial Y^*}{Y^*}\right]$ [33]

Even though: $\gamma = \eta_X\left(\beta + (1-\beta) \cdot \xi_X^{e^*}\right) - \eta_M\left(1 - \alpha + (1-\alpha) \cdot \xi_M^{\tilde{e}}\right)$

Estimating the rates of exports and imports:

From the reduced equation [33], the export rates η_x and the imports η_M are defined as follows:

$\eta_X = \mathrm{P_X.X/P.Y}$[34]

$\eta_M = \mathrm{P_M.M/P.Y}$ [35]

whereas:

$\mathrm{P_X}$and$\mathrm{P_M}$ are the export and import prices, respectively.

X andM are export and import volumes, respectively.

Y is the production volume.

The estimation of the parametersη_X and $\eta_M$we take it from testing the existence of a long-term relationship between exports and production, and the relationship between imports and production.Thus, the application of the co-integration method requires testing the stationarityof the variables under study.From whichthe results of the upward Dicky-Fulartest and the application of differences from the first degree are summarized tables (2) and (3).

Table (02): ADF test for unit root during the period (1970-2022)

Variables (sizes)	The degree of delay	Calculated value	Possibility of the existence of a unit root
$LPIBVOL$	9	1.085213	0.9967
$LEXPVOL$	9	-2.082128	0.9397
$LIMPVOL$	9	-0182390	0.9913

Source: Output Eviews 11

What can be observed is that all the variables under study have a unit root and thus we accept the null hypothesis, i.e. that the variables series are not stationary, and in order to make them stationary we apply the differences from the first degree.

Table (03): ADF first difference test

The differences from the first degree			
Variables	**The degree of delay**	**Calculated value**	**possibility of the existence of a unit root**
$DLPIBVOL$	0	-6.898847	0.0000
$DLEXPVOL$	9	-6.825873	0.0000
$DLIMPVOL$	0	-5.478137	0.0003

Source: Output Eviews 11

We note that after taking the differences from the first degree,all the series of variables have become integratedfrom the first degree at the level of significance of 5%,from which we test the relationship of integration betweenproduction-exports and production-imports. The results are summarized in the following table:

Table (4) Estimation of parameters η_X and η_M during (1970-2022)

Variables	**The degree of integration**	**Long-term balance equation**
Exports and production	$COI(1) - 5\%$	$X - 0.36829Y = 0$
Imports and production	$COI(1) - 5\%$	$M - 0.7627Y = 0$

The relationship of equilibrium in the long term allows us to conclude that the rate of exports is estimated at 36.68%. This means that Algeria's exports, including hydrocarbons, are originally from the composition of more than this percentage of GDP,and that the rate of imports is estimated at 76.27%,this means that more than this percentage of income is directed to financing imports.

2.3 Estimating the elasticities of the foreign trade bloc:

In this element, we will estimate the elasticities of the foreign trade block, as the elasticities will be calculated on the basis of semantic variables rather than private variables.

a. Estimating the elasticity of export and import prices:

In order to estimate the elasticities of the foreign trade bloc, we will show the Williamson model solution as follows:

$BC = \frac{1}{\mathrm{P}}(\mathrm{P_X X} - \mathrm{P_M M})$[36]

whereas:

BC Trade balance by volume (denominated in internal production prices)

PDomestic prices (GDP Index *DPIB*or consumer goods price index *CPI*)

*X*and*M*Export and import volumes

$P_X = \mathrm{P}^{1-\beta}(\mathrm{e.P}^*)^{\beta}$[37]

$P_M = (\mathrm{e.P}^*)^{1-\alpha}\mathrm{P}^{\alpha}$[38]

$q = \mathrm{eP}^*/\mathrm{P}$[39]

Even though:

$\mathbf{P}^*$ Foreign prices

eNominal exchange rate

αimport price flexibility at domestic prices

βFlexibility of export prices at external prices

qThe real exchange rate

By compensating the equations [37],[38],[39] in the equation[36]we get:

$BC = \mathrm{R}^{\beta}\mathrm{X} - \mathrm{R}^{1-\alpha}\mathrm{M}$[40]

The latter measures the sensitivity of the current balance of the real exchange rate and the feed of the trade balance of the real exchange rate, from which we write:

$$\partial N_X/\partial R = \partial\left(\mathrm{R}^{\beta}\mathrm{X} - \mathrm{R}^{1-\alpha}\mathrm{M}\right)/\partial \mathrm{R}\ [41]$$

$$= \frac{\partial \mathrm{R}^{\beta}}{\partial \mathrm{R}}\mathrm{X} + \frac{\partial \mathrm{X}}{\partial \mathrm{R}}\mathrm{R}^{\beta} - \frac{\partial \mathrm{R}^{1-\alpha}}{\partial \mathrm{R}}\mathrm{M} - \frac{\partial \mathrm{M}}{\partial \mathrm{R}}\mathrm{R}^{1-\alpha}$$

There fore:

$$\frac{\partial N_X}{\partial R} = \mathrm{R}^{\beta}\left[\beta\frac{\mathrm{X}}{\mathrm{R}} + \frac{\partial \mathrm{X}}{\partial \mathrm{R}}\right] - \mathrm{R}^{1-\alpha}\left[(1-\alpha)\frac{M}{R} + \frac{\partial M}{\partial R}\right]\ [42]$$

From equations [37] and [38] we can calculate import elasticities at import competitiveness, and export elasticities at export competitiveness as follows:

$E^* = \mathrm{eP}^*/\mathrm{P_X}$ [43]

$\breve{E} = \mathrm{P}/\mathrm{P_M}$ [44]

Even though:

$\boldsymbol{E}^*$ Represents export competitiveness, $\boldsymbol{\breve{E}}$ Represents import competitiveness.

a.1 Estimation of (β):

The price of exports in Algeria is a guiding variable in defining economic policies, and therefore we replace it with a proxy variable, namely oil prices, and this is due to the dominance of fuels on

Algerian exports.From this, the price of exports is known from the equation [37], where we have tested the stationarity of export prices represented in oil prices. For a small country in the growth phase, exporters are like a price taker.This shares a uniform elasticity of export prices with foreign prices, and from it the internal price does not play any role in its definition, i.e. (β = 1),

a.2 Estimation of (α):

The price of imports is defined as in the equation [38], just as in a small country we see that importers use a price taker.This is equivalent if it is established that the elasticity of import prices with internal prices should tend to zero, and from this the estimate of (α) is related to the following:

$$\log \tilde{E} = (\alpha - 1) \log q$$

Thus, after estimating this relationship, we concluded that the value of ($\alpha = 0.41$), which leaves a margin of 59% of foreign prices in determining import prices.

Table 5: Estimation of the elasticity of export prices (β) and imports (α)

Export prices elasticity relative to foreign prices (β)	1
Import prices elasticity relative to domestic prices (α)	0.41

Source: Output Eviews 11

2.4 Estimating export and import elasticities at Competitiveness:

In order to be able to estimate the elasticities of both exports at competitiveness for exporting, and exports relative to foreign production, as well as import elasticities at competitiveness for importing, and imports relative to domestic production, then we complete the solution of the Williamson model. Thus, by converting equations [43] and [44], and by compensating the prices of exports and imports (equation [37] and [38])

$$\mathrm{P_X} = \mathrm{P}^{1-\beta}(\mathrm{e.P^*})^{\beta-1}.\mathrm{e.P^*}$$

Which means that:

$$\frac{\mathrm{P_X}}{\mathrm{e.P^*}} = \left(\frac{1}{\mathrm{P}}\right)^{\beta-1}(\mathrm{e.P^*})^{\beta-1} = \left(\frac{\mathrm{e.P^*}}{\mathrm{P}}\right)^{\beta-1}$$

From equation [39], export competitiveness can be written as a function of the real exchange rate:

$$E^* = \mathrm{eP^*}/\mathrm{P_X} = q^{1-\beta} [45]$$

The same is true for the relationship between import competitiveness and the real exchange rate:

$$\breve{E} = \mathrm{P}/\mathrm{P_M} = q^{-(1-\alpha)} [46]$$

Thus, ε_X^q and ε_M^q represent export and import elasticities with respect to the real exchange rate as follows:

$$\varepsilon_X^q = \frac{\partial X}{\mathrm{X}}\frac{\mathrm{q}}{\partial q} [47]$$

$$\varepsilon_M^q = \frac{\partial M}{\mathrm{M}}\frac{q}{\partial q} [48]$$

By substituting the elasticities in equation [42], and by compensating the limits of differentials in the function of elasticities, on the other hand, equations [36] and [40] can be expressed as follows:

$$q^{\beta} = \frac{\mathrm{P_X}}{\mathrm{P}} [49]$$

$$q^{1-\alpha} = \frac{\mathrm{P_M}}{\mathrm{P}} [49]'$$

By substituting for the elasticities of foreign trade in the equation [42], the converted equation is as follows:

$$\frac{\partial BC}{\partial q} = \frac{\mathrm{P_X X}}{\mathrm{Pq}}(\beta + \varepsilon_{\mathrm{X}}^{\mathrm{q}}) - \frac{\mathrm{P_M}}{\mathrm{Pq}}\mathrm{M}(1 - \alpha - \varepsilon_{\mathrm{M}}^{\mathrm{q}})[50]$$

On the other hand, the import and export competitiveness elasticities can be arranged from equation [35] to rewrite the elasticities of foreign trade (equations [47] and [48]) in the competitive elasticities function (equations [43] and [44]).

$$\varepsilon_M^{\check{E}} = \frac{\partial \mathrm{M}}{\mathrm{M}} \frac{\check{E}}{\partial \check{E}} [51]$$

$$\check{E} = q^{\alpha-1}$$

$$\left\{\begin{matrix} \partial \check{E} + \partial(q^{\alpha-1}) = (\alpha - 1)q^{\alpha-2}dq \overset{U}{\Rightarrow} \dfrac{\partial \check{E}}{\check{E}} = (\alpha - 1)\dfrac{\partial q}{q} \\ \check{E} = q^{\alpha-1} \end{matrix}\right\} [52]$$

$$\varepsilon_{\mathrm{M}}^{q} = (1 - \alpha)\varepsilon_{\mathrm{M}}^{\check{E}} [53]$$

Likewise in relation to the relationship between export elasticity to the real exchange rate and export elasticity at export competitiveness is:

$$\varepsilon_X^{E^*} = \frac{\partial \mathrm{X}}{\mathrm{X}} \frac{E^*}{\partial E^*} [54]$$

$$E^* = q^{1-\beta}$$

$$\left\{\begin{matrix} \partial E^* + \partial(q^{1-\beta}) = (1 - \beta)q^{-\beta}dq \overset{U}{\Rightarrow} \dfrac{\partial E^*}{E^*} = (1 - \beta)\dfrac{\partial q}{q} \\ E^* = q^{1-\beta} \end{matrix}\right\} [55]$$

$$\varepsilon_{\mathrm{X}}^{q} = (1 - \beta)\varepsilon_{\mathrm{X}}^{E^*} [56]$$

Estimating import elasticity at importing competitiveness ($\varepsilon_{\mathrm{M}}^{\check{E}}$) and import elasticity for domestic production ($\varepsilon_{\mathrm{M}}^{\mathrm{Y}}$)

These two elasticities can be calculated from the relationship with the indicators:

$$\log IND\,\mathrm{M} = \varepsilon_{\mathrm{M}}^{\mathrm{Y}} \log \mathrm{INDY} + \varepsilon_{\mathrm{M}}^{\check{E}} \log(\mathrm{IND}\check{E})$$

We have the time series statistics of the variables (INDM, INDY, INDĔ) from the International Financial Statistics (IFS) and by applying the ADF test to the logarithm of the variables proved to be integrated from the degree of COI (1) and at the level of significance (5%),the

JohansonTestdemonstrated that there is a cointegration relationship between them at the same level usingthe error correction model (ECM), which gives us the following result:

$$\log IND\,\mathrm{M} = 1.4371 \log \mathrm{INDY} - 0.6277 \log(\mathrm{IND}\breve{E})$$

Table 6: Estimating import elasticity at importing competitiveness $(\varepsilon_{M}^{\breve{E}})$And import elasticity for domestic production ε_{M}^{y}

import elasticity at importing competitiveness $(\varepsilon_{M}^{\breve{E}})$	-0.62
import elasticity for domestic production(ε_{M}^{Y})	1.43

B.Estimating export elasticity at export competitiveness$(\varepsilon_{X}^{E^*})$and export elasticity to foreign production$(\varepsilon_{X}^{Y^*})$:

These two elasticities can be calculated from the following relationship with indicators

$$\log INDX = \varepsilon_{X}^{Y^*} \log \mathrm{INDY}^* + \varepsilon_{X}^{E^*} \log(\mathrm{IND}E^*)$$

After we applied the ADF test to the variables (INDX, INDY*, INDE*), it proved that they are integrated from the degree of COI (1) at the level of significance (5%), and that the Johanson test proved that there is a cointegration relationship between them at the same level and this Using the error correction model (ECM), which gives us the following result:

$$E_{X}^{Y^*} = 0.77 \varepsilon_{X}^{E^*} = 0.03$$

$$\log INDX = 0.77 \log \mathrm{INDY}^* - 0.03 \log(\mathrm{IND}E^*)$$

Table (7): Estimating export elasticity at export competitiveness$(\varepsilon_{X}^{E^*})$and export elasticity to domestic production$(\varepsilon_{X}^{Y^*})$

Export elasticity relative to export competitiveness $(\varepsilon_{X}^{E^*})$	-0.03
Export elasticity relative to external production$(\varepsilon_{X}^{Y^*})$	0.77

2.5. Estimatingthe elasticities of exports and imports relative to the real exchange rate and the terms of trade:

Here we will estimate the elasticity of exports relative to the real exchange rate(ε_{X}^{q}), as well as the elasticity of imports in relation to the real exchange rate(ε_{M}^{q}), Finally, the terms of trade are estimated, which are defined as $TEC = \frac{\eta_X}{\eta_M}$

Table (8): Estimation of the elasticity of exports and imports and the terms of trade

Export elasticity to the real exchange rate(ε_{X}^{q})	0.00
imports elasticity to the real exchange rate(ε_{M}^{q})	-0.3658
terms of trade$TEC = \eta_X/\eta_M$	0.48

Note: For the elasticity of exports to the real exchange rate, it is calculated as follows: $\boldsymbol{\varepsilon_X^R} = (\mathbf{1}-\boldsymbol{\beta})\boldsymbol{\varepsilon_X^{E^*}}$

The flexibility of imports for the real exchange rate is calculated as follows:$\boldsymbol{\varepsilon_M^R} = (\mathbf{1}-\boldsymbol{\alpha})\left(\boldsymbol{\varepsilon}_{\mathbf{M}}^{\breve{E}}\right)$

The long-term coverage rate for foreign trade is calculated as follows

$$TEC = \frac{\eta_X}{\eta_M}$$

In order to reach the general formof the Williamson model, we then continue to resolve it,and by substituting equations [52] and [55] in equation [50] we find:

$$\frac{\partial BC}{\partial q} = \frac{\mathrm{P_X X}}{\mathrm{P}q}\left(\beta + (1-\beta)\varepsilon_X^{E^*}\right) - \frac{\mathrm{P_M}}{\mathrm{P}q}\mathrm{M}\left(1-\alpha+(\alpha-1)-\varepsilon_M^{\breve{E}}\right)[57]$$

The equation [57] gives the trade balance deviation in the equilibrium relative to the real exchange rate, from which the trade balance is a function in three variables:

$$BC = q^{\beta}\mathrm{X} - q^{1-\alpha}\mathrm{M} = \tau(q,\mathrm{X},\mathrm{M})[58]$$

$$\frac{\partial BC}{\partial q\partial X\partial M} = \frac{\partial(q,\mathrm{X},\mathrm{M})}{\partial q\partial X\partial M}[59\,]$$

$$\partial BC = \partial BC\partial q + \partial BC\partial X + \partial BC\partial[60]$$

By compensating the equation[61] in the equation[56] we get the equation of the analytical solution of the model, and after compensating for all the previously calculated elasticities, we will reach the final and general formula for the Williamson model, which was previously calculated from the previously reduced equation[33].By compensating for the estimated parameters in the reduced equation[33], we obtain a model for determining the real bilateral equilibrium exchange rate for the Algerian dinar. By employing the basics: target current account deviation, internal production gap, and external gap, after calculation we have found the value$\gamma = 0.19$.

With substitution in equation [33] we find:

$$\frac{\partial q}{q} = \frac{q-\tilde{q}}{q} = \frac{1}{\gamma}\left[\frac{\partial NX}{Y} + \eta_M \cdot \xi_M^Y \cdot \frac{\partial Y}{Y} - \eta_X \cdot \xi_X^{Y^*} \cdot \frac{\partial Y^*}{Y^*}\right]$$

$$\frac{\partial q}{q} = \frac{1}{0.19}\left[\frac{\partial NX}{Y} + 0.76(1.43)\cdot\frac{\partial Y}{Y} - 0.36(0.77)\cdot\frac{\partial Y^*}{Y^*}\right]$$

$$\frac{\partial q}{q} = 5.26\left[\frac{\partial NX}{Y} + 1.086\cdot\frac{\partial Y}{Y} - 0.277\cdot\frac{\partial Y^*}{Y^*}\right] = 5.26\left[\frac{NX_A - \widetilde{NX}}{Y}\right]$$

Even though:

$\widetilde{NX}$: Target current account (external debt stability)

NX_ACorrected current account from circumstantial deviations between the national and foreign economies

$$\frac{\partial NX_A}{Y} = \frac{NX}{Y} + 0.206.\mathrm{ogd} - 0.052.\mathrm{oger}[62]$$

whereas:

ogd: Domestic output gap Oger: Foreign output gap

$$\text{ogd} = \frac{dY}{Y} \quad [63]$$

$$\text{oger} = \frac{dY^*}{Y^*} \quad [64]$$

3. Measuring real exchange rate misalignment:

Exchange rate misalignment is defined as follows: $\frac{q^*}{q} - 1$ whereas q^* represents the equilibrium exchange rate;

q: represents the observed real exchange rate.

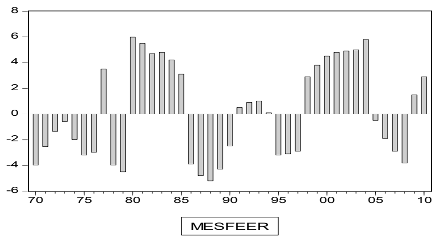

Figure (1): Measurement of the bilateral real exchange rate misalignment of the Algerian dinar according to the FEER model (1970-2022)

Source: Personal calculations by applying the equation [33].

The evolution of the real exchange rate imbalance related in terms of the significance of the comparative evolution between the actual current account, the target and the structural, as the equation [33]shows, when the structural current account is smaller than the target current account, the real exchange rate is overvalued and vice versa when it is greater than the target current account, the real exchange rate is undervalued.

If the observed real exchange rate is greater than the equilibrium price, thus a return to equilibrium requires a devaluation of the valueof (q), and therefore the degree of price competitiveness deteriorates, then in this case there is an overvaluation of the real exchange rate.If the observed real exchange rate is smaller than the equilibrium rate, then the value of (q) must be raised to join its equilibrium level. In this case, the price competitiveness improves and the real exchange rate becomes undervalued.

According to Figure (09), we notice that the exchange rate was valued greater than its real value during the period (1970-1979), but during the phase of the exchange control system, it appears to us that the real exchange rate remained broadly less evaluated during the 1980s, with the exception of the explosion years. And with the beginning of the nineties, the gradual decline of the dinar witnessed a significant acceleration, a stage that was accompanied by extensive economic reforms aimed at reaching an acceptable level for the stability of the dinar exchange rate. At the beginning of this phase, as shown in figure 13, the exchange rate of the dinar was undervalued, with the nominal devaluation of the dinar in 1991 and 1994.As for the period (1995-1998), coinciding with the implementation of the extended facilities agreement, and within the framework of the structural adjustment program, the real exchange rate was overvalued.

CONCLUSION:

The determination of the equilibrium level of the exchange rate is essential and important, it has been using several methods to determine the exchange rate equilibrium Among these curricula approach the real exchange rate basic equilibrium FEER proposed by Williamson, which allows for the economy that are stationed in the path of potential growth (absolute) or internal balance, And up to the external balance in the medium term, because the exchange level which allows for the use of resources at the international level, without prejudice to the internal equilibrium of economics, This rate allows the discovery of cases of deviation compared with the situation of balance, and here we tried to apply this approach in the case of Algeria, where we estimated potential output of Algeria during the period (1970-2018), As well as the output gap and the unemployment rate, which does not affect inflation (NAIRU) and the potential output estimates vary depending on the method of estimation used, And from it we have adopted single-variable method for estimating the output potential where we find from them liquidator (Hodrick-Prescott, HP), The method of multiple variables, including the production function methodology, and in another phase have included stability ratio of external debt to gross domestic product guide, which shows us that it is the most worthy to adjust the current situation of the Algerian economy, So it is one of its foreign chains, but in the race we have done the analytical evaluation model (Williamson), which allows us to estimate the difference between the real exchange rate of the Algerian dinar and its value of balance by employing foreign trade parameters.

BIBLIOGRAPHY

Abderrahmane, H. N. (1990). *The Purchasing Power of the Dinar.* alger: ENAG.

Adamu. (2009). Estimating potential output for Nigeria. *14 thAnnual Conference.* Econometrie Modeling for africa.

Benes, J.-p. N. (2004). *Multivariate Filter for Measuring Potential Output and theNARU :Application to the Czech Republic.* Washington: International Monetary Fund.

Beveridge, S., & Charles R, N. (1981). A New Approach toDecomposition of Economic TimeSeries into Permanent and Transitory Components with ParticularAttentiontu Measurement of theBusiness Cycle. *Journal of Monetary Economics* , 74-151.

Denis-al. (2002). *production Function Approach to calculating potential Growth and output Gaps:Estimates for the Eu member states and the us.* "Europen Commission Economic paper 176.

Epstein-Macchiarelli. (2010). *Estimating Poland's Potential output : A production Function Approach.* Washington: International Monetary Fund.

Harvey, A., & Thomas, T. (2008). Trend Estimation and The HodrickPrescott Filter. *J-JapanStatist* , Vol.38.Nov1/41-49.

HocineBenissad. (1994). *Algeria restructuring and economic reform 1979-1993.* Algeria: OPU.

Konuki. (2008). *Estimating potential output and the output Gap in Slovakia.* Washington: International Monetary Fund.

Mise, E., Kim, T.-H., & paul, N. (2003). The Hodrick Prescott Filter Time seriesEndpoints ,. *Discussion Papers in Economics* . University of Nottingham, UK.

Nehru-Dhareshwa. (8(1) June1993). A New Database on Physical CapitalStork:Sources; 1993., Methodology and Results . *Revista de AnalisisEconomica* , 37-59.

OdiaNdongo, Y. F. (2006). *Dating the Cycle of Cameroonian GDP Between 1960 and 2003*. Retrieved 2024, from http: //mpra.ub.uni-muenchen.de/552/

R.J, C. (1996). The time Varying NAIRU and its Implications for Economic policy. *"NBER Working paper 5735.*