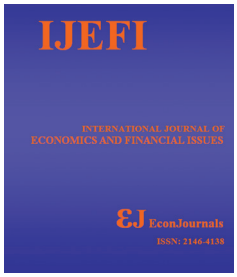

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Equilibrium Real Exchange Rates and Capital Flows in Tunisia

Hadhek Zouheir[1]*, Sakli Hniya[2], Mosbah Lafi[1]

[1]Higher Institute of Management of Gabès, University of Gabès, Tunisia, [2]PhD Student in Economics, University of Sfax, Tunisia. *Email: hzouhair2000@yahoo.fr

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ABSTRACT

The objective of this paper is to study the impact of the variability (volatility and misalignment) of the real exchange rate (RER) on trade flows over the period 1980-2014. In order to estimate the RER misalignment, we use the methodology of Edwards (1994) which defines the equilibrium RER as a pathway of fundamental variables to ensure internal and external macroeconomic balance. The relation between equilibrium RER and its determiners is obtained by applyingan error-correction model. Results show that the volatility of the exchange rate causes a decline in exports and imports. The impact of the misalignment is significant only on imports.

Keywords: Equilibrium Real Exchange Rate, Misalignment, Cointegration, Export, Import, Vector Error Correction Model
JEL Classifications: F14, F62

1. INTRODUCTION

The main objective of the Bretton Woods system was to provide a stable monetary framework for international trade. However, during the 1960's, it presented several failures, and it eventually collapsed in 1973. The collapse of this system was the origin of change in the international monetary environment since most countries of the world have adopted a system of floating exchange rate.

According to International Monetary Fund (IMF) exchange rate arrangements and exchange restrictions, Tunisia has adopted a sliding parity regime since the late 1980s. The latter consists in stabilizing the real exchange rate (RER) around a constant value. Thus, the policy of targeting a stable RER is to let the dinar depreciate at the same rate as the inflationary differential in order to preserve the competitiveness of local products (Charfi, 2008). Since April 2012, the value of dinar is determined by the confrontation between the supply and the demand of the currencies compared to the dinar on the interbank market. The intervention of the Central Bank of Tunisia (BCT) is limited to smoothing the exchange rate volatility, which clearly explains the cause of the dinar depreciation. From April 2012; the BCT changed its operational framework of exchange rate policy to make it more adaptable and flexible. Thus, the BCT has just taken action to fix a reference rate based on the average exchange rate on the interbank market instead of fixity against a basket of currencies. These changes are in consistent with IMF recommendations as more flexible exchange rate management will help preserve foreign exchange reserves, and support currency demand by reducing liquidity absorption due to foreign exchange interventions.

Given that the floating of the exchange rate can have a negative effect on trade flows, the study of the relationship between exchange rate variability and trade flows has interested most economists. The purpose of this article is to estimate a long-term relationship between equilibrium RER and its fundamentals using Edwards' methodology (1994). Once the equilibrium RER has been determined, it is easy to calculate the misalignment which is the difference between the actual RER and the long-term RER. Finally, we will study the relationship between the variability (volatility and misalignment) of RER and trade flows.

2. LITERATURE REVIEW

Several theoretical studies have shown that an increase in exchange rate volatility will have adverse effects on the volume of international trade. Taking the example of a risk-averse firm, Ethier (1973) tried to show that the volatility of the exchange rate does not have a significant impact on trade flows. He showed that the uncertainty of foreign exchange determines the degree of risk hedging a company must take. He found a negative relationship linking the volatility of the exchange rate and the volume of trade.

Using a model similar to that of Ethier, Clark (1973) studied the impact of exchange rate variability on bilateral trade. He showed that the volatility of the exchange rate has a negative impact on the level of trade.

Also Baron (1976) has studied in his work, the effect of the choice of the billing currency on production, by taking the case where exchange rates are volatile. He found two results:

- If exports are invoiced in foreign currency, then the exporter faces price risks. In this case, the quantity requested is known while the prices remain the same during the contract period
- If exports are invoiced in national currency, then the exporter faces a quantity risk. In this case, the price expressed in foreign currency is known while the quantity demanded is uncertain.

De Grauwe (1988), considered the case of an enterprise which is in a situation of pure and perfect competition. He showed that, if the exporters are risk-averse, then the dominance of the income effects on the substitution effects generates a positive effect of exchange rate volatility on the export volume.

Demers (1991) has shown that the adoption of a risk aversion hypothesis is not sufficient to prove a negative effect of volatility. Thus, he showed that even in the case of a risk-averse firm, volatility has a negative effect on trade.

In their work, Barkoulas et al. (2002) have developed a simple framework to study the effects of exchange rate uncertainty on trade flows. By using different sources of exchange rate risk, the authors have shown that the volatility of RER has a negative effect on trade flows.

Empirical studies, which have investigated the relationship between exchange rate volatility and foreign trade, have shown that the results are mixed: there are positive and negative relationships. Among the first suggestive empirical studies, we can mention that of Hooper and Kohlhagen (1978), who have tried to test the different types of trade flows between the United States and Germany over the period 1965-1975. They showed, on one hand, that if the importer likes the risk, then the increase in the exchange rate risk has a negative impact on the demand for imports and the market price. On the other hand, if the exporter is risk averse, then the increase in foreign exchange risk has a positive and significant effect on the export price.

Cushman (1983) studied the impact of exchange rate volatility on bilateral trade flows between industrialized countries over the period 1965-1977. He found a negative effect of exchange real volatility on trade flows. He showed that, in a multinational context, changes in one of the exchange rates can be offset by movements in other exchange rates. Thus, the relative variability between several currencies can affect bilateral trade. In his work, Cushman 1983; Cushman, 1986) found a negative effect of exchange rate variability on international trade flows.

Baum et al. (2004) studied the impact of exchange rate volatility on trade flows. By using monthly bilateral export data from thirteen countries over the period 1980-1998 and a nonlinear specification, the authors find a positive relationship between exchange rate uncertainty and trade flows.

Using the panel data method and data covering the period 1972-1987, Ghura and Grennes (1993) tried to test the link between exchange rate volatility and trade flows of Sub-Saharan African countries. Their results show that the volatility of the exchange rate has a negative effect on trade flows. However, this study concerns only those countries that have adopted fixed exchange rate regimes. For this reason, it does not make it possible to study the likely impact of volatility if countries adopt floating exchange rate regimes.

Rey (2006) examines the impact of nominal and real effective exchange rate (REER) volatility on exports from six MENA countries to 15 EU countries for the period 1970:Q1-2002:Q4. He used two measures of volatility namely: The ETM and the ARCH model, which indicated the existence of a long-term cointegration relationship. He found a significant negative impact of the RER volatility on export for four countries namely: Algeria, Egypt, Tunisia and Turkey. While, for Israel and Morocco, the impact of the RER volatility on exports was positive.

Arize et al. (2000) tested the link between the RER volatility and the volume of exports of thirteen developing countries for the period 1973-1996. They found a negative effect of the RER volatility upon developing countries' exports.

The empirical work of the 1980s, which examine the relationship between the effects of the RER variability and foreign trade, has been enriched by the incorporation of misalignments. Grobar (1993) studied the impact of the RER variability (volatility and misalignments) on the exports of manufactured goods. He used data from ten middle-income countries (Argentina, Brazil, Colombia, Greece, Malaysia, Mexico, Philippines, South Africa, Yugoslavia and Thailand). In his work, the black market premium was a measure of misalignment of the exchange rate. He showed that the RER volatility negatively affects exports, while, misalignments have no significant effects.

Bouoiyour and Rey (2005) studied the equilibrium RER of the Dirham in comparison with the European currencies over the period 1960-2000. The RER volatility is measured by a moving standard deviation of the exchange rate variations, while the misalignments (over/under assessments) is defined as the difference between the actual RER and the equilibrium RER (NATREX). They have

shown that the increase in Dirham volatility has a negative effect on trade flows. Moreover, an overvaluation of Dirham reduces Moroccan exports to Europe and favours imports. They showed that neither volatility nor misalignment affect foreign direct investment (FDI).

Ghura and Grennes (1993) have shown that RER misalignment generates a decline in the profitability of the industry with low relative prices. Indeed, misalignment, often in the form of overvaluation of domestic prices, has a negative impact on tradable goods activities. This affects the macroeconomic balance through deterioration in the balance of payments and a destruction of foreign exchange reserves.

Finally, Sidek et al. (2011) used two measures of the misalignment of the bilateral RER (US Dollar/Malaysian Ringgit): The PPP approach and the BEER model over the period 1984-2009, by which they showed that misalignments of the exchange rate has a negative effect on exports.

Using a sample model of African countries, Oscar Kuikeu has studied the impact of RER misalignment on exports. He has retained the work of Baffes and Alii which is executed in two stages namely: the first step is to define the equilibrium RER, while the second step allows measuring the RER of balance compatible with the sustainable values of its fundamentals. He found a negative relationship between misalignment and exports.

This consideration of RER policies as a means forfostering the development of sectors that are associated with lar-ger technological progress is backed up now by a growing litera-ture that shows that long-term growth in developing countries ispositively associated with the capacity to guarantee a competitiveexchange rate (Rodrik, 2008; Rapetti et al., 2012; Razmi et al., 2011; Rapetti, 2013; and for a review of the liter-ature, Frenkel and Rapetti, 2014; Damill and Frenkel, 2012; Missio et al., 2015).

3. ESTIMATING THE MISALIGNMENT OF THE RER

Our research consists of estimating the equilibrium RER based on its fundamentals. Hence, the equilibrium REER calculation is carried out in two stages: First of all, we will check whether there is a long-term cointegration relationship between the RER and the economic fundamentals, then we will calculate the different series of fundamentals variables to determine their sustainable values, and eventually reintegrate them into the long-term relationship of the equilibrium RER.

3.1. Choice of Variables

Themacroeconomic fundamentals.retained in our model are:

- Terms of trade (TOT)
- Commercial opening (OPEN)
- Productivity (PROD)
- Public expenditure (PEXP)
- FDI
- The current account balance (CAB)
- Transfers received from outside (TRSFRT).

The combination of these variables according to the long-term relationship allows us to determine the equilibrium values of the RER for each period.

The data used are annual covering the period 1980-2014.

- TOT

  This variable is defined by the ratio between the unit values of exports and that of imports. An improvement in the TOT reflects a real appreciation of equilibrium if the income effect dominates the substitution effect, while, a deterioration of the TOT leads to a real depreciation.
- Commercial opening (OPEN)

  Taking into account trade openness is explained by the fact that a change in a country's trade policy towards greater liberalization impacts the TCR.
- The productivity (PROD)

  In practice, this variable is represented by the growth rate ratio per capita of the GDP/(GDP/inhabitant).
- Public expenditure (PEXP)

  This variable is represented by the ratio of government expenditures to GDP.
- FDI

  Studies have shown that an increase in FDI leads to a real appreciation of the exchange rate in the longer run.
- The CAB

  This variable presents two situations: a real depreciation if the country is a debtor and an appreciation if the country is creditor(Saadi-Sedik and Petri, 2006).
- Transfers received from outside (TRSFRT)

  This is a fundamental variable of RER. An increase in the transfer flows received from outside leads to an appreciation of the RER (Haque and Montiel, 1998, Izquierdo and Montiel, 2006, Barajas et al., 2010).

3.2. Stationarity and Cointegration Tests

3.2.1. The unit root test

The purpose of the unit root test is to determine the order of integration of the variables. Table 1 below summarizes the results of the enhanced augmented Dickey-Fuller (ADF) test.

The results of the ADF test showed that the variables are non-stationary in level since the ADF statistic is greater than the critical value. While, in first differences, all the variables are stationary because the ADF statistic is lower than the critical value. We deduce that all variables are integrated in the same order I (1).

3.2.2. Cointegration test

The cointegration test allows us to check whether there is a long-term relationship between the RER andmacroeconomic fundamentals.

Based on Tables 2 and 3, it may be stated that the values calculated from trace statistics and maximum eigenvalue statistics are greater than the critical values associated with them.

Therefore, we deduce that there is at least one cointegrating relationship between the variables. We can estimate vector error correction model. The Johansen procedure of cointegration

Table 1: Results of augmented Dickey-Fuller test

Variables	Stationarity	t-stat	Critical value	Prob.	Results
PEXP	İn level	−1,5406	−3,5442	0,7957	Non-stationary
	İn firstdifferences	−6,1270	−1,9510	0,0000	Stationary
FDI	İn level	−3,3932	−3,5442	0,6686	Non-stationary
	İn firstdifferences	−8,0587	−3,2070	0,0000	Stationary
OPEN	İn level	−2,8020	−3,5442	0,2061	Non-stationary
	İn firstdifferences	−5,6623	−3,5484	0,0003	Stationary
REER	İn level	−2,7337	−3,5489	0,2303	Non-stationary
	İn firstdifferences	−3,8298	−3,5529	0,0000	Stationary
TOT	İn level	−1,6085	−3,5448	0,7685	Non-stationary
	İn firstdifferences	−3,7593	−1,9510	0,0004	Stationary
TRNSFRT	İn level	−3,1832	−3,5484	0,2047	Non-stationary
	İn firstdifferences	−5,2232	−3,5484	0,0000	Stationary
CAB	Inlevel	−1,8729	−3,5442	0,6470	Non-stationary
	İn firstdifferences	−5,6864	−2,9511	0,0000	Stationary
PROD	İn level	−2,1071	−3,5442	0,5011	Non-stationary
	İn firstdifferences	−7,3127	−3,5484	0,0000	Stationary

Table 2: Results of trace statistics

Null hypothesis	Eigenvalue	Trace statistic	Critical value	P-value
None	0.924527	333.0125	197.3709	0.0000
At most 1	0.896489	245.1570	159.5297	0.0000
At most 2	0.766647	168.0425	125.6154	0.0000
At most 3	0.714739	118.5656	95.75366	0.0006
At most 4	0.606884	75.91772	69.81889	0.0150
At most 5	0.491767	44.17357	47.85613	0.1064
At most 6	0.329010	21.16183	29.79707	0.3476
At most 7	0.196784	7.595784	15.49471	0.5096

Table 3: Results of maximal Eigen statistics

Null hypothesis	Eigenvalue	Maximal Eigen statistic	Critical value	P-value
None	0.924527	87.85551	58.43354	0.0000
At most 1	0.896489	77.11450	52.36261	0.0000
At most 2	0.766647	49.47689	46.23142	0.0218
At most 3	0.714739	42.64788	40.07757	0.0251
At most 4	0.606884	31.74415	33.87687	0.0880
At most 5	0.491767	23.01174	27.58434	0.1730
At most 6	0.329010	13.56604	21.13162	0.4016
At most 7	0.196784	7.450478	14.26460	0.4373

Table 4: Estimation of the cointegration relationship

RER	PROD	Open	TOT	PEXP	FDI	CAB	TRSFRT
1	0.71	−0.66	0.96	0.09	0.35	−0.07	0.12
t-stat	6.87	−7.12	7.12	−6.38	3.17	−8.30	0.15

test suggests that there is at least one cointegrating relationship between the variables.

Table 4 presents the results of long-term estimated cointegration relationship.

- The coefficient of the productivity differential variable is positive. Thus, if the productivity increases in Tunisia, compared to the Euro Area, the "Prod" decreases and the RER will be more appreciated.
- For the trade opening variable, the coefficient is negative. An increase in the opening rate reflects an increased liberalization of foreign trade. Thus, an increase in the opening rate reflects a real depreciation of the RER.
- For the exchange term variable, the theoretical model shows that an improvement in the TOT can generate a real appreciation or depreciation of equilibrium, depending on the superiority of the substitution effect with respect to income effect. In our case, the coefficient of this variable is positive and statistically significant. While an improvement in the TOT of 10% results in an appreciation of the RER of 9.6%.
- Regarding the coefficient associated with PEXP, it is positive. This means that an increase in public expenditure leads to a real depreciation of the equilibrium RER.
- An increase in FDI reflects an appreciation of the equilibrium RER.
- The coefficient associated with the current account variable is negative. This implies a real depreciation, because the Tunisian CAB is still in deficit.
- The coefficient associated with the transfers received from outside is not statistically significant.

Once the equilibrium RER is determined[1], it is easy to calculate the RER misalignment which is the difference between the actual RER (base IMF) and the equilibrium RER. Indeed, if the value of the misalignment is positive, the Tunisian dinar knows an overvaluation. On the other hand, we have an undervaluation if the value is negative.

We use the method of Kamar (2005) to calculate the RER misalignment:

$$MIS=(ACT\ RER–EQ\ RER)/(EQ\ RER)$$

The following figure illustrates the RER misalignment. We note that the reporting period was marked by episodes of overvaluation and undervaluation of the Tunisian dinar.

We note that prior to the adoption of the structural adjustment programs (SAP), the divergence of the RER from its equilibrium value is very important. This distortion between the RER and its equilibrium position can only increase the instability of the RER

1 See Annex 1

and exacerbate the country's economic crisis, which ended with a devaluation of the Tunisian dinar under the SAP.

During the period 1980-1983, the RER has an underestimation of about 8.7% which favours the competitiveness of the Tunisian economy.

The period "1984-1986," as it may be called "the period of crisis" of the Tunisian economy: the bread revolution of Tunisia "Jasmine Revolution," the massive return of Tunisian workers in Libya, the economic crisis of the country. This period was marked by an overvaluation of 9.7%.

For the period after 1986, the equilibrium RER is undervalued, exactly in the sub-period from 1986 to 1991, which corresponds to the devaluation of the Tunisian dinar in 1986.

In the period between 1991 and 2010, the RER misalignment narrowed to 4.7%. As part of the economic reform program, the government declared in 1992 the convertibility of dinar. This decision was accompanied by the creation of the interbank market in March 1994.

The year 2011, which corresponds to the period of economic crisis, was marked by an overvaluation of around 7.1%. During the period 2012-2014, the dinar was undervalued, with a misalignment of 5.2% (Graph 1).

4. THE IMPACT OF THE VARIABILITY OF THE RER ON THE TRADE FLOWS

4.1. Estimating the Volatility of RER

The volatility of RER is defined as frequent and non-persistent currency exchange rate fluctuations (Sekkat and Varoudakis (1998). It is generally associated to the notion of currency risk.

To calculate the volatility of RER[2] in annual data, we will proceed in two steps: First, we calculate a moving standard deviation of the relative changes in the real monthly exchange rate over 12 months. Then, the average of the standard deviations is calculated for each year.

4.2. Estimation Results

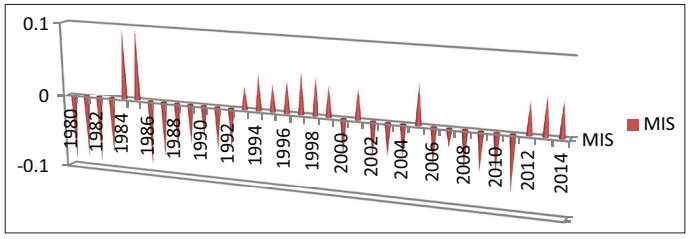
The results as presented in the Table 5 below have shown that, on the one hand, volatility has a significant impact on exports and imports. On the other hand, the impact of misalignment is significant only on imports.

Thus, an increase in RER volatility leads to a fall in the export ratio, while the impact of misalignments is not significant. Thus, the misalignment has a significant effect on imports.So, an overvaluation of RER avours imports.

Since the variability of TCR negatively affects trade flows, then, policies to reduce exchange rate volatility and reduce the RER misalignment are required.

2 See Annex 2

Graph 1: The real exchange rate misalignment



Source: Author's estimations

Table 5: Relationship between RER variability and trade flows

	Export		Import	
	Coefficient	T-stat	Coefficient	T-stat
RER VOL	−2,1720	−6,2138**	0,8585	2,3630**
RER Mis	1 ,0044	0 ,7412	0,4638	4,2730**

RER: Real exchange rate

5. CONCLUSION

The purpose of this article is to study the impact of the RER variability of the RER on trade flows during the period 1980-2014. Thus, the RER variability concerns both volatility and misalignment. At the theoretical level, researchers have studied variability mainly through volatility. While, the misalignment was taken into consideration only in the empirical work, primarily in the work of Edwards who explained the RER by the fundamentals variables.

The equilibrium RER is explained by economic fundamentals. If the latter improve, the RER will appreciate, and if they deteriorate the RER can only depreciate. Then, we calculated the RER misalignment, which is the difference between the actual RER and the equilibrium RER. The study period was marked by phases of overvaluation and undervaluation. If the value of the misalignment is positive, the Tunisian Dinar is overvalued.

We examined the relationship between the variability of the RER and trade flows for Tunisia for the period between 1980 and 2014. The results showed that the volatility of RER decrease the export of Tunisia. The impact of misalignment is significant only on imports.We have found that the periods of overvaluation of the Tunisian dinar correspond to an improvement in the ratio of imports since the overvaluation of national currency makes imported products cheaper than domestic products, which will destroy the trade balance. Given that the variability of RER negatively affects trade flows, then implementation of policies to reduce exchange rate volatility and reduce the RER misalignment are required.

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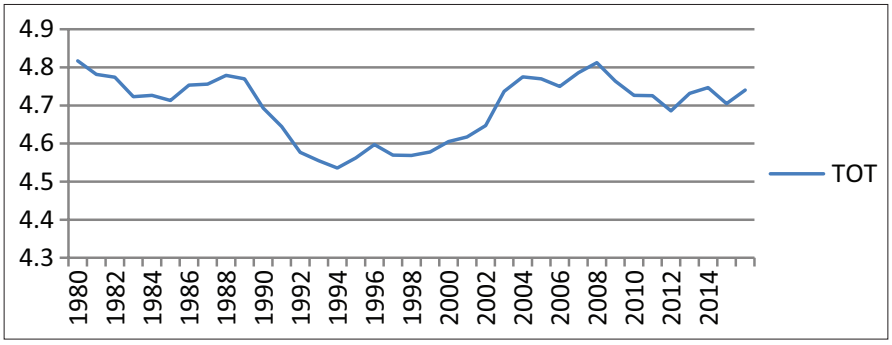
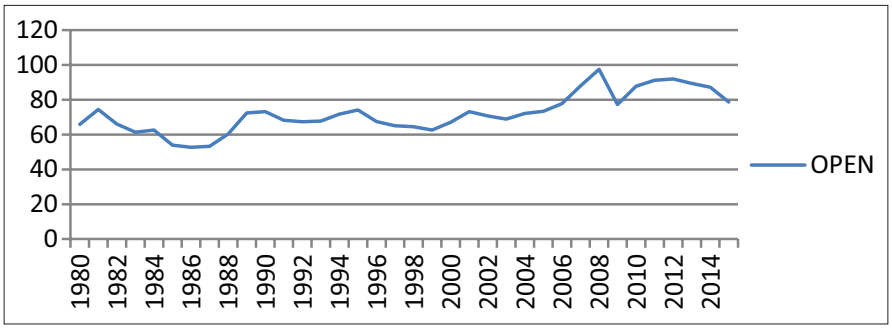
ANNEX 1: THE DETERMINANTS OF THE REAL EXCHANGE RATE

Figure 1: Evolution of terms of trade



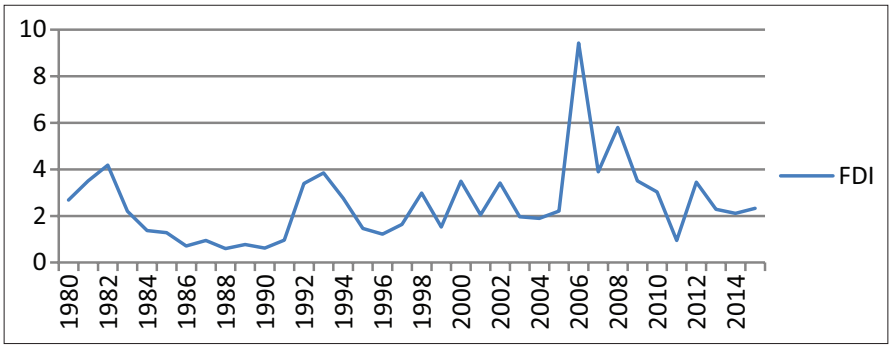
Source: WB

Figure 2: Evolution of open



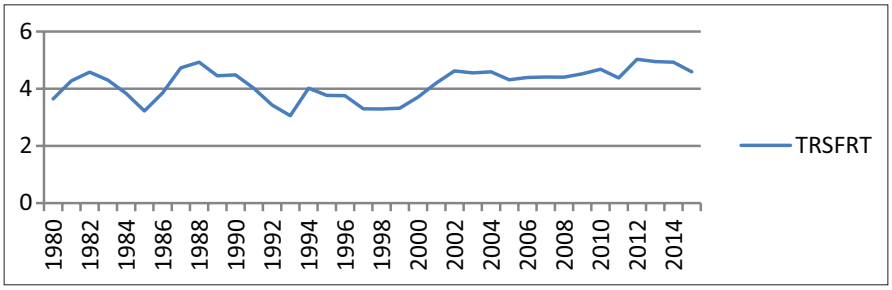
Source: IFS

Figure 3: Evolution of foreign direct investment



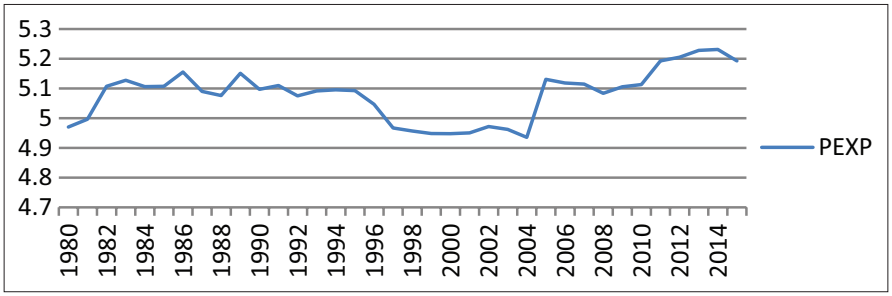
Source: WB

Figure 4: Evolution of TRSFRT



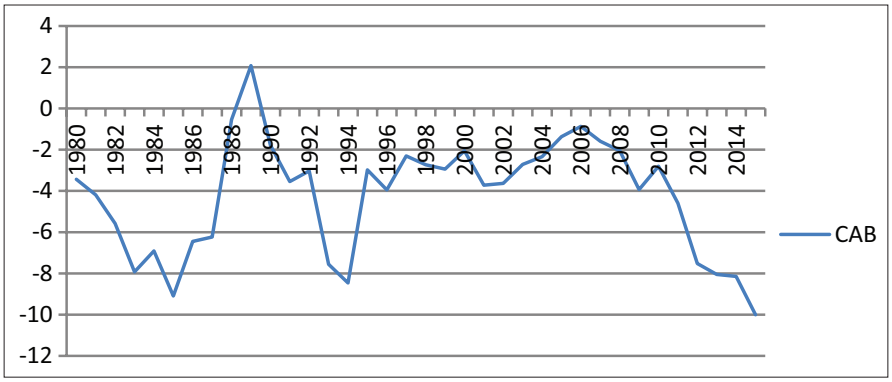
Source: WB

Figure 5: Evolution of public expenditure



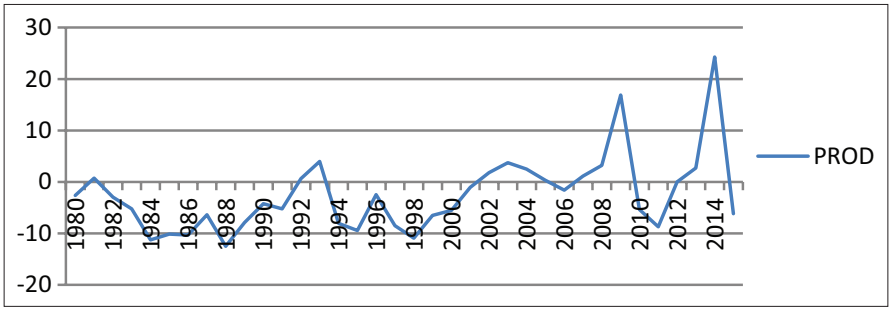
Source: IFS

Figure 6: Evolution of current account balance



Source: WB

Figure 7: Evolution of PROD



Source: WB

ANNEX 2: THE VOLATILITY OF REAL EXCHANGE RATE

Annex 2: The volatility of real exchange rate

Dependent variable: REER				
Method: ML-ARCH (marquardt)-normal distribution				
Sample: 1980M01 2014M12				
Included observations: 432				
Failure to improve likelihood after 241 iterations				
Presample variance: Backcast (parameter=0.7)				
GARCH=C(1)+C(2)×RESID(−1)²+C(3)×RESID(−2)²+C(4)×RESID(−3)²+C(5)×GARCH(−1)+C(6)×GARCH(−2)+C(7)×GARCH(−3)				
Variable	Variance equation		Z-statistic	Prob.
	Coefficient	Std. error		
C	9263.296	140066.1	0.066135	0.9473
RESID(−1)²	0.673309	10.42063	0.131788	0.8952
RESID(−2)²	0.285543	25.02371	0.075350	0.9399
RESID(−3)²	0.246803	32.35313	0.035446	0.9717
GARCH(−1)	−0.173944	11.34503	−0.156363	0.8757
GARCH(−2)	0.226316	21.21274	−0.071953	0.9426
GARCH(−3)	−0.297017	12.56996	−0.047496	0.9621
R^2	−10.957845	Meandependent var		134.4464
Adjusted R^2	−10.930164	S.D. dependent var		40.66210
S.E. of regression	140.4472	Akaikeinfocriterion		12.59809
Sumsquaredresid	8521377.	Schwarzcriterion		12.66401
Loglikelihood	−2714.186	Hannan-quinncriter		12.62411
Durbin-Watson stat	0.000276			

Sample (adjusted): 1980M06 2014M12				
Included observations: 427 after adjustments				
Trend assumption: Linear deterministic trend				
Series: REER				
Lags interval (in first differences): 1-4				
Unrestricted cointegration rank test (trace)				
Hypothesized no. of CE(s)	Eigen value	Trace statistic	0.05 critical value	Prob.**
None*	0.010297	4.419686	3.841466	0.0355

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-value

Unrestricted cointegration rank test (maximum Eigen value)				
Hypothesized no. of CE(s)	Eigen value	Max-eigen statistic	0.05 critical value	Prob.**
None*	0.010297	4.419686	3.841466	0.0355

Max-eigenvalue test indicates 1 cointegratingeqn(s) at the 0.05 level
*Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) P-values

Unrestricted cointegrating coefficients (normalized by b'*S11*b=I)
REER
0.025133
Unrestricted adjustment coefficients (alpha)
D(REER) −0.232217