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The Variability of the Tunisian Real Exchange Rate

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Abstract

This article presents an estimate of the equilibrium real exchange rate for Tunisia using the model of Edwards (1998) and Elbadawi (1994). We calculate the distortion between the actual RER and the equilibrium RER and the misalignments related thereto. The study period was marked by phases of overvaluation and undervaluation of the RER.

Keywords: equilibrium real exchange rate, misalignment, cointegration

1. Introduction

The evolution of a country’s competitiveness vis-à-vis the rest of the world can be assessed by comparing the real effective exchange rate (REER) to its equilibrium level, or by determining the RER misalignment. Thus, the latter is defined as the difference between the actual real exchange rate and the equilibrium real exchange rate. The RER is overvalued when it is appreciated relative to its equilibrium rate, while, it is undervalued when it is depreciated compared to RER of Balance. Misalignment, whether positive or negative, reflects a bad exchange rate policy, which may lead to the crisis (the Asian crisis of the 90s).

Theoretically, the overvaluation of the national currency has a negative effect on growth and economic performance. Indeed, it leads to a misallocation of resources (Edwards, 1988, 1989; Dornbusch, 1988; Cottani & alii, 1990; Ghura & Grennes, 1993; Domaç & Shabsigh, 1999; Gylfason, 2002; Aguirre & Calderón, 2005; Easterly, 2005; Johnson & alii, 2007; Jongwanich, 2009; Diallo, 2011). The persistence of overvaluation can be seen as a precursor to the crisis (Edwards, 1989 and 2000; Williamson, 1983 and 1994; Stein & Allen, 1995), and which also constitutes a currency crash indicator (Krugman, 1979b; Frankel & Rose, 1996; Kaminsky & Reinhart, 1999).

On the contrary, undervaluation appears to be more beneficial. It helps to boost the performance of the export sector and overall economic activity (Aguirre & Calderón, 2005). Thus, it leads to an increase in the share of tradable goods in the national value added. However, it may be conducive to growth (Musyoki et al., 2012; Lévy-Yeyati & Sturzenegger, 2007; and Rodrik, 2009), and lead to an increase in the share of tradable goods in national value added. According to LévyYeyati and Sturzenegger, undervaluation increases production and productivity. However, when it persists, it can cause economic overheating, which puts pressure on domestic prices and leads to a misallocation of resources between tradable and non-tradable goods sectors (Jongwanich, 2009).

2. RER’ Determinants

2.1 Terms of Trade and RER

In theory, the change in the terms of trade is regarded as an important source of fluctuations of RER. However, the final effect on the RER may not be known a priori because of the existence of two effects (Aliyu, 2007): an income effect and a substitution effect

- The income effect: following a reduction of import tariffs, the domestic price of import decreases. Thus, a positive income effect generates an increase in demand for non-tradable and importable goods .To absorb the excess demand for non-tradable goods, the non-tradable price must be increased and therefore, it generates an appreciation of the equilibrium RER;

- The substitution effect: lower import tariffs make imports cheaper than non-tradable goods. Then, the excess supply of non-tradable goods will be corrected by a reduction in non-tradable prices, and thus by a depreciation of the equilibrium RER.

Briefly, the net effect of the terms of trade on the equilibrium RER depends on the dominating effect: if the income effect outweighs the substitution effect, then the improvement in the terms of the exchange will generate an appreciation in the RER (Domaç & Shabsigh, 1999; Bogoev et al., 200; AlShehabi & Ding, 2008). Conversely, deterioration in the terms of trade tends to appreciate the equilibrium RER if the substitution effect is not only positive but also above the income effect. Otherwise, depreciation in the RER will take place.

2.2 Trade Opening And RER

The trade openness policy is a potential source that affects the RER. Thus, a tariff reduction can decrease the domestic prices of imports. This will generate a decline in prices of tradable goods, and therefore creates an appreciation of the RER. However, greater trade liberalization leads to a depreciation of the RER, since it allows for increased trade and price convergence (Goldfajn & Valdes, 1999; IEQ, 2003; Drine & Rault, 2005). This depreciation allows to absorb excess labor from the importable goods sector (Goldfajn & Valdés, 1999). Studies of the IEQ (2003), Hadj Amor and El Araj (2009) on the MENA countries and Drine and Rault (2005) on Africa, Asia and Latin America confirm the negative relationship between trade openness, Technological progress and RER.

2.3 Technological Progress and the RER

Technological progress can take two different forms: technological progress that increases the product ‘income augmenting’ and technological progress that increases the factors of production ‘factor augmenting’ (Balassa, 1964).

• Technological progress ‘income augmenting’ increases real incomes, and thus it creates excess demand for consumables. Since technological progress is less important in the non-tradable goods sector than in the tradable goods sector, then the price of non-tradable goods will tend to increase more slowly than the price of tradable goods, an appreciation of the RER will take place.

• Technological progress ‘factor augmenting’ allows having a bigger production with the same quantity of production factors. Thus, the excess supply will be corrected by a fall in the prices of non-tradable goods and thus by a depreciation of the equilibrium RER (De Gregorion & Wolf, 1994).

2.4 Capital Flows and RER

The long-term impact of foreign capital flows on the RER is associated with a real appreciation (Edwards, 1989, 1994; Athukorala & Rajapatirana, 2003). According to Toma (2006), the effect of long-term capital movements depends on the use of these assets. If this capital has been used to promote the competitiveness of the economy and improve productivity in the tradable goods sector, then the final effect will be an appreciation of the RER. However, if the use of the capital flows generates an increase in consumption, then the initial appreciation of the RER will be followed by a real long-term depreciation.

Edwards (1994) points out that liberalization of the capital account produces an appreciation of the equilibrium RER. Indeed, a reduction in taxes on external borrowing makes future consumption more expensive and encourages agents to substitute their future consumption for current consumption. Thus, there is pressure on the price of non-tradable goods while producing a real appreciation of the equilibrium RER. However, lowering taxes on external borrowing reduces distortions in the economy by creating a positive welfare effect through a positive income effect. The latter increases consumption and generates a real appreciation of the equilibrium RER.

3. Estimating the Misalignment of the Real Exchange Rate

The analysis of the behavior of the RER will be conducted following the co-integration technique applied to non-stationary series. Before proceeding to the estimation of the model, we will first describe the variables used in our regression.

3.1 Choice of Variables

We study the relationship between RER and some macroeconomic fundamentals that are considered relevant in our work, and which are also expected to influence internal and external macroeconomic balance. The fundamentals retained in our model were chosen based on theoretical analysis and data availability. The most statistically significant fundamental variables are productivity, terms of trade, trade openness and capital flows.

Terms of trade (TOT):

They are calculated as the ratio of export prices (unit value index) to import prices (unit value index) of Tunisia. They may lead to real appreciation or depreciation depending on the significance of income effects and substitution effects.

Commercial opening (OP):

It is expressed as the sum of imports and exports relative to GDP. Given that the Tunisian economy is following a policy of trade liberalization, the relationship between openness and RER is expected to be negative.

GDP per capita (GDP)

It is represented by GDP per capita. It captures the Balassa-Samuelson effect that fast-growing countries tend to experience a real appreciation of their exchange rate.

Capital flows (FDI):

Capital flows are usually materialized in the form of FDI or portfolio investment (PFI). However, the IPF are not crucial sources of financing for the Tunisian economy, therefore they will not be included in our model. As a result, capital flows will be composed solely of FDI. Thus, an increase in FDI leads to a real appreciation of the exchange rate.

Current account balance (CAB)

A current account deficit leads to an increase in net external debt that can be financed by various international investments (MacDonald & Ricci, 2003; Chudik & Mongardini, 2007). Since the Tunisian current account is still in deficit, expected relationship between the current account balance and the RER can only be negative.

The symbols and definitions of the different variables used in our model are described in Table 1 below. All these variables are expressed in natural logarithms (denoted lx for the variable x, except the variable ‘current account balance’):

Table 1. Variables used in our model

Symbol of the variable used in the model	Meaning of the variable used in the model
LREER	The logarithm of the real effective exchange rate (quoted at the uncertain)
LTOT	The logarithm of the terms of trade
LFDI	The logarithm of foreign direct investment flows as a percentage of GDP
LGDP	The logarithm of GDP per capita
LOP	The logarithm of the degree of trade openness
CAB	The current account balance

The data is extracted from the following sources:

- The Real Effective Exchange Rate is available in the IMF’s International Financial Statistics (IFS) database,
- The terms of trade and the current account balance are available on the website of the World Bank,
- The commercial opening is calculated from the IFS data,
- The GDP per capita and the FDI are provided by the World Bank,

The data in our study are annual and cover the period 1980-2015

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 2 below summarizes the results of the enhanced Dickey-Fuller (ADF) test.

Table 2. Results of ADF test

Variables	Stationarity	t-stat	Critical Value	Prob	Results
LREER	in level	-1,3400	-3,5402	0,8613	non-stationary
	In first differences	-2,9664	-2,6128	0,0481	stationary
LTOT	in level	-1,8742	-3,5442	0,6464	non-stationary
	In first differences	-4,2866	-3,5442	0,0090	stationary

LFDI	in level	-3,4200	-4,2349	0,0645	non-stationary
	In first differences	-8,1902	-3,5442	0,0000	stationary
LOP	in level	-2,7265	-3,5403	0,2326	non-stationary
	In first differences	-5,5883	-3,5442	0,0003	stationary
LGDP	in level	-0,3750	-2,9458	0,9030	non-stationary
	In first differences	-4,7756	-2,9484	0,0005	Stationary
CAB	in level	-2,1110	-3,5403	0,5225	non-stationary
	In first differences	-5,8889	-3,5442	0,0001	Stationary

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 difference, 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 if there is a long-term relationship between non stationary variables. Two cases arise: in the absence of a wedge-integration relation, we estimate an autoregressive model, whereas, if there is a cointegeration relation, we must estimate an error-correction model (ECM).

Table 3. Results of trace statistics

Null Hypothesis	Eigenvalue	Trace Statistic	Critical Value	P-value
None	0.893798	222.9774	117.7082	0.0000
At most 1	0.835747	146.7353	88.80380	0.0000
At most 2	0.611716	85.31940	63.87610	0.0003
At most 3	0.511887	53.15477	42.91525	0.0035
At most 4	0.427099	28.76969	25.87211	0.0212
At most 5	0.251082	9.830259	12.51798	0.1351

Table 4. Results of maximal eigen statistics

Null Hypothesis	Eigenvalue	Maximal Eigen statistics	Critical Value	P-value
None	0.893798	76.24215	44.49720	0.0000
At most 1	0.835747	61.41588	38.33101	0.0000
At most 2	0.611716	32.16463	32.11832	0.0493
At most 3	0.511887	24.38508	25.82321	0.0765
At most 4	0.427099	18.93943	19.38704	0.0580
At most 5	0.251082	9.830259	12.51798	0.1351

Johansen’s trace and maximum eigenvalue statistics showed the existence of at least one cointegrating relationship. Thus, the trace test indicates the existence of five cointegrating vectors at 5%. While, the maximum eigenvalue statistics indicates the existence of three cointegrating vectors at 5%.

3.3 Estimation Results

Table 5 below presents the long-term relationship between RER and macroeconomic fundamentals.

Table 5. Estimation of the long-run relationship between the equilibrium RER and macroeconomic fundamentals

	Determinants of the equilibrium RER				
	LOP	LTOT	LFDI	LGDP	LCAB
Coeff	-0,62	0,65	0,03	0,34	-0,01
T.Stat	10 ,01	13 ,08	3,77	6,93	5,88

The negative coefficient corresponding to the trade opening variable supports the idea that trade liberalization is accompanied by a depreciation of the RER. Thus, a 10% improvement in the degree of openness of the Tunisian economy generates a real depreciation of around 6.2%.

For the variable ‘terms of trade, the empirical results show that an improvement in the terms of trade leads to an appreciation of the RER, thus implementing an income effect that dominates the income effect. Then an improvement in the terms of trade of 10% leads to an appreciation of 6.5% of the real value of Tunisian dinar.

The long relationship between FDI and RER fits well into the theoretical predictions. Indeed, the cointegration coefficient for FDI is positive; indicating that an increase in foreign capital inflows leads to an increase in domestic demand whose reallocation of factors of production is in favor of non-tradable sectors. This rise in demand for non-tradable goods allows the real exchange rate to be raised in the long run. Thus, an increase in foreign capital flows of 10% generates an appreciation of 0.3% of the real value of Tunisian Dinar.

Regarding the relationship between the current account balance and RER, it fits well in the theoretical predictions. Thus, the current account deficit generates a real depreciation of the RER equilibrium.

The effect of per capita income on the RER contributes to long-run changes in the RER. The positive coefficient corresponding to the productivity variable implies that the economic development is accompanied by an appreciation of the RER (Balassa-Samuelson effect).

Regarding the short-term of the equilibrium RER, it was examined by estimating an error correction model (ECM).

Table 6. Estimation of ECM

	The short-term of the equilibrium RER					
	ΔTOT	ΔFDI	ΔGDP	ΔOP	ΔCAB	ECM
Coeff	0,04	0,58	-0,14	-0,22	0,09	-0,11
T.Stat	0,21	2,63	-0,69	-0,88	0,44	-1,66

We note that the TOT, FDI and trade openness, exert on the RER the same effects already found in the long-term relationship. While, the GDP per capita and the current account balance occur in contrast to their effect under steady-state conditions.

The coefficient associated with the error correction term is negative and statistically significant. This indicates a gradual convergence of the equilibrium RER towards its long-term value.

To determine the equilibrium RER, it is necessary to replace the fundamentals by their sustainable values. Most authors choose to replace fundamentals with their multi-year moving averages (Edwards, 1989; El Badawi, 1994).

The following Figure shows the evolution of the actual RER compared to its equilibrium value.

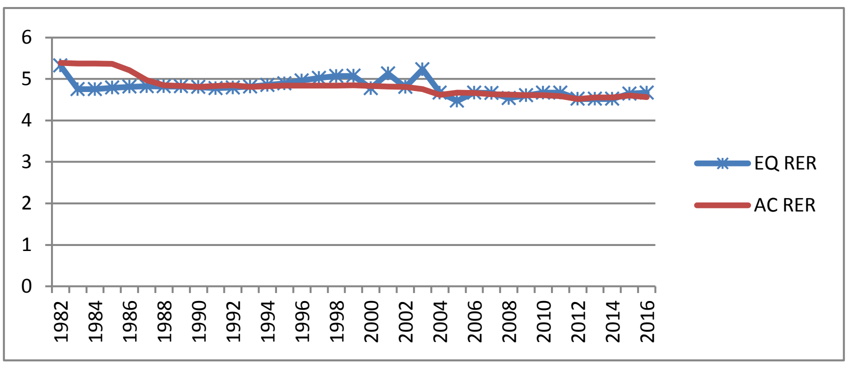

Figure 1. Evolution of the actual RER and the equilibrium RER

Source: Author’s estimations.

Once the equilibrium RER has been determined, it is possible to calculate the RER misalignment, which is defined as the difference between the actual RER (FMI base) and the equilibrium RER.

Analytically, the measurement of the misalignments is done according to the following formula:

$$MIS_t = \frac{AC\ RER_t - EQRER_t}{EQRER_t}$$

$EQRER_t$ is the equilibrium RER; $AC\ RER_t$ is the actual RER.

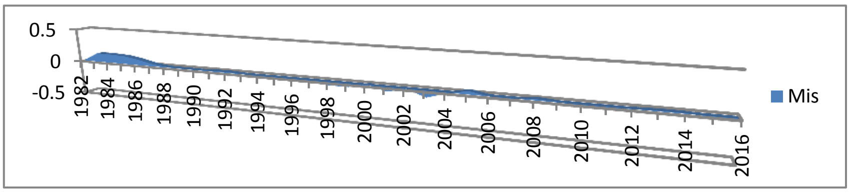

Figure 2. Misalignment of the Tunisian Dinar

Source: Author's estimations.

It can be seen in Figure A4 below that, before the adoption of the SAP, the divergence of the RER from its equilibrium value is very important. This discrepancy between the actual RER and its equilibrium value can only aggravate the country's economic crisis, which ended with a devaluation of the Tunisian Dinar under the SAP. Starting in 1988, the actual RER revolves around a constant value. Thus, the 1986 devaluation was justified by the model as that from 1988 to 1994 when the actual value of the RER merges with its equilibrium value. The end of the 90s was marked by an important underestimation, therefore, we can say that Tunisia could not preserve its competitiveness. During the period 2000-2015, except for the year 2006, Tunisia has sharply reduced the fluctuations in the value of its currency.

4. Conclusions

The aim of this paper is to estimate the equilibrium RER for Tunisia .The estimate covers 35 observations over the period from 1980 to 2015. First, we have determined the equilibrium RER by means of the cointegration relationship, and second, the equilibrium values of the fundamentals which are moving averages over three years. Then, the equilibrium RER is explained by economic fundamentals. Afterwards, we calculated the misalignment, which is the difference between the actual RER and the long-term RER.

The study period was marked by phases of overvaluation and undervaluation of the RER. Our study shows that an improvement in the TOT , an increase in the degree of openness, and a rise in income per capita lead to a long-term appreciation in the real exchange rate. In contrast, an increase in the degree of openness of the Tunisian economy and a deficit in the current account lead to depreciation in the real exchange rate.

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Appendix A. The determinants of the RER

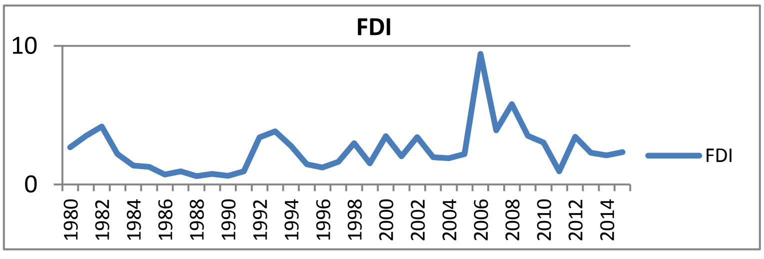

Figure A1. Evolution of FDI

Source: WB.

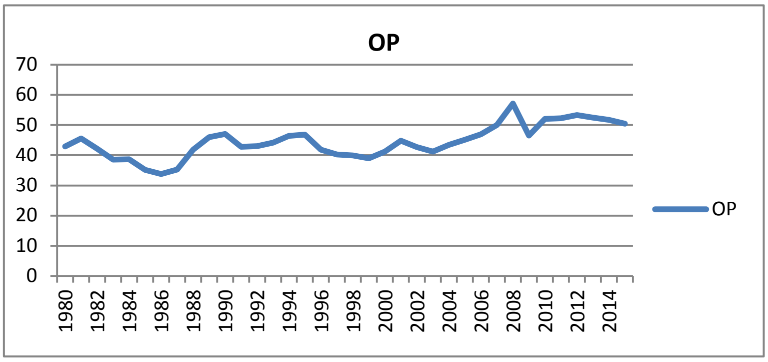

Figure A2. Evolution of OP

Source: WB.

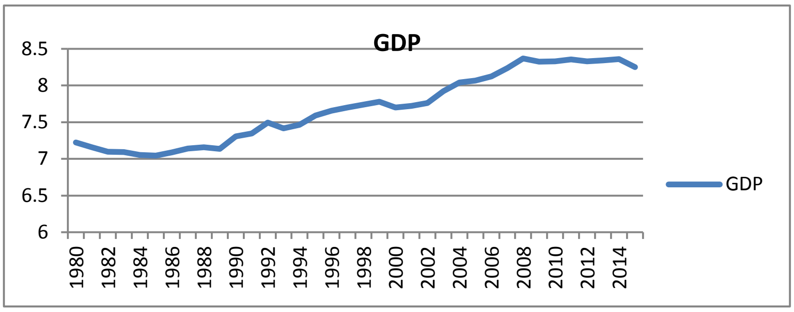

Figure A3. Evolution of GDP

Source: WB.

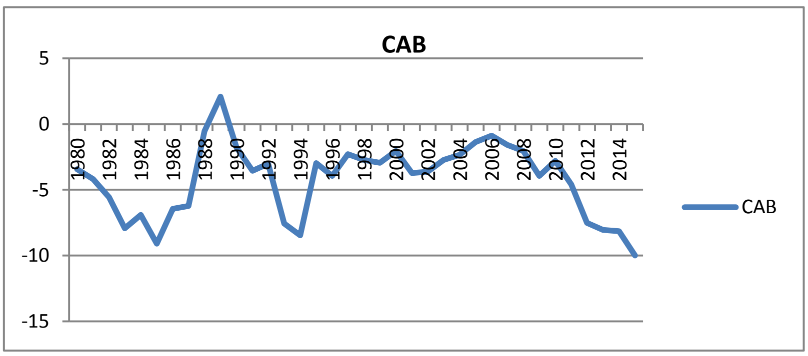

Figure A4. Evolution of CAB

Source: WB.

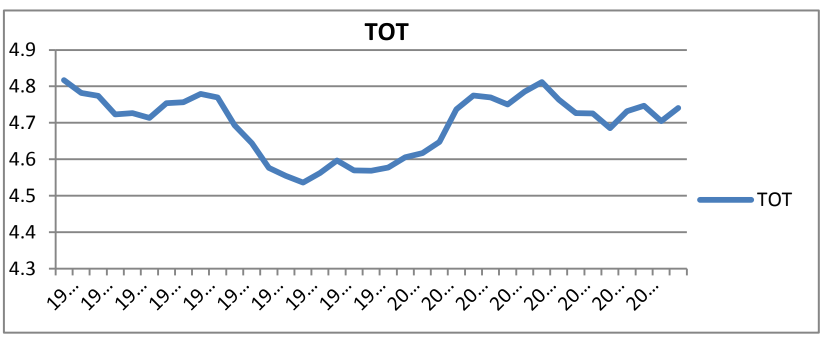

Figure A5. Evolution of TOT

Source: WB.

Appendix B. Stationary tests of the variables

- REER

Null Hypothesis: TCRE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.340055	0.8613
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER)
Method: Least Squares
Date: 06/20/18 Time: 10:51
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REER (-1)	-0.095095	0.070963	-1.340055	0.1894
C	0.457997	0.375519	1.219635	0.2312
@TREND("1980")	-0.001008	0.001812	-0.556089	0.5819

R-squared	0.105411	Mean dependent var	-0.023111
Adjusted R-squared	0.051194	S.D. dependent var	0.051612
S.E. of regression	0.050273	Akaike info criterion	-3.063040
Sum squared resid	0.083404	Schwarz criterion	-2.931080
Log likelihood	58.13471	Hannan-Quinn criter.	-3.016982
F-statistic	1.944227	Durbin-Watson stat	0.859596
Prob(F-statistic)	0.159143		

Null Hypothesis: D(REER) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.966457	0.0481
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER,2)
Method: Least Squares
Date: 06/20/18 Time: 10:57
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REER (-1))	-0.420860	0.141873	-2.966457	0.0056
C	-0.010644	0.007976	-1.334465	0.1912

R-squared	0.210524	Mean dependent var	-0.001155
Adjusted R-squared	0.186600	S.D. dependent var	0.047928
S.E. of regression	0.043225	Akaike info criterion	-3.389331
Sum squared resid	0.061658	Schwarz criterion	-3.300454
Log likelihood	61.31329	Hannan-Quinn criter.	-3.358650
F-statistic	8.799864	Durbin-Watson stat	1.555924
Prob(F-statistic)	0.005566		

❖ TOT

Null Hypothesis: TOT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.874219	0.6464
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOT)
Method: Least Squares
Date: 06/20/18 Time: 10:58
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TOT(-1)	-0.134765	0.071904	-1.874219	0.0704
D(TOT(-1))	0.310237	0.165959	1.869352	0.0710
C	0.621577	0.337137	1.843692	0.0748
@TREND("1980")	0.000560	0.000588	0.952884	0.3480

R-squared	0.195771	Mean dependent var	-0.001173
Adjusted R-squared	0.117942	S.D. dependent var	0.036716
S.E. of regression	0.034483	Akaike info criterion	-3.789474
Sum squared resid	0.036862	Schwarz criterion	-3.611720
Log likelihood	70.31579	Hannan-Quinn criter.	-3.728113
F-statistic	2.515409	Durbin-Watson stat	1.981678
Prob(F-statistic)	0.076513		

Null Hypothesis: D(TOT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.286609	0.0090
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOT,2)
Method: Least Squares
Date: 06/20/18 Time: 10:59
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TOT(-1))	-0.731972	0.170758	-4.286609	0.0002
C	-0.009845	0.013170	-0.747476	0.4602
@TREND("1980")	0.000502	0.000610	0.822594	0.4168

R-squared	0.364782	Mean dependent var	0.002028
Adjusted R-squared	0.325081	S.D. dependent var	0.043591
S.E. of regression	0.035812	Akaike info criterion	-3.739277
Sum squared resid	0.041039	Schwarz criterion	-3.605961
Log likelihood	68.43734	Hannan-Quinn criter.	-3.693256
F-statistic	9.188191	Durbin-Watson stat	1.946587
Prob(F-statistic)	0.000703		

- FDI

Null Hypothesis: FDI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.420046	0.0645
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI)
Method: Least Squares
Date: 06/20/18 Time: 11:01
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI (-1)	-0.510349	0.149223	-3.420046	0.0017
C	0.140475	0.189392	0.741716	0.4635
@TREND("1980")	0.012164	0.009135	1.331578	0.1921
R-squared	0.262248	Mean dependent var		-0.005155
Adjusted R-squared	0.217536	S.D. dependent var		0.605628
S.E. of regression	0.535720	Akaike info criterion		1.669247
Sum squared resid	9.470880	Schwarz criterion		1.801207
Log likelihood	-27.04644	Hannan-Quinn criter.		1.715304
F-statistic	5.865254	Durbin-Watson stat		2.136555
Prob(F-statistic)	0.006615			

- OP

Null Hypothesis: OP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.726509	0.2326
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OP)
Method: Least Squares
Date: 06/20/18 Time: 11:05
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OP(-1)	-0.368240	0.135059	-2.726509	0.0102
C	1.341664	0.492036	2.726757	0.0102
@TREND("1980")	0.002975	0.001581	1.881545	0.0687
R-squared	0.183853	Mean dependent var		0.001640
Adjusted R-squared	0.134389	S.D. dependent var		0.076520
S.E. of regression	0.071193	Akaike info criterion		-2.367193
Sum squared resid	0.167258	Schwarz criterion		-2.235233
Log likelihood	45.60948	Hannan-Quinn criter.		-2.321136
F-statistic	3.716939	Durbin-Watson stat		1.682196
Prob(F-statistic)	0.035009			

Null Hypothesis: D(OP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.588315	0.0003
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OP,2)
Method: Least Squares
Date: 06/20/18 Time: 11:06
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OP(-1))	-1.008862	0.180531	-5.588315	0.0000
C	-0.005641	0.028559	-0.197540	0.8447
@TREND("1980")	0.000296	0.001330	0.222914	0.8250

R-squared	0.494143	Mean dependent var	-0.004675
Adjusted R-squared	0.462526	S.D. dependent var	0.108109
S.E. of regression	0.079258	Akaike info criterion	-2.150410
Sum squared resid	0.201017	Schwarz criterion	-2.017095
Log likelihood	40.63218	Hannan-Quinn criter.	-2.104390
F-statistic	15.62946	Durbin-Watson stat	1.868713
Prob(F-statistic)	0.000018		

- **GDP**

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.375045	0.9030
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 06/20/18 Time: 11:08
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP (-1)	-0.009589	0.025568	-0.375045	0.7100
C	0.101215	0.197047	0.513661	0.6108

R-squared	0.004120	Mean dependent var	0.027450
Adjusted R-squared	-0.025171	S.D. dependent var	0.070757
S.E. of regression	0.071642	Akaike info criterion	-2.380332
Sum squared resid	0.174505	Schwarz criterion	-2.292358
Log likelihood	44.84597	Hannan-Quinn criter.	-2.349627
F-statistic	0.140659	Durbin-Watson stat	1.536300
Prob(F-statistic)	0.709957		

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.775619	0.0005
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 06/20/18 Time: 11:09
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP (-1))	-0.804431	0.168445	-4.775619	0.0000
C	0.024338	0.012764	1.906721	0.0653

R-squared	0.408671	Mean dependent var	0.000773
Adjusted R-squared	0.390752	S.D. dependent var	0.089225
S.E. of regression	0.069644	Akaike info criterion	-2.435406
Sum squared resid	0.160058	Schwarz criterion	-2.346529
Log likelihood	44.61960	Hannan-Quinn criter.	-2.404726
F-statistic	22.80653	Durbin-Watson stat	2.064819
Prob(F-statistic)	0.000036		

- **CAB**

Null Hypothesis: CAB has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.111057	0.5225
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CAB)
Method: Least Squares
Date: 06/20/18 Time: 11:10
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CAB (-1)	-0.260559	0.123426	-2.111057	0.0424
C	-0.923600	0.879830	-1.049748	0.3015
@TREND("1980")	-0.020982	0.033420	-0.627820	0.5344

R-squared	0.124924	Mean dependent var	-0.131787
Adjusted R-squared	0.071889	S.D. dependent var	2.158459
S.E. of regression	2.079427	Akaike info criterion	4.381717
Sum squared resid	142.6925	Schwarz criterion	4.513677
Log likelihood	-75.87090	Hannan-Quinn criter.	4.427774
F-statistic	2.355509	Durbin-Watson stat	1.795047
Prob(F-statistic)	0.110600		

Null Hypothesis: CAB has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.111057	0.5225
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CAB)
Method: Least Squares
Date: 06/20/18 Time: 12:58
Sample (adjusted): 1981 2016
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CAB (-1)	-0.260559	0.123426	-2.111057	0.0424
C	-0.923600	0.879830	-1.049748	0.3015
@TREND("1980")	-0.020982	0.033420	-0.627820	0.5344
R-squared	0.124924	Mean dependent var		-0.131787
Adjusted R-squared	0.071889	S.D. dependent var		2.158459
S.E. of regression	2.079427	Akaike info criterion		4.381717
Sum squared resid	142.6925	Schwarz criterion		4.513677
Log likelihood	-75.87090	Hannan-Quinn criter.		4.427774
F-statistic	2.355509	Durbin-Watson stat		1.795047
Prob(F-statistic)	0.110600			

Null Hypothesis: D(CAB) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.888976	0.0001
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CAB,2)
Method: Least Squares
Date: 06/20/18 Time: 11:11
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CAB (-1))	-1.033392	0.175479	-5.888976	0.0000
C	0.374702	0.804414	0.465807	0.6445
@TREND("1980")	-0.025080	0.037495	-0.668902	0.5084
R-squared	0.520213	Mean dependent var		0.042317
Adjusted R-squared	0.490226	S.D. dependent var		3.124398
S.E. of regression	2.230772	Akaike info criterion		4.524389
Sum squared resid	159.2430	Schwarz criterion		4.657704
Log likelihood	-76.17681	Hannan-Quinn criter.		4.570409
F-statistic	17.34812	Durbin-Watson stat		2.007123
Prob(F-statistic)	0.000008			