

ESTIMATE THE EQUILIBRIUM REAL EFFECTIVE EXCHANGE RATE OF THE ALGERIAN DINAR : A RECENT EMPIRICAL STUDY (1981-2008)

DRARNI Nacer

Maitre assistant A, faculté des sciences économiques et de gestion, U.Blida

Abstract: The real effective exchange rate (REER) plays an important role in the broad allocation of resources in production. The REER, as a measure of competitiveness, also determines and influences the performance of export sector.

This paper estimates the long-run relationship between the REER and fundamentals: terms of trade, net foreign assets and productivity. This paper employs the behaviour equilibrium exchange rate (BEER) model to estimate the equilibrium real effective exchange rate of Algerian dinar (DZD) and exchange rate misalignments in Algeria, with covers the period and annual data from (1981-2008), by using advanced cointegration testing techniques as developed by (Johansen,1988) and (Johansen-Juselius,1990)¹ vector error correction model², the existence of cointegrating

ملخص: يلعب سعر الصرف الفعلي الحقيقي دوراً هاماً في توزيع واسع النطاق للموارد في الإنتاج. ويعتبر أهم مؤشر من أجل قياس القدرة أيضاً ومحدد ومؤثر في كفاءات على التنافسية، تهدف هذه المقالة لتقدير قطاعات الصادرات. العلاقة طويلة المدى بين متغيرات أساسيات الإقتصاد الكلي (معدلات التبادل، انحرافات الإنتاجية وصافي الأصول الأجنبية)، وسعر للدينار الجزائري. الصرف الفعلي الحقيقي وسوف نستخدم نموذج سعر الصرف السلوكي من أجل تقدير سعر الصرف الفعلي الحقيقي الجزائري وقيمة عدم توازنه التوازني للدينار (2008-). أين خلال الفترة الممتدة بين (1981-2008) يتم استخدام تقنيات التكامل المشترك ونموذج تصحيح الخطأ، من أجل تحديد وجود علاقة طويلة المدى بين سعر الصرف الفعلي الحقيقي ومتغيرات أساسيات الإقتصاد (Johansen- Juselius, 1990) و (Johansen, 1988) الكلي.

تشير نتائج التحليل إلى أن كل من انحرافات يؤديان إلى إرتفاع الإنتاجية ومعدلات التبادل، في سعر الصرف الحقيقي التوازني، بينما صافي الأصول الأجنبية تؤثر سلباً وبالتالي تؤدي إلى انخفاض في سعر الصرف الحقيقي

relationships among fundamental variables³ and real effective exchange rate⁴ can be effectively analyzed.

The analysis concludes that (REER) appreciates with productivity and term of trade but, with, net foreign assets depreciate. Generally, lower misalignments are linked to more flexible exchange rate regimes then to fixed regimes⁵.

Keywords: Real effective exchange rate, equilibrium real exchange rate, misalignments, cointegration.

التوازن. بصفة عامة، تكون قيمة عدم التوازن أقل في إطار نظام سعر الصرف المرن.

الكلمات المفتاحية: سعر الصرف الفعلي قيمة الحقيقي، سعر الصرف الحقيقي التوازني. عدم التوازن، التكامل المشترك.

Introduction

Real effective exchange rate (REER) is a key macroeconomic relative price, which plays an important role in the broad allocation of resources in production and spending behavior in the economy. (REER), as a measure of competitiveness⁶, also determines and influences the performance of the export sector (Caballero and Corbo, 1989). It is because of these allocative and competitive roles of (REER) that developing and emerging economies⁷ are encouraged by IMF to keep the actual (REER) close to the equilibrium real exchange rate (ERER henceforth), which is defined as the value of the (REER) consistent with a simultaneous attainment of internal and external equilibrium⁸.

In this paper, we estimate a behaviour equilibrium exchange rate model (BEER) for Algeria to establish to what extent (REER) movements have been driven by an adjustment to its equilibrium values, consistent with changing fundamentals⁹. The real effective exchange rate (REER) of the Algeria dinar

(DZD) depreciated sharply in (1990) as a result of a large negative terms-of-trade shock and the collapse of the dinar (DZD) in nominal terms¹⁰ in (1986–1996). Since then the dinar (DZD) has been appreciating¹¹ in real effective terms, despite the depreciation¹² of the nominal effective rate¹³ (2000-2010). What factors are driving the (REER) in Algeria? Is there a misalignment between the actual and equilibrium (REER) at present? In this paper these questions are addressed by estimating a behavioral equilibrium exchange rate (BEER) model for the (REER) of the Algerian¹⁴ dinar using annual data from (1981 to 2008).

The paper is organized as follows: in Section 1 reviews the theoretical (REER) literature with the view of selecting a model to be estimated. In Section 2 empirical approaches to estimate the equilibrium exchange rate¹⁵ of the Algerian dinar. In Section 3 describes the data used in the empirical analysis and investigates the presence of a long-run Cointegrating relationship between the REER and a set of fundamentals¹⁶. The results are then used to derive measures of the equilibrium (REER) and the gap between the actual and estimated equilibrium values of the (REER) and describes the Misalignment of the Algerian dinar (REER), and finally ,in Section 4 concludes and recommendations.

1- EMPIRICAL STUDY: THE DETERMINANTS OF REAL EFFECTIVE EXCHANGE RATE

The literature has proceeded in two separate directions. The first one includes Williamson's (1994) Fundamental Equilibrium Exchange Rate (FEER)¹⁷ concept, the IMF's (1994) Desirable Equilibrium Exchange Rate (DEER)¹⁸ concept and Stein's (1994) Natural Exchange Rate (NATREX)¹⁹ concept. The second direction consists of Edwards (1989, 1994) and Elbadawi (1994) and their concept of Equilibrium Real Exchange Rate (ERER).

The second feature of the (BEER), (FEER), (PEER)²⁰, (DEER) and (NATREX) is their use of simultaneous equations structural models. By doing so, they capture macroeconomic interactions and allow for potential feedback among variables.

The model of the equilibrium real exchange rate (ERER) is designed for developing countries and first developed by (Edwards, 1989). It estimates directly an ERER for each country based on reduced-form single equation models (see Elbadawi, 1994). Moreover, the empirical applications of Edwards model and subsequent revisions to developing countries have yielded generally significant results. In the case of developing countries, the ERER²¹ model has been used in most of the literature (Clark, Bartolini, Bayoumi & Symansky, 1994); (Chinn, 1998); (Hinkle & Montiel, 1999); (Lin, 2002; Goh & Kim, 2006).

In general, the (ERER) model has been considered sufficient to depict the characteristics of the transformation process of developing countries and suitable for the measurement of a developing country's equilibrium exchange rate (Edwards, 1994) found that only real "fundamental" variables influence the ERER in the long term. Moreover, by using advanced cointegration testing techniques as developed by (Johansen, 1988) and (Johansen-Juselius, 1990), the existence of cointegrating relationships among fundamental variables and real effective exchange rate can be effectively analyzed. For example, (Montiel, 1997, 1999) and (Baffes, Elbadawi and O'Connell, 1999) used a cointegration procedure to estimate the (ERER).

The (BEER) models²², on the other hand, emphasize variables that affect the relative prices of traded to nontraded goods at home and in foreign countries, such as differing trends in productivity in traded goods sectors and asymmetric terms-of-trade shocks. In addition to using fundamental variables, the (BEER) methodology according to (Driver and Westaway, 2001), categorizes as "current and cyclical equilibrium exchange rates", since their computation is based on the current levels of the fundamental factors.

(Clark and MacDonald, 1998) used fundamental variables such as terms of trade, the ratio of the domestic consumer price index to the producer price index and the stock of net foreign assets, as well as the relative supply of domestic to foreign government debt as a risk premium factor and discovered that the US dollar was overvalued by 35 percent in 1984. Studies by (Albarelo and al, 1999) and (Roeger and Hansen, 2000) were heavily criticized by (Maesofernandez, Osbat and Schnatz, 2001) for lack of sufficient fundamental

variables and poor statistical analysis. In a very elaborate (fashion, Lorenzen and Thygesen, 2000) accounted for the Balassa-Samuelson effect²³ among other variables in their study on empirical assessment of bilateral euro exchange rate against the US dollar. A similar study on the fundamental determinants of bilateral euro exchange rate was carried out by (Clostermann and Schnatz, 2000).

Their results showed the existence of one cointegration vector and the standard statistical coefficients were significant and had the expected signs. (Maesofernandez, Osbat and Schnatz, 2001) using quarterly data from 1975 to 1998 and up to four different specifications of (BEER/PEER) methodology arrived at results that show that the euro effective exchange rate is unambiguously undervalued in 2000, although the extent largely depends on a particular specification chosen. The driving fundamental variables in their models were long term real interest rates differentials, productivity, net foreign assets, relative fiscal stance, real price of oil²⁴, and relative total consumption differentials. (Iimi, 2006) used the BEER methodology and found that the Algeria's dinar seems to have been overvalued²⁵ in the late 1980s and undervalued²⁶ by 5% to 10% percent in recent years, though the misalignment in the 1990s seems to have been very marginal. Although the researcher, (Iimi, 2006) used fewer fundamental variables for fear of loss of degree of freedom, it should still be recognized that these pieces of evidence were arrived at from a sample comprising of only 31 observations (1985–2004).

It may therefore suffer from limited sample bias. (Iossifov and Loukoianova, 2007) estimated (BEER) model for Algeria and results show that most of the (REER's) long-run behavior can be explained by real oil price, productivity (both relative to trading-partner countries), net foreign assets and the real world prices of Algeria's main export commodities. The (REER) in late 2006 was found to be very close to its estimated equilibrium level and deviations from the equilibrium path are eliminated within two to three years.

Before implementing the (BEER) approach, we should choose the economic fundamental variables as the determinants of real exchange rate. In this paper there are four economic fundamentals which are chosen: the relative price of non-traded to traded goods (the Balassa-Samulalson effect), net foreign assets

position, term of trade and commercial policy (degree of openness as the proxy).

As to this choice of these fundamental variables, there are two principle reasons: first of all, as mentioned above, naturally, we choose the same fundamental variables as that they choose. Secondly, BEER itself is not a theory of determination of real exchange rate, it needs the guidance of other theories when choosing the determinants. Our manner to do this conforms to this point. All of these variables are identified in some theoretical models, for example, (Faruquee,1994), (MacDonald,1997) and (Montiel,1999), and are considered as the economic fundamentals to affect the real exchange rate.

The study by (Zaldueño, 2006)²⁷ also found that parallel market rate of Venezuela was 15% percent more appreciated than its equilibrium rate (but still below the official rate) and that the speed of adjustment to this equilibrium was much higher. Some of the studies carried out in transition economies are: (Civcir, 2003), (Egert and Halpern, 2005), (Egert, 2005), (Egert, 2005), (Halpern and MacDonald, 2005) and (Kim and, Korhonen, 2005). Using mostly the technique of cointegration analysis, most of these studies found that the currencies of these countries were largely undervalued at the outset of transition process. Over time, however, a process of substantial real appreciation allowed the currencies to converge to their equilibrium levels. The three studies reviewed and which were carried out in the Baltic States⁵ Union were those by: (Martins, 2000), (Ranki, 2002) and (Beguna, 2002), (Martins, 2000), for instance, explored the phenomena of Latvian RER appreciation during the transition period 1993-99 in order to assess its effect on the country's competitiveness. Using cointegration analysis, the study found that the (RERs) had not been continuously overvalued and that their levels could have been supported by the then existing structure of Latvian economy.

Some of the studies carried out in Africa are: (Baffes, et. al,1997), (Aron et al.,1997), (Mongardini,1998), (Cady, 2003), (MacDonald and Ricci, 2003), (Mathisen, 2003), (Koranchelian, 2005), (Achy Lahcen, 2001),(Achy L.&Sekkati Kh., 2001) and (Limi, 2006). Majority of these studies used the technique of cointegration to estimate the equilibrium RER path and from derive the degree

of (RER) misalignment in the respective countries. It is generally agreed that the (RER) is a very significant relative price in the economic system. This is because changes in the (RER) influence foreign trade flows, the balance of payments, the level and structure of production and consumption and therefore employment, the allocation of resources in the economy and domestic prices (Khan and Lizondo, 1987). The RER is seen as an important mechanism for transmitting trade shocks to changes in the current Account.

These studies view the equilibrium rate as a path of real effective exchange rates that varies with factors affecting economic balances. But what are the factors that might explain a time-varying equilibrium exchange rate? The literature identifies numerous factors causing the variation in equilibrium real effective exchange rates: resource endowments (e.g., oil discoveries), terms of trade (e.g., oil prices²⁸), real interest rates, openness and labor productivity differentials relative to a country's trading partners, and changes that arise as a result of economic policies and other factors. The effect on appreciation or depreciation pressures obviously depends on the direction of these changes.

2. EMPIRICAL APPROACH TO ESTIMATE THE EQUILIBRIUM EXCHANGE RATE OF THE ALGERIAN DINAR (BEER)

Once the testing of presence of unit root tests in the data had been completed, the next step involved estimating the equilibrium (REER) using Joansen cointegration²⁹ analysis. The framework provides for the estimation and testing of cointegrating relations in the context of VAR error correction models. Unlike the Engle-Granger, the Joansen method has the advantage of making all the variables explicitly endogenous. It also has the advantage of allowing for the testing of certain restrictions suggested by economic theory, such as the sign and the size of the elasticity estimates. Before testing a cointegration relation among these variables, we must assure that every variable should be integrated with same order. At first, we use the tests of unit root to see if they are stationary. The test of ADF (Augmented Dickey Fuller) and the test of PP (Phillips-Perron) are used for the whole period and the results are reports in the Table 1.

We use the (BEER) approach to estimate the equilibrium exchange rate of the Algerian dinar , because this method is well suited to developing countries in which large and complex models are often not feasible because of data limitations. The discussion here about this approach is based on (Clark and Macdonald,1998), (Faruquee, Hamid,1994), (Koranchelian, 2005) and (Alberoa, E., 2003). An estimated reduced-form equation is used to explain the behaviour of the real effective exchange rate with the associated economic fundamentals. In this paper, we choose 3 economic fundamentals as the variables in other words, the current equilibrium exchange rate of the Algerian dinar is a function of these variables: **$REER = f(PROD, NFA, TOT)$** .

There is a consensus in the literature that the most important fundamentals are: the international terms of trade (TOT), net foreign assets (NFA) and productivity (PROD). This paper employs the behaviour equilibrium exchange rate (BEER) model to estimate the equilibrium real exchange rate of dinar (DZD) and exchange rate misalignments in Algeria , with covers the period end annul from (1981-2008). What we need to do is to estimate a single equation in the form below:

$$BEER = f(PROD, NFA, TOT) \quad (1)$$

If we can identify a long-run relationship, here cointegration relationship technically speaking, between real effective exchange rate and its economic fundamentals, it means that the linear combination of these variables is stationary. The mean of this cointegrating relationship can be identified econometrically as the equilibrium exchange rate towards which the actual real exchange rate gravitates over time. So we should test if there exists this cointegration relationship and derive the equilibrium exchange rate determined by it if it exists (we used logarithm method in the form below).

$$LnREER = \alpha + \beta_1 Ln(PROD)_{(i,t)} + \beta_2 Ln(NFA) + \beta_3 Ln(TOT)_{(i,t)} + \varepsilon \quad (2)$$

Ln: logarithm.

i : partners countries.

t : time.

$REER$: Real effective exchange rate.

NFA : net foreign assets.

$PROD$: productivity(effet BS).

TOT : terms of trade.

$\beta_1, \beta_2, \beta_3$:coefficients.

$\mathcal{E}$: term of error.

This paper employs the (BEER) methodology to estimate the equilibrium real exchange rate in Algeria. As part of a vector error correction model (VECM).

3- THE DATA SOURCE AND ECONOMETRIC METHODOLOGY METHODS

Firstly, the econometric methods used here are cointegrating methode of Johansen (1995). The advantage of Johansen's method is that it provides more robust results than other cointegrating methods when more than two variables are used, because it can not only provides a test for cointegration, but also tells the number of cointegrating relationships. Secondly, the data are annually ones and their spans are from the 1981 to 2008. We will give the definitions of the variables and the data sources below (The data in logarithm form are expressed in lower case).

3.1 Data source of variables and preliminarily Statistical Properties

Time series data for all the relevant variables was obtained mainly for the period (1981-2008). The method of data collection was secondary research, which essentially involved reviewing data sources that have been collected for some other purpose than the study at hand. Thus, all the relevant data for this study were available in secondary form both from local and international sources. The main sources of data internationally and regionally were the

International Financial Statistics (IFS) and the (WDI). The local sources were: bank of Algeria; ONS; Ministries of Finance, Planning and Economic.

- **Productivity (PROD)**: This variable is defined as the ratio of domestic consumer price index (CPI) to the domestic wholesale or producer price index (WPI or PPI) relative to the equivalent foreign effective ratio. This captures the Balassa-Samuelson effect.. According to Balassa-Samuelson effect, the productivity differential has positive effect to the (REER).

- **Net foreign assets (NFA)**: This variable is defined as the stock of net foreign assets, defined as total foreign assets, expressed as a ratio to GDP .

- **Terms of trade (TOT)**³⁰ : the ratio of export to import prices.

3.2 Unit Root Tests (ADF, PP)

Before estimating the parameters of the equilibrium (REER) model, the order of integration of each series was examined using standard tests for presence of unit root. A series which is stationary after being differentiated once is said to be integrated of order 1 and is denoted by $I(1)$, meaning first (1st) difference. In general, a series, which is stationary after being differentiated d times is said to be integrated of order d , denoted $I(d)$. Thus, a series, which is stationary at levels, implying without differentiating, is said to be $I(0)$. Other variables may prove stationary $I(0)$ or trend stationary i.e. $I(0)$ after removing a deterministic trend component through differentiating twice.

The (ADF and PP) tests were employed to ascertain the integration order of all the variables in the (REER) Model. Before presenting the results of the formal unit root tests (tables 1,2). Using (ADF and PP) tests and the results are shown. The conclusion drawn from these results is that all the variables were clearly integrated of order 1, i.e. $I(1)$.

For the series (REER , NFA , PROD , and TOT) in level, both the ADF tests and the PP tests do not reject the null hypothesis of a unit root (nonstationary) at the 5% percent. After first differencing of the four nonstationary series, each series rejects the null hypothesis of nonstationary at the 5 % percent level.

Evidence from both the (ADF) tests and the (PP) tests suggest that there are three variables integrated of the order one, $I(1)$, implying that the series are stationary in the first difference. Because the series both are $I(1)$, so it is possible that there is a cointegration relationship between (REER) and these three ($I(1)$) fundamental variables. The Johansen cointegration test is used to explore this possibility.

Table 1: Tests for unit root (ADF, PP) results

Variables Trend and Intercept		t-Statistics	Critical Value	t-Statistics
Critical Value				
at 1% or 5%		Levels		First difference
ADF: Augmented Dickey-Fuller Test)(Test for unit root				
REER	-1.263875	-3.587527	-4.553629	3.603202-
NFA	-2.392748	-3.587527	-5.735803	-3.603202
PROD	-2.664169	-3.587527	-4.076301	-3.595026
TOT	-0.886559	-3.587527	-4.523709	-3.603202
PP: Phillips-Perron)(Test for unit root				
REER	-1.346822	-3.587527	4.733517-	3.595026-
NFA	-2.576029	-3.587527	-12.28311	3.595026-
PROD	-2.803930	-3.587527	-4.084849	-3.595026
TOT	-0.130718	-3.587527	-6.891079	-3.595026

Source: Author.

Table 2: classifications results

Variables
classifications

Test of ADF		classification
REER		I(1)
PP		classification Test
of REER		I(1)

Source: Author.

3.3 Cointegration Analysis

To estimate the long-run relationship between the (REER) and its fundamentals, the Johansen cointegration technique was employed. The results are presented in Table 3 below. Consequently, we conclude the there is only one cointegrating relationship involving the (REER) and its fundamentals(four variables), determines the number of cointegrating vectors, which is obtained based on a method proposed by Johansen (1988). Two test statistics produced by the Johansen's maximum likelihood procedure include the Trace statistic and Maximal-eigenvalue statistic, trace-eigenvalue λ and Max-eigenvalue λ . Both can be used to determine the number of cointegrating relations.

In order to implement the Johansen cointegration analysis, a VAR³¹ in level including these three I(1) variables should be determined with the optimal number of lags in the cointegration analysis (4 numbers of lags SC and AIC). Two criteria are used here to choose the optimal lag length: the Akaike information criterion (AIC), the Schwarz criterion (SC)(see table6 in appendix)

The estimated values of the trace statistics and the Max-eigenvalue statistics are reported in Table 3 .According to the results of the two tests, we conclude that there are two cointegration relation between these three variables at 5% percent significance level.

The trace statistics and the maximum eigenvalue show that there are two cointegrating vector. These statistics confirm the appropriateness of proceeding with the vector error correction methodology (VECM).

3.4 estimation results and equilibrium equation of Dinar REER

The following equilibrium relationship(with standard error in parenthesis) can be obtained from the Cointegrating vector in the Table 7.Since the Vector Autoregression (VAR) model requires that all series are integrated in the same order (Harris, 1995), determining the order of integration is an important part of the empirical analysis.

The following equilibrium relationship (with standard error in parenthesis) can be obtained from the Cointegrating vector in the Table 7(see in appendix : table7).The long-run cointegration equation for the real effective exchange rate of Algeria can be written as (t-statistics in parentheses)

Table 3: Johansen cointegration test results

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.826008	66.95163	47.85613	0.0003
At most 1	0.571839	26.73044	29.79707	0.1084
At most 2	0.244124	7.220564	15.49471	0.5522
At most 3	0.033486	0.783378	3.841466	0.3761

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**

None *	0.826008	40.22119	27.58434	0.0007
At most 1	0.571839	19.50988	21.13162	0.0830
At most 2	0.244124	6.437186	14.26460	0.5578
At most 3	0.033486	0.783378	3.841466	0.3761

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

$$LnREER = 0.202511 * PROD - 0.409197 * NFA + 0.360039 * TOT + 4.098650$$

$$(0.12710) \quad (0.06647) \quad (0.22393)$$

$$[-1.59327] \quad [6.15636] \quad [-1.60779] \quad (4)$$

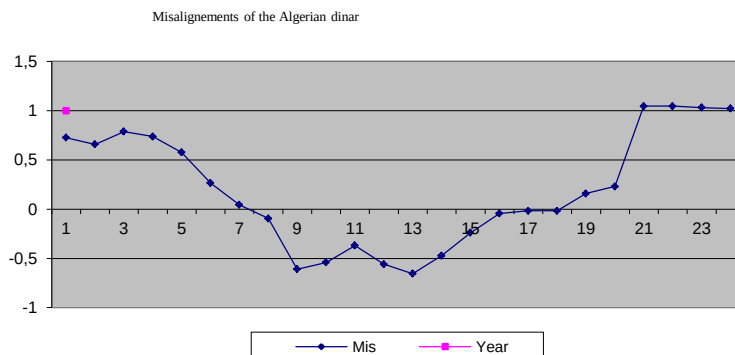
In this equation, we note that all of the coefficients are correctly signed and all statistically significant. As mentioned in the theoretical section, the fact that the (TOT) and the (PROD) have the positive effects on the equilibrium rate, and (NFA) has a negative effect on real effective exchange rate is proved empirically.

3.5 Misalignment of the Algerian dinar (REER)

In the final step, we have computed the degree of misalignment (see in appendix : table11) which is simply the percentage deviations of actual (REER) from equilibrium (REER). The (REER) misalignment³¹ was derived as the difference between the fitted and the actual value of the REER. In According to (Elbadawi, 1994), the expressions of the REER misalignment is given as follows:

$$Mis = (LnREER - LnEEER) \quad (3)$$

Figure1: Misalignment of the Algerian dinar



Our results show that remarkable success in reproducing the wellknown overvaluation and undervaluation episodes in the recent macroeconomic history of the Algeria. When misalignment is superior to zero , it means that (REER) is over-evaluated ; When misalignment is inferior to zero, it means that (REER) is under-evaluated.

In order to analyze the robustness of our empirical results, we use two measures to work out the degree of (REER) misalignment. First, the misalignment is obtained by subtracting the equilibrium from the observed real effective exchange rate. Second, we compute the misalignment as the (REER) deviations from the trend .our calculations indicate that there is one episodes of undervaluation (1990–2000) and two episodes of overvaluation (from 1983–1989) and from (2001–2006).

First episode (1983–1989): The first episode of appreciation or positive misalignment is observed from 1983 to 1989 (indicate overvalued exchange rate).The main reasons for former were lower inflation differential and the weakening of US Dollar against other major currencies .while the latter was depreciated(misalignment value) due to rise in current government expenditures, deterioration in the terms of trade ,deterioration in the oil price ,devaluation in the nominal exchange rate and trade liberalization.

Second episode (1990–2000): Exchange rate misalignment posted a sharp reversal from positive misalignment (indicate undervalued exchange rate) to negative misalignment (undervalued exchange rate) in 1990 and remained positive in 2001.During this episode, actual (REER) started to appreciate after

2001 mainly due to the appreciation of US Dollar vis-à-vis major currencies and higher oil price in 1997 until 2006 and the abandoning of fixed exchange rate regime in the beginning of 1998.

The downward adjustments in nominal exchange rate gathered pace in the managed float regime and actual (REER) appreciations in (2001 and 2006) respectively.

Third episode (2001–2006): A major structural shift was observed in the aftermath From (2006) when large inflows of foreign exchange brought the fundamentals to the convergence of equilibrium real exchange rate. While dinar was under heavy pressure of appreciation due to excess foreign exchange liquidity in the bank of Algeria (reserve). Despite the appreciation of dinar, interestingly, real exchange rate³³ continued to maintain the competitiveness due to:

- (i) the fact that basket of currencies appreciated against Dollar more than the dinar.
- (ii) absorbed the negative impact due to the relatively higher inflation compared to trading partners.

4- CONCLUSION AND RECOMMENDATIONS

4.1- Conclusion

The results from cointegration analysis showed that in the long run, the equilibrium (REER) for the Algerian dinar is only affected by real variables, which may be categorized as either external or internal 'fundamentals'. The former fundamentals were terms of trade, and net foreign assets, and productivity. Thus, as the theory of (REER) determination postulates, an improvement (deterioration) in terms of trade leads to an appreciation (depreciation) of the (REER). Similarly, an increase (decrease) in net foreign asset appreciation (depreciation) of (REER) as expected. The results of the study also showed that an increase (decrease) in term of trade leads to a depreciation (appreciation) in the (REER) as postulated in theory. Finally, the results showed that an increase (decrease) in the productivity.

In this paper, we employ the behavioural equilibrium exchange rate (BEER) model to estimate the equilibrium real effective exchange rate of the Algerian dinar and the exchange rate misalignment in Algeria, which covers the period from (1981 to 2008). Using the Johansen co-integration technique to estimate (EREER) for Algeria, based on various macroeconomic fundamentals suggested in economic literature.

(1) the term of trade (TOT), the net foreign asset(NFA) and productivity(PROD) are the important determinants of long-run equilibrium real effective exchange rate of the Algerian dinar. The tot and prod have the positive effects on the equilibrium rate, but the NFA has a negative effect on it.

(2) since 1983, the Algerian dinar equilibrium exchange rate has exhibited a steady appreciation, but after, it started to depreciate until 2000.

(3) that Algerian dinar (REER) has been over-evaluation during the most part of sample period, but this misalignment has a trend to become smaller and small, and in recent after-reform period, a small degree of over-evaluation replaces this under-valuation.

The analysis concludes that (EEER) appreciates with productivity and term of trade but ,with net foreign assets, depreciate .Generally, lower misalignments are linked to more flexible exchange rate regimes then to fixed regimes.

4.2 Recommendations

In light of these results, it is recommended that should maintain its market determined exchange rate policy and implement a monetary policy aimed at confining inflation to levels that are at par or lower than those of Algeria's trading partners. It should also undertake further macroeconomic, institutional and structural reforms as well as export diversification in order to reduce (REER) misalignments and thus improve the international competitiveness of the Algeria. In particular, the following recommendations are made based on the results obtained in this study:

- Ensure an entrenched macroeconomic stability.

- Implement medium term policy measures that would lead to the creation of a conducive investment environment that in turn would attract foreign direct investments (FDI).
- Pursue of an export diversification strategy .

4.3 Limitations of the Study

This study faced two major limitations that may have introduced greater margins of error into econometric estimates that aimed to uncover the long-run relationship between (REER) and its fundamental determinants in Algeria under review. They are:

- Data limitations that seriously hampered the assessment of (REERs),
- Structural factors.

LISTS OF APPENDIX

Appendix 1: Lists of Abbreviation and Acronyms

REER: real effective exchange rate.

BS : effet Balassa samuelson.

BEER : behaviour equilibrium exchange rate.

DZD : Algerian dinar.

NFA: Net foreign assets .

TOT : Terms of Trade.

PROD: Productivity .

GDP: Gross Domestic product .

RER : Real Exchange Rate.

ERER: equilibrium real Exchange Rate.

EREER :equilibrium real effective exchange rate.

NEER : Nominal Effective Exchange Rate.

ADF: Augmented Dickey Fuller Test.

PP: Phillips-Perron Test.

VAR : Vector Auto Regression.

VECM :- Vector Error Correction Models.

OECD : Organization for Economic Co-operation and Development.

IMF : International Monetary Fund.

CPI : Consumer Price Index.

WPI: Wholesale Price Index.

PPI: product price index.

BEER : Behavioural Equilibrium Exchange Rate.

FEER : Fundamental Effective Exchange Rate.

NATREX: Natural Equilibrium exchange Rate.

PEER: Permanent effective exchange Rate.

BIS: Bank for international settlements.

AIC : Akaike information criterion.

SC: Schwarz information criterion .

IFS: International Financial Statistics.

WDI: World Development Indicator.

WEO: World Economic Outlook.

FDI : Foreign direct investment.

Appendix 2:Lists of Tables.

Table 4 : data sources of variables

Fundamentals variables	Data source
Real effective exchange rate, Net foreign assets , Terms of trade , Productivity .	IMF(WEO , IFS) , WDI,ONS,BA,BIS.

Source: Authour.

Table 5 : Lists of the trading–partner countries

	Zone Europe	North and South American	Asia
Algeria	France,Italy,Espagne,Great Britain,Germany, Netherland, Portugal, swiss, Turkey.	USA,Cabada,Brazil, Argentina.	Japan,China,

Source: Author.

Table 6 : AIC and SC test results.

Included observations: 24

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-70.26408	NA	0.005727	6.188673	6.385015	6.240763
1	-1.679080	108.5929 *	7.34e-05	1.806590	2.788302 *	2.067038
2	18.80786	25.60867	5.74e-05	1.432679	3.199759	1.901486

3	41.26456	20.58531	4.83e-05	0.894620	3.447070	1.571786
4	74.38827	19.32216	2.81e-05*	-.532356*	2.805464	0.353169*
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

source: Author.

Table 7 : Vector Error Correction Estimates.

Vector Error Correction Estimates	
Sample (adjusted): 1986 2008	
Included observations: 23 after adjustments	
Standard errors in () & t-statistics in []	
Cointegrating Eq:	CointEq1
AEER(-1)	1.000000
NFA(-1)	0.409197
	(0.06647)
	[6.15636]
PROD(-1)	-0.202511
	(0.12710)
	[-1.59327]
TOT(-1)	-0.360039
	(0.22393)

	[-1.60779]
C	-4.098650

source: Authour.

Table 8 : Lists of variables(value).

~~Variables~~ Obser	<i>NFA</i>	<i>TOT</i>	<i>PROD</i>
1981	2.319793112-	0.812126206	0.781490638-
1982	2.698967765-	0.681973872	1.108952689-
1983	3.024852352-	0.711851594	1.150315302-
1984	-3.343244443	0.514373895	2.193693857-
1985	-2.974630232	0.481003579	2.328559205-
1986	3.459959575-	0.335685085-	129305094-
1987	3.531947843-	0.389824355-	-1.131058502
1988	-3.623791184	0.505177905-	1.221472507-
1989	4.170207103-	0.484358173-	1.1865514-
1990	-4.439945711	0.225254505-	1.422720331-
1991	3.56851922-	0.135111986-	1.917830594-
1992	3.85873135-	0.275589928-	1.963106116-
1993	4.103404327-	0.506069909-	-0.732016835
1994	3.202996912-	0.514563508-	0.465736536-

1995	4.331160053--	0.485231859-	-0.232346372
1996	-2.95366454	0.351297358-	0.082148952-
1997	2.071245216-	0.317222055-	0.441756502-
1998	2.310602279-	0.68657565-	0.547404787-
1999	2.952590398-	0.403291298-	0.870535734-
2000	1.670256462-	0.038038706-	0.753576755-
2001	-1.170833689	0.145606465-	-0.723879446
2002	0.94649455-	0.103917989-	0.835574411-
2003	0.807316599-	0.082302543-	0.889377711-
2004	-0.67842061	0.084161831	0.956679575-
2005	0.593174566-	0.40333963	858688326-
2006	0.432957849-	0.650709216	0.612142974-
2007	0.231519148-	0.583941445	558595192-
2008	0.07225015-	1.034408892	0.266704141-

source: Authour.

$\ln(\text{NFA}) = \ln(\text{NFA}/\text{GDP})$.

$$\ln \text{TOT}(\text{DZD}) - \sum_{I=1}^n \ln \text{TOT}(\text{P}) \quad \ln(\text{TOT}) =$$

$$\ln \text{PROD}(\text{DZD}) - \sum_{i=1}^n \ln \text{PROD}(\text{P}) \quad \ln(\text{PROD}) =$$

P: partners countries.

Table 9 :Misalignment value.

Mis	
Observations	Misalignment of Algerian dinar Value(+/-)
1983	0,725554488
1984	0,657149489
1985	0,787139311
1986	0,737509142
1987	0,575387426
1988	0,264409223
1989	0,043809327
1990	-0,095364392
1991	0,610222412-
1992	-0,541259557
1993	0,368432571-
1994	-0,558783683
1995	0,654329477-
1996	0,472137613-
1997	0,239832595-
1998	0,044761693-
1999	-0,016887634

2000	0,017327982-
2001	0,159218727
2003	0,229427167
2004	1,044924124
2005	1,045194603
2005	1,030479398
2006	1,020572547

source: Author.

Table 10: Results of empirical studies explaining the (REER) by commodity prices for commodity-exporting countries.

Authors	Sample	Explanatory variables	Results Long run elasticity to commodity price(LRE)
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Cashin et al	158 countries	Commodity TOT	Cointegration for.(2004)
Annual, 1980-2001	19 out of 58,	LRE = 0.1 to 2	median 0.42

Ricci et al.	48 countries	Commodity TOT; net foreign assets; productivity differentials;	Panel cointegration
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(2008)	industrialized and	assets; productivity differentials;	LRE = 0.6
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Emerging	government consumption; trade
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Annual, 1980-2004	restriction; price controls
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The empirical literature also evidences a significant effect of oil price on oil-exporting countries' real exchange rate.

Table 11: Results of empirical studies explaining the (REER) by oil prices for oil exporting countries

Authors	Sample	Explanatory variables	Results Long run elasticity to commodity price(LRE)
Koranchelian (2005)	Algeria Annual 1970-2003	Real oil price; real GDP per capita relative to trade partners	LRE = 0.2
Bhattacharya and Dhaneshwar (2006)	Congo Annual 1972-2004	Real oil price	LRE = 0.2
Zaldueño	Venezuela Annual 1950-2004 based on official rates)	Real oil price; real GDP per capita relative to trade partners; differential of real interest rates on parallel market rates)	LRE = 1.0 (for REER(2006) LRE = 0.44 (for REER based
Habib and Cointegration only for	Russia, Norway, Kalamova	Real oil price; Saudi Arabia	GDP per

capita	Russia, LRE = 0.29(2007)
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Overall, taking a look at the results of the papers reviewed in Tables (10 and 11), it follows that the (REER) long-run elasticity with respect to the terms of trade is often lower for oil exporting countries than for commodity-exporting countries. This may be due to (i) greater fluctuations in the oil price than in commodity price and (ii) pegged exchange rates that prevent the nominal adjustment from happening (case Algeria).

Appendix 3: Lists of Footnotes and references

Footnotes:

¹ The econometric methodology employed in this paper uses Johansen's cointegration analysis to identify the long-run relationships among the variables (REER,NAF,PROD and TOT). adopts the BEER model and the cointegration technique to assess the Algeria exchange rate and its misalignment from (1981 to 2008).

² A Vector Error Correction Model (VECM) can lead to a better understanding of the nature of any nonstationarity among the different component series and can also improve longer term forecasting over an unconstrained model. From the VECM model we are able to estimate the cointegrating vectors. We find that the cointegrating vectors (both lead and lag) explain the logarithmic returns nearly completely and thus propose a VECM-lead model.

³ The fundamental variables include A number of other fundamentals have been suggested in the literature. These include net foreign debt, tariffs and trade restrictions, the level and composition of government expenditure, and the level and composition of investments. See e.g. (Alberola, Cervero, Lopez and Ubide ,1999), (Clark and MacDonald ,1999), (Edwards,1989), (Faruquee ,1995), (MacDonald,1999),(Stein, Allen and associates,1995), and (Williamson,1994).

⁴- which plays an important role in the country's economy (policy exchange regimes import prices export prices detect possible changes in international competitiveness exchange rate policy).

⁵- is the way a country manages its [currency](#) in respect to foreign currencies and the [foreign exchange market](#). It is closely related to [monetary policy](#) and the two are generally dependent on many of the same factors. Where the market dictates the movements of the exchange rate, a pegged float, where the central bank keeps the rate from deviating too far from a target band or value. The floating rates are extensively used in most countries of the world. And the fixed exchange rate, which ties the currency to another currency, mostly more widespread currencies such as the [U.S. dollar](#) , the British pound, Japanese Yen or the [euro](#).

⁶-The relation between a competitive exchange rate and economic development is clear. Given that growth depends on the rate of investment and the productivity of capital, and that the investment rate depends on the existence of profit opportunities, only a competitive exchange rate will stimulate the export oriented investments that are necessary to the middle income country to profit from its key economic advantage – low wages – and grow. It is also clear how strategic the policy of exchange rate is. But we cannot just assume that the exchange rate tends to equilibrium and, so, is competitive. If it is difficult to keep the public budget in reasonable balance and the interest rate at an overall moderate level, it is considerably more difficult to keep the exchange rate competitive because policymakers are not supposed just to behave Moderately and reasonably, they must also proactively neutralize a structural tendency: the tendency to the overvaluation of the exchange rate.

⁷-Competitiveness: is a comparative concept of the ability and performance of a firm, sub-sector or country to sell and supply goods and/or services in a given [market](#).

⁸-Simultaneous attainment of internal (refers to a situation that clears the non-tradable goods market) and external (is attained when the current account is

sustainable) equilibrium refers to the situation in which present and future current account balances are compatible with sustainable capital flows.

⁹-more details see Bayoumi, Tamim and Martin Mühleisen (2006), "Energy, the Exchange Rate, and the Economy: Macroeconomic Benefits of Canada's Oil Sands Production", IMF Working Paper 06/70, International Monetary Fund.

Amano, Robert and Simon van Norden(1995), "Terms of trade and real exchange rates: the Canadian evidence", Journal of International Money and Finance, 14(1), pp 83-104.

Ronald MacDonald and Preethike Dias(February,2007), "Behavioural equilibrium exchange rate estimates and implied exchange rate adjustments for ten countries", Peterson Institute of International Economics, Washington DC.

¹⁰-the nominal exchange rate (NER) is defined as the number of units of the domestic currency that can purchase a unit of a given foreign currency. By contrast, the real exchange rate (RER) is defined as the ratio of the domestic price level and the price level abroad, where the latter is converted into domestic currency units via the current nominal exchange rate.

¹¹-refers to an increase in the value of that country's currency In contrast [revaluation](#).

¹²- Is the loss of value of a country's currency with respect to one or more foreign reference currencies, typically in a [floating exchange rate](#) system In contrast Devaluation.

¹³-The NEER represents the relative value of a home country's currency compared to the other major currencies being traded.

¹⁴ - about more details see

Achy, L.& Sekkat, Kh.(2000), "The European single currency and MENA's export to Europe»,ed. FMISE report manuscript.

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Bénassy-Quéré, Agnès, Sophie Béreau and Valérie Mignon (2008a), "How Robust are Estimated Equilibrium Exchange Rates? A Panel BEER Approach", CEPII Working Paper 2008–01.

¹⁵ -The FEER, as defined by Williamson, is the real exchange rate that is expected to generate a current account balance equal to the underlying capital flow over the cycle, given that the country is pursuing internal balance.

¹⁶ -When analysing the relationships between the real effective exchange rate and the fundamental variables, Johansen's Maximum Likelihood method of cointegration provides a tractable framework. With this approach it is possible to test for the number of long-run relationships (cointegrating vectors) between the variables in the model and to identify which variables should enter the various relationships.

¹⁷ -by Williamson (1985), which defined equilibrium as equating to the supply and demand for a currency in the absence of government intervention?

¹⁸ -The (DEER) concept refers to the real exchange rate consistent with achieving a set of macroeconomic objectives (Bayoumi et al., 1994).

¹⁹ -Stein (1994) defines the (NATREX) concept as the real exchange rate that wouldprevail if speculative and cyclical factors could be removed while unemployment is at its natural rate.

²⁰ -Clark and MacDonald (2000) described the (PEER) as a decomposition of BEER using Gonzalo-Granger method. This method ensures smoother equilibrium exchange rate than BEER, and is better interpretable.

²¹ The real exchange rate (RER), defined as the rate at which goods and services produced at home can be exchanged for those produced in another country or group of countries abroad, is arguably one of the most important policy instrument. fluctuations in real commodity prices have an impact on real exchange rate. The real exchange rate is also dependent on productivity (Cashin et al., 2002). The results are also in line with those obtained by (Koranchelian, 2005) for Algeria. Since Algeria is a commodity exporting country.

More details see Elbadawi Ibrahim (1994), "Estimating Long-Run Equilibrium Real Exchange Rates." In John Williamson, ed., *Estimating Equilibrium Exchange Rates*, ed. Institute for International Economics, Washington D.C, p 131.

Elbadawi I & Soto R (1997), "Real Exchange Rates and Macroeconomic Adjustment in Sub-Saharan Africa and Other Developing Countries", ed. *Journal of African Economies*, 6(3), , pp 74-120.

Macdonald R (1993), "long-run ppp : is it for real ? ", ed. *review of economics and statistics* (75), PP 690-695.

²² more details see Bénassy-Quéré, Agnès, Sophie Béreau and Valérie Mignon (2008b), "Equilibrium exchange rates: A guidebook for the euro-dollar rate", CEPII Working Paper 2008-02.

²³ Balassa Samuelson (1964), "the purchasing parity doctrine: a reappraisal", ed. *journal of political economy* (72), pp 584 -596.

²⁴ Habib and Kalamova (2007) investigate whether the real oil price and productivity differentials against 15 OECD countries have an impact on the real exchange rates of three main oil-exporting countries: Norway and Saudi Arabia (in the period of 1980-2006) and for Russia (in the period of 1995-2006). In the case of Russia it is possible to establish a positive long-run relationship between the real oil price and the real exchange rate. However, authors find virtually no impact of the real oil price on the real exchange rates of Norway and Saudi Arabia.

²⁵ -When the official rate is above its fundamental value, the currency is said to be overvalued.

²⁶ -When the official rate is below its fundamental value, the currency is said to be undervalued.

²⁷ For example, the simple correlations between (REERs) and oil prices are high in Venezuela and Nigeria (63% percent and 60% percent, respectively) and, to a lesser degree, this is also the case in Algeria and Mexico. (Norway, on the other hand, has managed to insulate the (REER) from oil prices by strong macro-policy rules).

²⁸ more detail see Spatafora, Nikola and Emil Stavrev, (2003), "The Equilibrium Real Exchange Rate in a Commodity Exporting Country: The Case of Russia", IMF Working Paper 03/93, International Monetary Fund.

Rautava, Jouko(2004), "The role of oil prices and the real exchange rate in Russia's economy - a cointegration approach", Journal of Comparative Economics, 32 (2), 315-327.

Korhonen, Iikka and Tuuli Juurikkala(2007), "Equilibrium exchange rates in oil-dependent countries" , BOFIT Discussion Papers 8, Bank of Finland.

Taline Koranchelian(2005), "The Equilibrium Real Exchange Rate in a Commodity Exporting Country : Algeria 's Experience", ed. IMF Working Paper WP/05/135 , pp 3-16.

Chen, Shiu-Sheng and Hung-Chyn Chen, (2007), "Oil prices and real exchange rates", Energy Economics 29, pp 390–404.

²⁹ more detail see Pedroni P, "Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors," ed.Oxford Bulletin of Economy and Statistics, (1999),pp 653-670.

Johansen, S.,(1988), "Statistical Analysis of Cointegrating Vectors," Journal of Economic Dynamics and Control, Vol.12, pp.231-254.

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Pedroni, Peter (2004), "Panel cointegration. Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis", Econometric Theory, 20, 597-625.

³⁰ Some recent papers evidence the link between the real effective exchange rate (REER) and commodity terms of trade. The long run elasticity between the two variables is generally found around 0.5, which means that a 10% rise in the commodity terms of trade implies a 5% appreciation of the REER in the long run (Virginie Coudert, Cécile Couharde, Valérie Mignon, 2008).

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- Bénassy-Quéré, Agnès, Valérie Mignon and Alexis Penot (2007), "China and the Relationship between the Oil Price and the Dollar", Energy Policy, 35, pp 5795-5805.

³¹ Vector autoregression (VAR) is an [econometric](#) model used to capture the evolution and the interdependencies between multiple [time series](#), generalizing the univariate [AR models](#). All the variables in a VAR are treated symmetrically by including for each variable an equation explaining its evolution based on its own lags and the lags of all the other variables in the model.

³² - more details see Coudert, Virginie and Cécile Couharde(2008), “Currency Misalignments and Exchange Rate Regimes in Emerging and Developing Countries”, Review of International Economics, forthcoming, CEPII Working Paper 2008-07.

³³ - the Dutch disease is a concept that purportedly explains the apparent relationship between the increase in exploitation of [natural resources](#) and a decline in the [manufacturing sector](#) . The term was coined in (1977) by [The Economist](#) to describe the decline of the manufacturing sector in the [Netherlands](#) after the discovery of a large [natural gas field](#) in (1959). The classic [economic model](#) describing Dutch Disease was developed by the economists [W. Max Corden](#) and [J. Peter Neary](#) in (1982). In the model, there is the non-traded good sector (this includes [services](#)) and two [traded](#) good sectors: the booming sector, and the lagging sector, also called the non-booming tradable sector. The booming sector is usually the extraction of oil or natural gas, but can also be the mining of gold, copper, diamonds or bauxite, or the production of crops, such as coffee or cocoa. The lagging sector generally refers to [manufacturing](#), but can also refer to [agriculture](#).

It is sometimes claimed that an increase in aid might cause Dutch Disease—that is, an appreciation of the real exchange rate (RER) which can slow the growth of a country’s exports— and that aid increases might thereby harm a country’s long-term growth prospects.

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