Is there a dynamic relationship between the real exchange rate and the fundamental variables on the Case of the Algerian economy?

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Summary

The objective of this paper is to test the dynamic relationship between macroeconomic variables for the Algerian economy and the real exchange rate during the period 1986-2010, based on the notions of the theory of cointegration, we will try to estimate a macroeconomic model to analyze the impact of different variables determining the real equilibrium exchange rate (RER) long-term Algeria. We are trying through this article to estimate the relationships existing between the RER, trade openness (Ouvr) term exchange (TE) Have Outside Net (NEA) and external debt (RDET) relative to GDP, the net domestic credit and the ratio of expenditure to GDP. We concluded from our study that the external debt RDET, has a significant and positive effect on the long-term real exchange rate. Outside the Net Assets are also significant in determining the real exchange rate equilibrium in Algeria. With an elasticity of 0.0267, its importance is reflected by an increase in the competitiveness of the Algerian economy (depreciation of the real exchange rate).

Keywords: TCR, cointegration, stationarity, ECM

1. Introduction

Based on the notions of the theory of cointegration, we will try to estimate a macroeconomic model to analyze the impact of different variables determining the real equilibrium exchange rate (RER) long-term Algeria.

In addition, various empirical studies have focused on the study of the relationship between the real exchange rate and balance of these variables. The present work is based on the study of El Hadj Amor Thouraya and Araj Rita. They evaluated the effects of trade liberalization and international financial integration on the long-term behavior of the real exchange rate for the Southern and Eastern Mediterranean (SEM).

Referring to the work of Edwards (1989), an increase in import barriers generates a RER(Real Exchange Rate) appreciation. Trade liberalization can induce a more open trade. The latter can be evaluated, as before, by the structure of protection or can be measured by the sum of exports and imports relative to GDP. According to Edwards (1989), Elbadawi (1994) and (2005 and Elbadawi al. (), The behavior of the RER depends essentially on the degree of trade openness, increased openness depreciates the RER. External debt as a variable important macro for determining the exchange rate. Yet, Algeria was considered one of the most indebted countries as ranked by the IMF in relation to other underdeveloped country, generally an increase in the stock of long-term debt due an appreciation of the RER and decreased this the opposite effect. Specifically, the increase in the ratio of external debt to GDP can lead to an appreciation of the real exchange rate. This influx of foreign currency lies mainly in government rather than the private sector and is therefore more likely to be spent on non-tradables. Another variable that can affect the RER is the financial liberalization that is characterized by the elimination of control of capital movements and deregulation of domestic financial markets . This variant renewed interest studies on the variability of the RER.

The objective of this paper is to estimate the existing relations between the RER, trade openness (Ouver) term exchange (TE) Net foreign assets (AEN) and external debt (Rdette) to GDP .

In this perspective, in order to find these relationships, we opt for the Engle and Granger (1987) method. The latter is divided into two stages: first, we estimate the ECM model for each independent variable after checking that they are integrated of the same order. Second, we check the stationarity of residuals (Augmented Dickey Fuller ADF). Then we apply the Johansen method. The latter offers a multivariate approach to cointegration by applying the method of maximum likelihood.

2. The theoretical framework of the model

There is a large body of literature on equilibrium real exchange rate determination, how it is measured and, the importance of having the exchange rate at its equilibrium level. What is important for each country is to identify those fundamentals that play an important role in determining the equilibrium real exchange rate. Although authors arrive at different conclusions in their analyses, especially on the definition of real exchange rate, there seems to be some similarity in conclusions reached on developing and developed countries. In other words, there are similar trends amongst developing countries which are not necessarily the same with developed countries. Most authors also agree that persistent exchange rate misalignment has negative consequences on macroeconomic balance (Montiel, 2003). In this paper we analyse previous work done on this phenomenon. We identify the econometric method and approach used and review what different studies found on the impact of fundamental variables on determining the equilibrium exchange rate. Furthermore, we identify which exchange rates were found to be misaligned. This will be important when we estimate the equilibrium exchange rate for this study. We begin with methods and approaches used in previous studies.

There are various approaches found in the literature for estimating the equilibrium real exchange rate of a country. From the literature reviewed, a common approach, found in developing countries, is the behavioural equilibrium exchange rate (BEER) approach as found in Chen (2007), Iimi (2006), MacDonald and Ricci (2004), and Zhang (2001). Other approaches found in the literature include the reduced form approach in Li and Rowe (2007) and the general equilibrium approach in Mathisen (2003), Devarajan (1997), and White and Wignaraja (1992). For developing countries, because of low level of data availability, some approaches, such as PPP, cannot be used thus for developing countries the most suitable approach is the BEER (Zhang, 2001:84).

Recently, most studies have employed the multivariate co-integration, Johansen approach to determine the long-run relationship between fundamental variables and the real effective exchange rate. This econometric method was employed in the studies of Chen (2007), Mathisen (2003), Mkenda (2001) and Zhang (2001). One of the advantages of the Johansen approach is that it allows for more than one co-integrating vectors to be determined. Other methods used include the generalised least squares (GLS) in Adenauer and Vagassky (1998), Engle and Granger in Kemme and Roy (2006) and ordinary least squares (OLS) in Li and Rowe (2007) and White and Wignaraja (1992). Kamar and Nuceur (2007) in their study used pooled mean group (PMG) estimator because it constrained only the long-run coefficients to be identical across groups.

The long-run variables determine the equilibrium REER, there are also short-run variables and these impact the equilibrium level in the short term. Long-run variables coefficients are decomposed using different filtering methods and from studies reviewed, the Hodrick-Prescott filter is found in studies of Chen (2007), Li and Rowe (2007), Eita et al, (2006) and, MacDonald and Ricci (2004).

We selected the variables in the model based on empirical studies dealing with the identification of a long-term relationship between the real exchange rate Algerian and some fundamentals. The factors that come up most often are: the terms of trade, the growth rate of money and quasi-money (annual %) trade liberalization, foreign exchange reserves, external debt, and domestic credit. The purpose of this paper is to describe briefly the main transmission channels predicted by the theory. It is performed in the period from 1986 until 2010, data are annual frequencies

The real exchange rate is adjusted by the difference in price increases between LDCs and their partners rate to reflect changes in price competitiveness and exchange. It measures the relative competitiveness of a country against another, taking into account the relative prices between countries. It overcomes the problem that is the nominal exchange rate measure that is to be invariant to inflation. In Algeria the RER (real effective exchange rate) is determined monthly by the Bank of Algeria, depends on both price indices in Algeria and among other partners and the structure of foreign trade and the nominal exchange rate against the U.S. dollar.

The purpose of the exchange rate policy is the stability of the RER. Three phenomena are at the origin of the exchange rate of the dinar: RER reference set by the authorities, changes from the free currency fluctuations between them, and finally the variations caused by the interplay of supply and demand on the interbank foreign exchange market. On the latter, the Bank of Algeria is as offerer currency, allowing it to influence the orientation of the course: it feeds the currency market are necessary and reduces any excess liquidity.

We present the theoretical formula applied to our model where the RER is expressed in terms of an array of variables that influence:

TCR = f (basic), or:

$TCRt = c + \beta 1\ V1t + \beta 2\ V2t + \ldots + \beta n\ Vnt + \varepsilon t$

Where TCR is the real exchange rate, β are coefficients that we want to estimate, V are N chosen independent variables, c is a constant and ε is an iid variable (random) stationary zero mean.

More specifically, the relationship of long-term test of the RER in terms of its fundamental

is written as follows:

$TCR_t = \beta_0 + \beta_1\ TE_t + \beta_2\ Ouver_t + \beta_3\ AEP_t + \beta_4\ Rdet_t + \beta_5\ DPIB_t + \beta_6\ NDC_t + \varepsilon_t$

$t = 1, 2, 3..., T$

In this equation: TCR is the real exchange rate, TE: the terms of trade, Ouver: trade openness, AEP: Net Foreign Assets ratio to GDP; Rdette: the ratio of external debt to GDP.et DPIB: the ration spending to GDP; NDC: Net Domestic Credit

The RER is explained by its fundamentals are theoretically justified:

The terms of trade: According to the value of the elasticity of substitution between imports and non-tradable goods, the terms of trade have a positive influence sometimes, sometimes negative on the real effective exchange rate (DEVARAJAN et al 1998). Deteriorating terms of trade generally has two effects: an income effect and income effect related to the decline in real income of consumers, on the one hand, a substitution of foreign assets by domestic assets of other. If the income effect is dominant, the RER depreciates as the country reduces the production of household goods and increases the exported goods. However, when the substitution effect is stronger, the RER tends to rise and exports fall. This promotes the production of domestic goods substitutes. The demand for non-tradable goods rises, driving up its prices.

But improved terms of trade always leads to a RER appreciation, because of the surplus of the trade balance due to a stronger effect of income than the substitution effect. So it is in the most developing countries, because of the income effect is dominant (Edwards, 1988; slaps and Alii, 1997 DEVARAJAN, 1998); We can therefore expect that the coefficient of the variable terms of trade is negative.

The effect of trade openness: On the theoretical side, several models have analyzed the impact of trade liberalization on the real exchange rate. The literature in this area shows that the real exchange rate equilibrium is a function of observable macroeconomic variables and the real exchange rate approaches with its equilibrium rate over time. Increased openness, expressed as the sum of exports and imports relative to GDP, leading to a strong movement of currencies. This opening to the developing rate is marked by a strong increase in imports. Thus, a decrease (increase) of the opening can appreciate (depreciate) the RER.

The net foreign assets: Net foreign assets represent the difference between foreign currency assets of the commercial banks and the Central Bank, comprised primarily of assets deposited in operating account with the treasury, on the one hand and the commitments of short term of these institutions, on the other hand; They gauge the outer cover of the currency of a country.

There is a direct relationship between the exchange rate and external assets. An increase in foreign assets leads to an appreciation of the real exchange rate. While a decline in foreign assets depreciate the real exchange rate.

External debt: gives rise to a currency depreciation when it increases and it decreases when it is an appreciation (CAGNON, 1996). The influence of foreign debt on the REER is that a faster growth in public expenditure over income worsens the budget deficit. Causing upward pressure on the prices of non-tradables relative to the price of tradables. This increase in the relative price of non-tradables in turn causes an appreciation of the REER (Haberger 1986). The coefficient on this variable should be negative.

Domestic credit is the exchange rate by increasing the money supply. When there is a stable relationship between domestic credit and money supply, stronger growth in the first compared to the demand for money is usually accompanied by an excess demand for all goods. However, excess demand for tradable goods leads to an increase in the trade deficit, which results in a decrease in international reserves and an increase in external borrowing. In a fixed system as that in force in Algeria exchange, any increase in domestic credit pushes individuals to get rid of their excess money balances by purchasing goods and foreign securities. This creates a deficit in the balance of payments.

Under these conditions, the monetary authorities are obliged to buy the domestic currency to cover the deficit. This gives rise to a decrease in foreign exchange reserves. And as the excess demand for non-tradable goods necessarily leads to higher prices for these goods, the decline in international reserves and rising prices lead to a RER appreciation.

Government spending (Dep), the effect of government spending on the real exchange rate is ambiguous on the theoretical plane. The impact of government spending depends on the relative importance of tradable and non-tradable goods in the economy.

To illustrate this, we summarize the results of Edwards (1989) as follows:

We consider two periods, the period (1 and 2). It is further assumed that the distortions in tax matters do not exist.

Assuming an increase in the consumption of non-tradable government in period 1, financed by public or international loan assets. The real exchange rate is affected in two ways. In a first phase the increase in demand for goods and services grows with an increase in prices of non-tradables. This price increase causes for an appreciation of the real exchange rate. However, the government will increase the level of taxes to pay its debt. This reduces the level of disposable income and therefore provision will result in period 2 a drop in aggregate demand leading to lower prices of non-tradable hence a depreciation of the real exchange rate property.

On top of that, it is difficult to determine a priori the impact of changes in government consumption of non-tradables on the real exchange rate. The same situation is obtained by analyzing the effect of changes in the consumption of tradable goods by the government on the real exchange rate.

3. Empirical application

3.1 Model specification

In this study, we will explain the real exchange rate between 1986 and 2010 by a model of fundamental variables that can be written as follows:

$$\boldsymbol{TCR_t = \alpha_0 + \alpha_1 TE_t + \alpha_2 AEP_t + \alpha_3 RDET_t + \alpha_4 OU_t + \alpha_5 NDC_t + \alpha_6 DPIB_t + \varepsilon_t} \quad \textbf{(1)}$$

with:

TCR: Real exchange rate.

TE: Term Exchange

DPIB: Share of total expenditure in GDP

AEP: Ratio Net foreign assets to GDP

RDET: external debt to GDP ratio

NDC: Domestic credit

OU: trade openness

3.2 The statistics of the empirical analysis

The data for this model are annual and cover the period 1986-2010, these data are derived from statistics from the World Bank (WDI 2011).

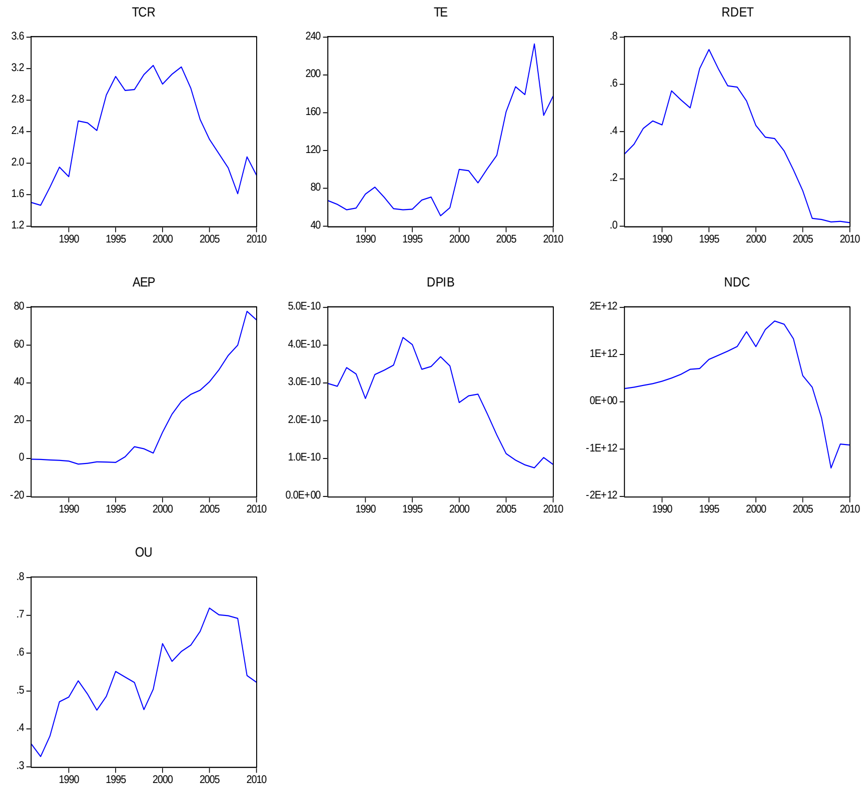
The real exchange rate is defined mathematically as follows: TCR = TCN / PPA.

Exchange policy has objective as how to determinate exchange rate of national currency. The exchange rate is the price at which one currency can be exchanged against another. The monetary value of the most common is the bilateral exchange rate quoted by a market operator or exchange published by a newspaper. The bilateral exchange rate of the dinar / dollar was fixed at 4.94 in 1974 was jump up in 2000 to 83.

Assessing the value of a currency on the foreign exchange market by studying one or more bilateral exchange rates, can be deceiver in the same way that estimating the general price level considering only the price of one or several baskets product. As any price index, the bilateral exchange rate of a currency can be combined in various ways to construct an index of effective exchange rate

The graphs of seven variables (real exchange rate, terms of trade, trade openness ratio to GDP have outside, outside debt to GDP ratio, Net Domestic Credit, ratio of spending to GDP) are given below show the presence of a tendency for each variable. That put the stationarity of the series in question

Graph 1: the evolution of the study variables



3.3 Unit root test

There are a large number of unit root tests. The pioneering work in this field are those of Fuller (1976) and Dickey and Fuller (1979.1980). The Dickey-Fuller tests are parametric tests to highlight the stationary or not a column by determining a deterministic or stochastic trend. These tests are based on an estimate of autoregressive process.

Dickey and Fuller consider three basic models for the series:

Model (1) model without constant or deterministic trend

$$X_t = \rho X_{t-1} + \varepsilon_t$$

Model (2) with constant model without deterministic trend

$$X_t = \rho X_{t-1} + b + \varepsilon_t$$

Model (3) model with constant and deterministic trend

$$X_t = \rho X_{t-1} + at + b + \varepsilon_t$$

In all three models, we assume that

The test principle is as follows:

$H_0 : \rho = 1$ presence of a unit where the root is series nonstationary

$H_0 : |\rho| < 1$ no unit root where the series is stationary

If the hypothesis $H_0 : \rho = 1$ is retained in one of these three models, then the process is not stationary.

The test strategy is sequential, it is assumed in the model (3) the model (1).

The model (3), we test the significance of the slope coefficient of a trend from Student statistic. When a is different from zero, then it is tested for the same model by the coefficient ρ of the same test.t.

Is rejected $H_0 : \rho = 1$, that is to say, the series is stationary if $t_\rho^c > t^t$

By cons, if the coefficient is significantly zero, we go directly to the test of the model (2), the significance of the constant b by Student's t test was tested. If b is significantly different from zero, then we test for this model the coefficient ρ par le même test. of the same test. If the constant b is zero significantly, we go on to test the model (1).

If the series X_t level is not stationary, the DF test and the same procedure is applied to the differentiated series ΔX_t

We recall that the DF test on all three models assume that the process residue is white noise. But there is no reason that a priori, the error is uncorrelated. To address this hypothesis, Dickey and Fuller have developed their test in 1981. This test is known as the Dickey-Fuller (ADF), which is based on three models:

Model (4) model without constant or deterministic trend

$$X_t = \varphi X_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta X_{t-j} + \eta_t$$

Model (5) model with constant without deterministic trend

$$X_t = \varphi X_{t-1} + \mu + \sum_{j=1}^{p} \lambda_j \Delta X_{t-j} + \eta_t$$

Model (6) model with constant and deterministic trend

$$X_t = \varphi X_{t-1} + \alpha + \delta\, t + \sum_{j=1}^{p} \lambda_j \Delta X_{t-j} + \eta_t$$

The implementation of the ADF test is similar to test DF only statistical tables differ.

The ADF test application first requires choosing the number of delay p to introduce in order to whiten the residuals. The p-value of delay is determined either by using the partial autocorrelation function, or using the Box-Pierce statistic or using Akaike criteria (AIC) where Schwartz (BIC).

In our study we will apply the ADF test we determined the number of delay using the function partial autocorréllations studying the significance of the partial correlation coefficients. The application of this method based on the study of corréllogramme different variables in the equation (1), we obtained a delay for all variables.

After we determined the delay for each variable, we adopted the strategy of sequential ADF test to examine the stationarity of the variables of the study. The following table summarizes our application:

Table 1: Test of Dickey-Fuller

Variable	Number of delay	ADF	Order of integration
TCR	4	-0,09	I(1)
DRER	1	-4.69	I(0)
TE	0	0,43	I(1)
DTE	0	-6,12	I(0)
OU	1	0,21	I(1)
DOU	0	-4,27	I(0)
RDET	0	-0.69	I(1)
DRDET	2	-3.39	I(0)
NDC	4	-3.08	I(1)
DNDC	0	-3.73	I(0)
AEP	0	3.19	I(1)
DAE	0	-2.95	I(0)
DPIB	0	-1.06	I(1)
DDPIB	1	-4.33	I(0)

By comparing the calculated ADF (Table 1) with the critical value of ADF for a significance level of 5%. This comparison shows us that the null hypothesis of nonstationarity is accepted for the level variables (real exchange rate, terms of trade, trade openness ratio to GDP have outside, external debt to GDP ratio, Net Domestic Credit, ratio of spending to GDP).

The séries $TCR_t, TE_t, OU_t, AEP_t, RDET_t, NDC_t, DPIB_t)$) are then integrated of order one, as the first difference of each of these variables is stationary I (0).

3.4 Cointegration tests

We recall, for a long-term relationship between several variables, two conditions must be met: first variables must be non-stationary and integrated of the same order. Secondly their stochastic trends must be linked.

The ADF tests therefore suggest the existence of a cointegration relationship between real exchange rate and terms of trade, trade openness ratio to GDP, external debt ratio to GDP, Net Domestic Credit, and the expense ratio to GDP.

To investigate the existence of a long-term relationship between the variables in the model, we applied two methods:

The general method of maximum likelihood (Johansen, 1988, 1991, and Jueslius Johansen, 1990).

The method of two-step Engle and Granger (1978)

3.4.1 Application of the Johansen test

The test of the Johansen trace, we can detect the number of cointegrating vectors. The assumptions of this test are as follows:

H_0 : There are at most r cointegrating vectors

H_1 : There are at least r vectors cointégation

We accept H_0 when Statistics Trace is less than the critical values at a significance level $\alpha\%$. Par contre, By cons, we reject H_0 otherwise. This test is applied sequentially from r = 0 to r = k-1

Table 2: Johansen cointegration test

eigenvalues	likelihood ratio (statistical trace)	critical value	Assumption on the number of EC
0.647	49.095	47.856	no
0.485	25.109	29.797	At least one
0.345	9.809	15.494	At least two
0.0025	0.057	3.841	At least three

We first tested the hypothesis that the number of cointegrating vectors is strictly zero (r = 0) (column Likelhood ratio, Table 2).

We note that the statistical Trace for r = 0 (49.095) is greater than the critical value 5% (47.85)the statistical We then test the hypothesis that the number of cointegrating vectors is strictly equal to one (r = 1). Statistics Trace for r = 1 (25.109) is less than the critical value (29 797), which leads us therefore accept the threshold. H_0 of 5% .

The tests of the Johansen trace, we can conclude that there is a cointegration relationship between the five variables.

3.4.2Application of the method of Engle and Granger

The concept of cointegration assumes that if two variables X and Y are (I) (1) integrated of order, and there is a linear combination of these variables is stationary I (0), then we may conclude that X and Y are cointegrated order (1,1).

We have already shown that the series are non-stationary and integrated of the same order. We have, then, to test if the residuals of this linear combination are stationary. If appropriate, the deviations from the equilibrium value tend to cancel over time and, therefore, a long-term relationship between the variables.

We believe in a first stage OLS the long-term relationship:

$$\boldsymbol{TCR_t} = \mathbf{0.442+0.0267} * \boldsymbol{AEP_t} + \mathbf{3.17} * \boldsymbol{RDET_t} + \mathbf{4.87e\text{-}13} * \boldsymbol{NDC_t} + \boldsymbol{\varepsilon_t} \qquad (2)$$

We deduce the estimate of the static equation (2) residue series, remember that:

If the residuals are non-stationary, the estimated long-term relationship (2) is a spurious regression

If the residuals are stationary, the estimated long-term relationship (2) is a cointegration relationship

To test the stationarity of residue, we will use the tabulated critical values of Engle and Yoo (1987) in applying the ADF test

The results from the application of the ADF test on the residuals of the static relationship between real exchange rate and Net foreign assets ratio to GDP , external debt to GDP ratio, Net Domestic Credit, is attached.

It is noted that the estimated ADF statistics (-4.86) is less than the tabulated value of Engle and Yoo at the 5% (-2.67), this allows us to reject the hypothesis of nonstationarity of residue where the remains of the static relationship between real exchange rate and ratio Net foreign assets to GDP, External debt to GDP ratio, Net Domestic credit are stationary. Therefore, the real exchange rate variables, and Net foreign assets ratio to GDP, the ratios of external debt to GDP, Net Domestic Credit are cointegrated. It is then possible to estimate the model error correction.

3.5 Estimation of the ECM model

The study of short-term relationship through ECM, allows us to analyze the one hand the speed of convergence of the real exchange rate to its equilibrium level of long-term and also the contribution of fundamental to the short-term dynamics. This leads us to test the significance of the equation parameters following short-term

$\Delta \boldsymbol{TCR_t} = \boldsymbol{\alpha_1} * \Delta\mathbf{AEP}_t + \boldsymbol{\alpha_2} * \Delta\boldsymbol{NDC_t} + \boldsymbol{\alpha_3} * \Delta\boldsymbol{RDET_t} + \boldsymbol{\alpha_4} * \boldsymbol{\varepsilon_{t-1}} + \boldsymbol{\mu_t}$ with $\boldsymbol{\mu_t}$ white noise

with :

$$\boldsymbol{\varepsilon_{t-1}} = \boldsymbol{TCR_{t-1}} - (\mathbf{0.442+0.0267} * \boldsymbol{AEP_{t-1}} + \mathbf{3.17} * \boldsymbol{RDET_{t-1}} + \mathbf{4.87e\text{-}13} * \boldsymbol{NDC_{t-1}} + \boldsymbol{\varepsilon_t})$$

Where $\boldsymbol{\varepsilon_{t-1}}$ is the residue from the cointegrating relationship of long-term (Equation 1), $\boldsymbol{\alpha_4}$ is the coefficient of error correction, representing the force towards the long-term equilibrium. This parameter must be significantly non-zero and negative if not the representation of model error correction is not valid.

Model the real exchange rate based on the residue from the previous period, the real exchange rate of a delayed period, the ratio Net foreign assets to GDP now and delayed by a period of net domestic credit and present a delayed period, the ratio of external debt to GDP and this delayed period.

The ECM model equation of our model by Granger approach is as follows:

$$\Delta \boldsymbol{TCR_t} = \mathbf{0.05\text{-}0.108} * \boldsymbol{\varepsilon_{t-1}} - \mathbf{0.18} * \Delta\boldsymbol{TCR_{t-1}} + \mathbf{0.08} * \Delta\mathbf{AEP}_t + \mathbf{4.03E13} * \Delta\boldsymbol{NDC_t} + \mathbf{2.80} * \Delta\boldsymbol{RDET_t} + \boldsymbol{\mu_t}$$

with μ_t white noise

From Table 2 in the Appendix, we find that the coefficient associated with the bias is negative (0.108). There is therefore a mechanism for error correction. Mechanism indicates that the convergence of trajectories of serial RER to the long-term target. Thus, the impact of RER corrects to 10% effect feedback.

Calculating the duration of the convergence can be achieved by the following formula: $(1-\delta) = (1-|\varphi|)^{T}$

with T, φ and δ are respectively the number of years, the error correction factor and the percentage of shock.

We used the inverse of the coefficient of restoring force to calculate the duration of convergence and we concluded that:

return speed after the deviation (shock) is 0.108. More simply, if there is a shock to the long-term equilibrium, should be exactly 9.25 years (1/0, 108) is a little more than nine years after a shock to return to the equilibrium . We note that this time gap between the occurrence of a shock and return to the stable long-run equilibrium is long.

We found the table ECM approach Granger (Appendix Table 3) that all the coefficients of the variables that explain the exchange rate is significant that allows us to say that there is a relationship between short dull rate real exchange rate and the ratio Net foreign assets to GDP and net domestic credit and the ratio of external debt to GDP

Johansen method (Appendix Table 3), shows that there is not a short-term relationship between the exchange rate and the explanatory variables of our model.

We interpret our static long-run equation obtained by the MCO:

$$TCR_t = 0.442+0.0267 * AEP_t + 3.17 * RDET_t + 4.87e\text{-}13 * NDC_t + \varepsilon_t$$

We see Table 1 in the Appendix that all coefficients of the equation are significant at the 5% level and the signs of the coefficients obtained correspond to economic theory:

External debt RDET, has a significant and positive effect on the long-term real exchange rate. This is consistent with the theoretical prediction that a rise in the relative price of non-tradables due to a faster increase in public expenditure over income, inflationary pressure has led to the depreciation of the exchange rate. This is a longer than the accumulation of debt really a problem period. Indeed, the competitiveness of domestic goods relative to foreign goods tends to decrease. The rising prices of domestic products discourages exports and encourages imports. The result is a development tradable sectors at the expense of those

non-tradables.

We supposite a direct relationship between the exchange rate and external assets. An increase in foreign assets leads to an appreciation of the real exchange rate. While a decline in foreign assets depreciate the real exchange rate, in the result of our studies we have the Net foreign assets (AEP) is also very significant in determining the equilibrium real exchange rate in Algeria. With an elasticity of 0.0267, its importance is reflected by an increase in the competitiveness of the Algerian economy (depreciation of the real exchange rate).

To implement the robustness tests on residues, stability coefficients, we followed the following steps:

i) the Chow test is used to test the stability of the coefficients (equalities between the coefficients). This test can only be put into practice only after determining the sub-periods.
To this end, it will take two sub-periods:

First period: 1986-1999, which was $T_1 = 15$ observations

Second Period: 2000-2010, which was $T_2 = 10$ observations.

We recall that this test is based on the following stat

$$\text{Chow} = \frac{RSS - RSS_1}{RSS_1} \frac{T_1 + T_2 - 2K}{2K} \rightarrow F(K,\ \mathrm{T}_1 + T_2 - 2K)$$

RSS is the residual sum of squares for all observations (25 observations) is the residual sum of squares for the first sub-period and the number of variables.

Under the assumption H_0 of equal coefficients against the instability of coefficients,

The application of this test gives us the following result (see Appendix Table 4):

the critical probability, we reject the hypothesis of stability coefficients over time as Prob F (4,17) = 0.0008 <5%

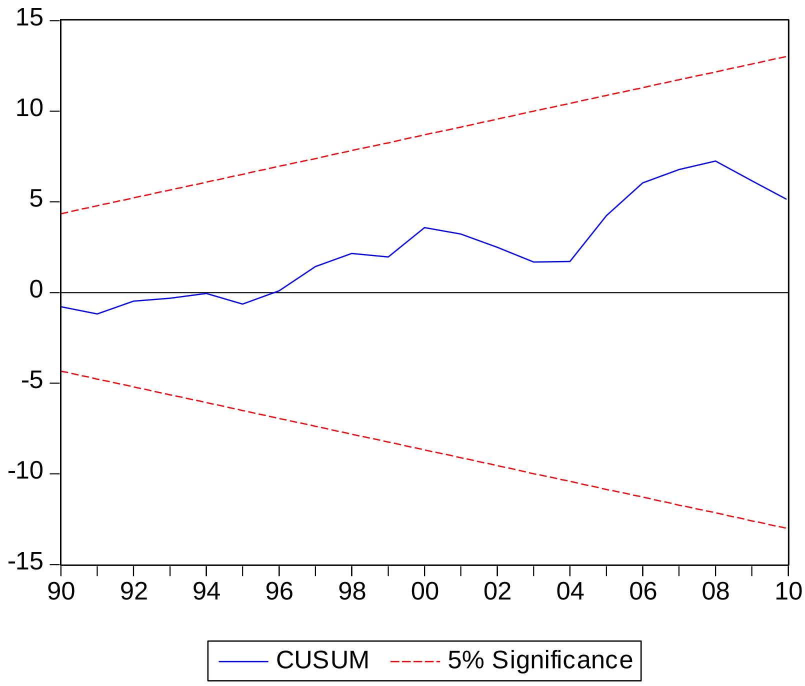
According to the Chow test, we can conclude that the coefficients are unstable.

ii) the residues of our empirical model meet four conditions: normality, stationarity, homoscedasticity and independence of residuals.

Residues are actually distributed as a normal distribution, the Jarque-Bera accept the null hypothesis of normality (JB=1,14<$\chi^2_{0,05}(2) = 5{,}99$. The ADF test on the residuals confirms stationarity residues using as critical values table Engle and Yoo (1987) (ADF = -4.85 estimated is less than the tabulated value which is equal to -2, 67). Testing White (1980) accepts the homosscédasticité the null hypothesis and reject the alternative hypothesis of heteroskedasticity $TR^2 = 13{,}79 < \chi^2_{0,05}(9) = 16{,}91$. he Durbin-Watson (DW) confirms the dependence of errors (DW=$\check{d} = 0{,}81; \check{d} < d_L$).

iii)To confirm that this relationship is generally stable, several tests may be used: tests of recursive residuals, CUSUM and CUSUM square. The last test we apply.

Graph 2: CUSUM test applied to the model coefficients



We observe in graph 2 that the CUSUM is the inner corridor, this test allows us to say that the relationship is stable.

iv) the explanatory power in our model is 92%, this allows us to say that the Net foreign assets ratio to GDP and domestic credit, the external debt ratio to GDP significantly explain the real exchange rate during the study period

According to the statistical study we addressed, we can conclude that our model is generally satisfactory.

4. CONCLUSION

This study analysed the behaviour of the real exchange rate and the relationship between the real exchange rate and its determinants. Real exchange rate dynamic adjustment is observed if there is a shock to the determinants. A number of studies have been conducted for, estimating equilibrium real exchange rate for different countries and making it possible to determine real exchange rate misalignment. Determining the correct level of the real exchange rate is important as RER is an indicator of a country‟s external competitiveness (Edwards, 1989). With constant changes in real exchange rate determinants, determining the appropriate equilibrium exchange rate level at different points in time is thus important.

The study commenced by discussing the importance of the real exchange rate and the theory behind it. The foreign exchange market is the most liquid of all global financial markets. A number of studies, for developing countries, were reviewed. Some of the variables identified in the literature as impacting on the RER include terms of trade, openness, government consumption, foreign aid, interest rate differentials, commodity prices, domestic credit, net capital inflows, the Balassa-Samuelson effect and the nominal exchange rate. For most developing country studies, data availability was raised as a limitation in measuring the equilibrium exchange rate.

The objective of this paper is to test the dynamic relationship between macroeconomic variables for the Algerian economy and the real exchange rate during the period 1986-2010, based on the notions of the theory of cointegration, we try estimate a macroeconomic model to analyze the impact of different variables determining the real equilibrium exchange rate (RER) long-term Algeria.

To determine the long-run and short-run relationships between the exchange rate and its determinants, the study employed the method of Engle and Granger and Johansen co-integration and the error correction methodology. This technique has been widely used in recent studies to determine the equilibrium exchange rate. Other estimation techniques are available, but the Johansen one has several advantages over them. To increase the number of observations for estimation some data series were interpolated. The study used Algeria"s annually data from 1986 to 2010.

Most variables were first differenced stationary. The model was identified for Algeria, with different combination of variables as some variables did not perform well when included together; for example TE and OU. The model that best expressed the equilibrium exchange rate was chosen.

We concluded from our study that the external debt RDET, has a significant and positive effect on the long-term real exchange rate. The AEP (the net foreign assets) is also very significant in determining the equilibrium real exchange rate in Algeria. With an elasticity of 0.0267, its importance is reflected by an increase in the competitiveness of the Algerian economy (depreciation of the real exchange rate).

POLICY RECOMMENDATIONS

Since the results have shown that there is a long-run relationship between the real exchange rate and its determinants, the government of Algeria may consider influencing one variable that may also have an influence on the other variables and the exchange rate. This shows how monetary and fiscal policies‟ stance of a country must be supportive of each other so as to minimise exchange rate misalignment.

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ANNEX

Table 1

Dependent Variable: TCR

Method: Least Squares

Date: 05/31/13 Time: 16:38

Sample: 1986 2010

Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RDET	3.172749	0.354076	8.960641	0.0000
NDC	4.87E-13	5.59E-14	8.712127	0.0000
AEP	0.026716	0.002831	9.435474	0.0000
C	0.442100	0.177953	2.484360	0.0215

R-squared	0.926197	Mean dependent var	2.433785
Adjusted R-squared	0.915654	S.D. dependent var	0.592966
S.E. of regression	0.172212	Akaike info criterion	-0.534538
Sum squared resid	0.622794	Schwarz criterion	-0.339518
Log likelihood	10.68173	Hannan-Quinn criter.	-0.480448
F-statistic	87.84717	Durbin-Watson stat	0.814690
Prob(F-statistic)	0.000000		

Table 2

Dependent Variable: D(RER)

Method: Least Squares

Date: 05/30/13 Time: 19:59

Sample (adjusted): 1988 2010

Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TCR(-1))	-0.180087	0.132696	-1.357141	0.1925
D(RDET)	2.802049	0.410980	6.817969	0.0000
D(NDC)	4.03E-13	8.04E-14	5.013940	0.0001
D(AEP)	0.008910	0.008693	1.025001	0.3197
RESD(-1)	-0.108438	0.215203	-0.503889	0.6208
C	0.055247	0.038502	1.434891	0.1695

R-squared	0.851301	Mean dependent var	0.016613
Adjusted R-squared	0.807566	S.D. dependent var	0.285863
S.E. of regression	0.125401	Akaike info criterion	-1.095150
Sum squared resid	0.267330	Schwarz criterion	-0.798934
Log likelihood	18.59422	Hannan-Quinn criter.	-1.020652
F-statistic	19.46492	Durbin-Watson stat	1.588833
Prob(F-statistic)	0.000002		

Table 3

Vector Error Correction Estimates

Date: 05/29/13 Time: 13:46

Sample (adjusted): 1989 2010

Included observations: 22 after adjustments

Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
TCR(-1)	1.000000			
NDC(-1)	-1.13E-13			
	(6.7E-14)			
	[-1.69888]			
RDET(-1)	-2.675771			
	(0.29829)			
	[-8.97027]			
AEP(-1)	-0.011293			
	(0.00341)			
	[-3.31177]			
C	-1.202230			
Error Correction:	D(TCR)	D(NDC)	D(RDET)	D(AEP)
CointEq1	-0.800177	-4.27E+11	-0.199857	10.24513
	(0.30948)	(4.6E+11)	(0.04709)	(4.71949)

	[-2.58554]	[-0.92431]	[-4.24442]	[2.17081]
D(TCR(-1))	-0.437777	1.34E+12	-0.326123	0.000718
	(0.66772)	(1.0E+12)	(0.10159)	(10.1824)
	[-0.65563]	[1.34234]	[-3.21013]	[7.1e-05]
D(TCR(-2))	0.493310	1.24E+11	0.238267	-0.329235
	(0.55642)	(8.3E+11)	(0.08466)	(8.48514)
	[0.88659]	[0.14923]	[2.81448]	[-0.03880]
D(NDC(-1))	1.98E-13	-0.468510	1.75E-13	-9.22E-12
	(3.2E-13)	(0.47360)	(4.8E-14)	(4.8E-12)
	[0.62468]	[-0.98924]	[3.62461]	[-1.90608]
D(NDC(-2))	-9.54E-14	0.520129	-1.21E-13	-2.05E-12
	(3.0E-13)	(0.45516)	(4.6E-14)	(4.6E-12)
	[-0.31294]	[1.14273]	[-2.61949]	[-0.44068]
D(RDET(-1))	0.811820	-3.17E+12	1.053496	-4.017334
	(2.30036)	(3.4E+12)	(0.35000)	(35.0797)
	[0.35291]	[-0.92348]	[3.01002]	[-0.11452]
D(RDET(-2))	-3.336924	1.69E+12	-1.456193	24.19906
	(1.99698)	(3.0E+12)	(0.30384)	(30.4532)
	[-1.67099]	[0.56752]	[-4.79268]	[0.79463]
D(AEP(-1))	0.001819	2.18E+10	0.002609	-0.149546
	(0.01775)	(2.7E+10)	(0.00270)	(0.27069)
	[0.10250]	[0.82400]	[0.96588]	[-0.55246]
D(AEP(-2))	-0.003753	2.87E+10	-0.004623	-0.059861
	(0.02522)	(3.8E+10)	(0.00384)	(0.38457)
	[-0.14883]	[0.76284]	[-1.20482]	[-0.15566]
C	-0.007727	-2.62E+11	-0.010057	3.661884
	(0.12494)	(1.9E+11)	(0.01901)	(1.90536)
	[-0.06184]	[-1.40664]	[-0.52905]	[1.92189]

R-squared	0.484490	0.319463	0.811462	0.629407
Adj. R-squared	0.097857	-0.190940	0.670058	0.351463
Sum sq. resids	0.902184	2.01E+24	0.020885	209.8047
S.E. equation	0.274193	4.09E+11	0.041718	4.181354
F-statistic	1.253100	0.625903	5.738619	2.264509
Log likelihood	3.917123	-612.7865	45.34093	-56.02313
Akaike AIC	0.552989	56.61695	-3.212812	6.002102
Schwarz SC	1.048917	57.11288	-2.716884	6.498031
Mean dependent	0.006903	-5.73E+10	-0.018141	3.365489
S.D. dependent	0.288682	3.75E+11	0.072628	5.192178

Determinant resid covariance (dof adj.)	1.41E+19
Determinant resid covariance	1.25E+18
Log likelihood	-583.2088
Akaike information criterion	57.01898
Schwarz criterion	59.20107

Table 4

Chow Breakpoint Test: 1999

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1986 2010

F-statistic	8.051797	Prob. F(4,17)	0.0008
Log likelihood ratio	26.57066	Prob. Chi-Square(4)	0.0000
Wald Statistic	32.20719	Prob. Chi-Square(4)	0.0000