

**Policy Note: PN 2022-02**

**Analysis of Equilibrium Exchange Rate and Exchange Rate Misalignment  
in Bangladesh**

Md. Nur-E-Alom Siddique

Md. Abir Hossain

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**Chief Economist's Unit**

**Bangladesh Bank**

## Analysis of Equilibrium Exchange Rate and Exchange Rate Misalignment in Bangladesh<sup>1</sup>

### *Abstract*

*The purpose of this paper is to estimate Equilibrium Real Effective Exchange Rate (EREER) and to derive exchange rate misalignment for Bangladesh covering the period of 1992-2021 using Dynamic Ordinary Least Square (DOLS). The study finds that REER misalignment showed a volatile trend over the period considered (1992-2021) and the REER was overvalued most of the time except from 1992 to 1994 and from 2003 to 2005. The REER overvaluation reached highest in 2019. However, in the last couple of years, currency misalignment became narrowed indicating that actual REER is closer to equilibrium REER (EREER) which is calculated based on economic fundamentals. In 2020, REER overvaluation was around 5% and in 2021 it was 7%. Although actual REER is continuously appreciating, indicating overvaluation of REER, considering the economic fundamentals the magnitude of the overvaluation is not significant.*

### **1. Introduction**

Exchange rate misalignment influences the economic performance of a country especially when it comes to developing countries like Bangladesh<sup>2</sup>. Exchange rate misalignment is defined as the deviation of the real exchange rate from its equilibrium level. Significant and persistent misalignment disturbs the balance of the economy and is regarded as one of the early warning indicators of economic vulnerability. Persistent overvaluation of the real exchange rate reflects unstable macroeconomic conditions making the countries vulnerable to speculative attack and leads to currency crisis (Williamson, 1995; Stein et. al., 1997; Edwards & Savastano, 1999; Jongwanich, 2009). On the other hand, an undervalued exchange rate makes overheating economy which creates inflationary pressure and misallocates the resources between tradable and non-tradable sectors. The Washington Consensus views that real exchange rate misalignment implies macroeconomic imbalances that can be disastrous for growth (Berg & Miao, 2010). Maintaining of real exchange rate close to equilibrium level is good for an economy from both its internal and external positions, though equilibrium real exchange rate is an unobservable variable. It mostly depends on a number of macroeconomic fundamentals, many of which are endogenously determined within the economy.

International Monetary Fund (IMF) often encourages developing and emerging economies to keep the actual Real Effective Exchange rate (REER) close to the equilibrium real exchange rate. REER is a

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<sup>1</sup> The authors are Md. Nur-E-Alom Siddique, Joint Director, and Md. Abir Hossain, Assistant Director, of Chief Economist's Unit (CEU). Views expressed in this policy note are authors' own and do not necessarily reflect those of the Bangladesh Bank. The authors are thankful to Dr. Md. Habibur Rahman, Chief Economist, Dr. Md. Ezazul Islam, General Manager, and Dr. Md Salim Al Mamun, Deputy General Manager of CEU for their valuable comments.

<sup>2</sup> The impact of exchange rate misalignment on growth is more relevant in developing countries than in developed countries (Rodrik, 2008; Dubas, 2012). According to Rodrik periods of rapid growth are associated with currency undervaluation for most countries. He argues that an increase in undervaluation boosts economic growth as powerfully as a decrease in overvaluation, and that this holds only for the developing countries and the effect disappears in the case of developed countries.

weighted average of a country's currency in relation to an index or basket of other major currencies which plays a significant role in the broad allocation of resources and pattern of spending behavior in the economy. REER is mostly used to determine the currency value of one country relative to other major trade countries' currencies. It is as a measure of competitiveness which also determines and influences the performance of the export sector (Caballero and Corbo (1989). It reflects the currency's position in terms of purchasing power with respect to other currencies and indicates whether a currency has appreciated or depreciated relative to the trade partners. Exchange rate misalignment can arise in any regime of exchange rate such as fixed exchange rate, floating exchange rate or manage floating exchange rate regimes.

Bangladesh adopted a floating exchange rate regime on May 30, 2003. While the advantages of a freely floating regime are well known, it is still debated whether this regime is suitable for the developing countries. Bangladesh regularly intervenes in the foreign exchange market to stabilize exchange rate. However, intervention in the managed floating regime causes the misalignment of exchange rate: either overvalued or undervalued. Therefore, in the context of Bangladesh, it is important to conduct study for the examination of real exchange rate behavior and possible exchange rate misalignment using updated data covering flexible exchange rate regime. This paper estimates real exchange rate misalignment for Bangladesh using time series techniques including Dynamic OLS (DOLS). In this paper, the equilibrium exchange rate is derived based on the BEER approach introduced by Clark and MacDonald (1998). The approach gives an equilibrium exchange rate estimating from the relationship between real exchange rate and a set of fundamental determinants where only permanent changes of these fundamentals drive the equilibrium exchange rate. Therefore, firstly, this paper calculates equilibrium REER for Bangladesh using updated annual data: REER from Bruegel<sup>3</sup> and other data from World Development Indicators (WDI)<sup>4</sup>. Secondly, it presents both the direction (Overvalued/Undervalued) and the magnitude of currency misalignment, if any, for Bangladesh.

## **2. Behavior of Nominal Exchange Rate, REER and NEER in Bangladesh<sup>5</sup>**

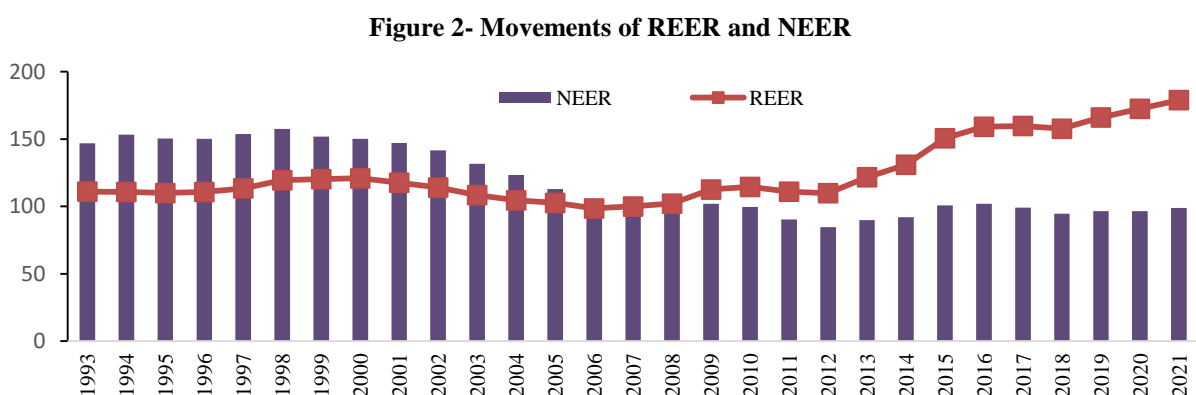
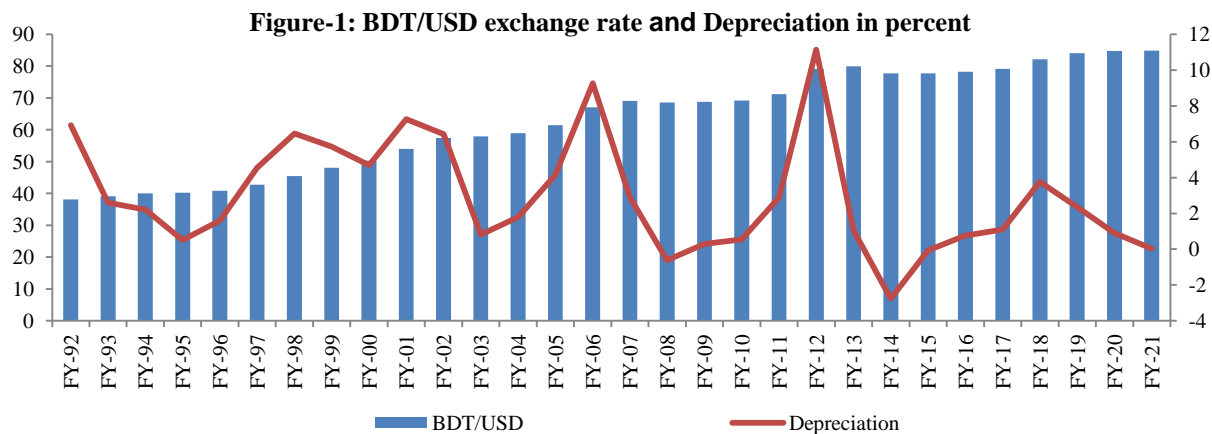
The figure-2 shows the movement of both the REER and the NEER in Bangladesh for the period of FY93 to FY21. Bangladeshi taka against USD (period average) stood at 84.81 in FY21 from 38.15 in FY92. The trend in the nominal bilateral exchange was somewhat volatile but it was upward indicating depreciation of the exchange rate for the period of FY92-FY21 except some periodic appreciation. Depreciation rate was highest in FY12 at 11 percent. Thereafter, depreciation level decreased and hovered within 4 percent except FY14 and FY15, when BDT appreciated somewhat against Dollar in FY14 and FY15.

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<sup>3</sup> Bruegel calculates REER which is consumer price index-based real effective exchange rate considering a large number of trading partners as weights.

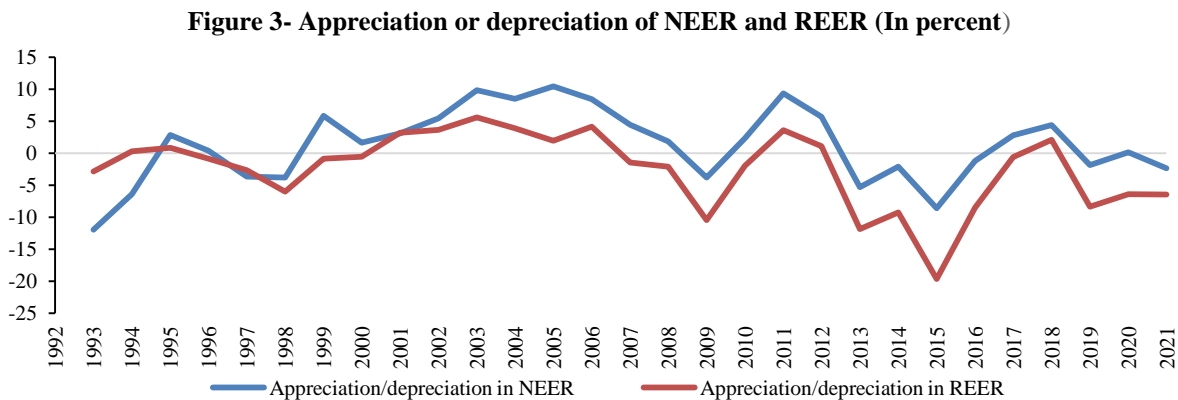
<sup>4</sup> Data for the year 2021 is estimated (not actual).

<sup>5</sup> Data Source: NEER and REER from Bruegel (2021) and Nominal exchange rate (taka per dollar) from Bangladesh Bank



Authors' own plot, Data Source: Bruegel,

Over the time, NEER is declining steadily from 146.90 in 1993 to 98.40 in 2021 which showed a decline of around 33 percent, on average. On the other hand, REER observed an upward trend from 1993 to 2000 (Figure-2). After that REER observed a declining trend till 2006 and after that it observed an appreciation from 100 in 2006 to 179 in 2021, reflected the domestic price level pressure in Bangladesh compared to its trading partner countries (figure-3).



Authors' own plot, Data Source: Bruegel (2021)

### 3. Equilibrium REER and REER Misalignment

Behavioural Equilibrium Exchange Rate (BEER) approach is applied to estimate equilibrium REER. In the BEER approach, the equilibrium exchange rate is determined by establishing a behavioural link between the real exchange rate and relevant economic variables using econometric methods (Clark & MacDonald, 1998).

First, Balassa-Samuelson effect is taken into account. From Balassa-Samuelson, it is well known that non-traded goods are cheaper than traded goods in poorer countries, which requires an adjustment to take this into account. Therefore, to capture Balassa-Samuelson effect, the relationship between REER and productivity differential is as follows:

$$LREER_t = \beta_0 + \beta_1 LPROD_t + u_t \dots \dots \dots (1)$$

REER stands for the Real Effective Exchange Rate, PROD for productivity proxied by the real GDP per capita as compared to the world's real GDP per capita in PPP terms,  $\beta_0$  is the intercept,  $u$  for the error term, and  $t$  time period. All variables are in natural logarithm form. An increase in REER means appreciation in the value of the domestic currency. Therefore, to hold Balassa-Samuelson effect, valid  $\beta_1$  is expected to be positive.

Then, the first equation is augmented by incorporating a set of fundamental determinants from the literature. To be more specific, the relationship between REER and the fundamentals can be written as follows:

$$LREER_t = \beta_0 + \beta_1 LPROD_t + \beta_2 LGEXP_t + \beta_3 NFA_t + \beta_4 LTOT_t + \beta_5 LOPEN_t + \beta_5 LM2_t + \beta_6 LREM_t + u_t \dots \dots \dots (2)$$

Equation-2 is the augmented version of equation (1). Where, GEXP is the government consumption, NFA is the net foreign assets, TOT is the terms of trade, OPEN is the trade openness, M2 is broad money growth, REM is remittance inflows. This is a log linear model, only NFA is expressed as percentage of GDP and other variables are in natural logarithm form.

We assess equilibrium REER, defined as EREER, as the predicted value of equation 2 with the coefficients estimated by the DOLS.

$$EREER_t = \hat{\alpha}_t + \hat{\beta}_1 PROD_t + \hat{\beta}_2 GEXP_t + \hat{\beta}_3 NFA_t + \hat{\beta}_4 TOT_t + \hat{\beta}_5 OPEN_t + \hat{\beta}_5 M2_t + \hat{\beta}_6 REM_t \dots \dots \dots (3)$$

Then, the corresponding misalignment is the difference between actual REER and EREER.

$$Mis_t = REER_t - EREER_t$$

Where,  $Mis$  denotes for exchange rate misalignment. A positive value of  $Mis_t$  is equivalent to overvaluation implies that the real exchange rate must depreciate to converge towards its equilibrium

and negative value is the undervaluation of the real effective exchange rate implies that the real exchange rate must appreciate to converge toward its equilibrium.

#### 4. Empirical Results

First, stationary has been checked by applying the augmented Dicky-Fuller (ADF) test. The results presented in the table and all the variables are integrated of order one, I(1) ensuring the criteria for estimating any long run relationship (Annexure).

While estimating the cointegrating vector, the OLS cannot be used. Though the coefficients of cointegrating regression is consistent, the non-normal distribution of error terms implies that the tests performed may provide an invalid statistical inference (Agbola and Damoense 2005, 152; Inoue, 2014). To overcome this problem, an alternative method namely the Dynamic Ordinary Least Squares (DOLS) is used.

We estimated four different equations by using Dynamic Ordinary Least Squares (DOLS). The results of the long-run parameter estimate of the regression equations are presented in the following table (2). Column1, column 2, column 3 and column 4 show estimated regression result for Model I, Model II, Model III and Model III. The results are quite encouraging as coefficients and signs in all regressions coincide with theoretical and practical studies. We believe that Model III is the best model that gives the expected result.

**Table:1. Estimation results of DOLS**

	Model I	Model II	Model III	Model IV
Constant	6.90 (0.75)	4.33 (0.31)	3.52 (0.39)	16.16 (1.37)
LPROD	1.24 (0.41)	0.76 (0.10)	0.50 (0.11)	3.17 (0.29)
LGEXP		-0.23 (0.04)	-0.28 (0.04)	
NFA			0.03 (0.01)	-0.07 (0.01)
LTOT				5.17 (0.69)
LOPEN			-0.36 (0.09)	0.93 (0.18)
LM2				0.10 (0.06)
LREM		-0.37 (0.03)	-0.25 (0.05)	1.57 (0.22)
R-sq	0.74	0.99	0.99	0.99
Adjusted R-sq	0.70	0.98	0.99	0.99
S.E. of regression	0.09	0.02	0.02	0.01

NB: Standard errors in parentheses. In the DOLS estimation, the number of both leads and lags are fixed as 1. The results do not change if the number of leads and lags is fixed at 2 or 3.

In the all cases, productivity differential (LPROD) positively affects REER which is strongly significant and robust, indicates that more advanced economies likely to have stronger currencies<sup>6</sup>. This result provides evidence for the famous Balassa-Samuelson effect: higher productivity in the tradable sector increases wages in the tradable sector and subsequently in the non-tradable sector which in turn puts upward pressure on the prices of non-tradable goods leading to stronger currencies (appreciation). In particular Rodrik (2008), Vieira and MacDonald (2012), and Gonçalves and Rodrigues (2017) find similar result. The former two measure equilibrium based on PPP deviation controlling for GDP per capita (Balassa-Samuelson effect) and the later based on BEER approach using multiple determinants.

However, LGEXP, LREM and LOPEN are negatively linked with LREER. On the other hand, NFA as percentage of GDP positively affect LREER. Model III shows that LM2 and LTOT are statistically insignificant. These findings are consistent with the existing literature. From the estimation of model-III it shows that on average, one unit increase in the productivity differential of Bangladesh relative to world (LPROD) tends to appreciate REER by around 0.5 percent. Similarly, an increase in NFA of one percentage point of GDP is associated with an appreciation of REER by 3 percent. On the other hand, if government expenditure (LGEXP) increases by 1 percentage point of GDP then REER depreciates by 0.28 percent. Similarly, a 1 percent increase in LOPEN, the proxy for trade openness, leads to REER depreciation by around 0.36 percent. These results are significant and robust.

## 5. Exchange Rate (REER) Misalignment

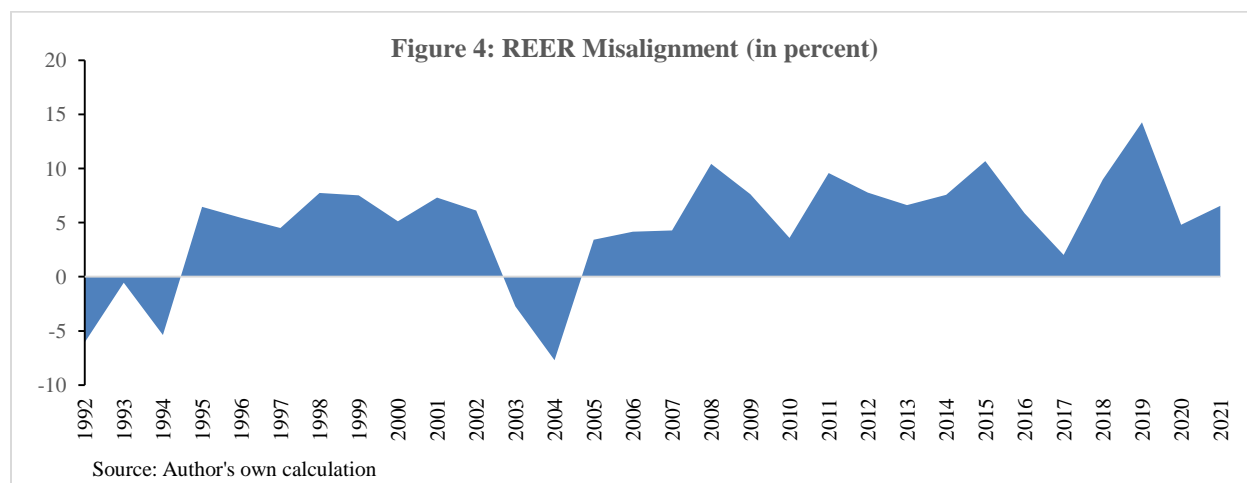
The figure-4 depicts the misalignment of REER during 1992 to 2021. The positive value of misalignment implies the overvaluation of REER where the negative value of REER implies the undervaluation of REER. The REER was overvalued most of the time except from 1992 to 1994 and from 2003 to 2005. Since 2002 REER started to become undervalued due to the continued lower inflation and occasional devaluations. Then Bangladesh adopted floating Exchange rate regime in mid of 2003. However, during the initial stage of the floating regime (2004-2006), the taka remained competitive due to high depreciation of taka and US high domestic inflation. The REER misalignment followed zigzag trend and continued overvaluation after 2003 and reached highest in 2019. However, in the last couple of years, currency misalignment became narrowed indicates that actual REER is closer to equilibrium REER (EREER) which is calculated based on economic fundamentals<sup>7</sup>. The study finds that in 2020, REER overvaluation was around 5% and in 2021 it was 7 percent. Although actual REER is continuously appreciating and stood at 115.76 in December 2021, the study finds that considering economic fundamentals Bangladeshi taka is slightly overvalued. Overvaluation in REER was somewhat compensated by the improvement in economic fundamentals such as productivity differential of Bangladesh during the pandemic. For instance, Bangladesh experience positive

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<sup>6</sup> An increase in REER indicates currency appreciation.

<sup>7</sup> Whereas REER reflects the currency's value in terms of purchasing power with respect to other currencies and indicates whether a currency has appreciated or depreciated relative to the trade partners. It does not consider the economic fundamentals of the countries.

economic growth during the COVID19 pandemic while most of countries in the world experienced negative growth, leads to higher the relative productivity slightly.



## 6. Conclusion and Policy Recommendations

The concept of real exchange rate misalignment is ambiguous because there is no universal consensus on equilibrium exchange rates. Therefore, different assumptions, methodology and datasets provide different results in the investigation of equilibrium exchange rate and calculating misalignment. This policy note measures equilibrium real effective exchange rate and exchange rate misalignment for Bangladesh. The equilibrium exchange rate is derived based on the BEER approach, which gives an exchange rate at a level that is consistent with the medium- and long-term economic fundamentals. Then, exchange rate misalignment is measured as the deviation of the actual real exchange rate from equilibrium level.

The note finds REER misalignment followed an unstable fashion over the period considered (1992-2021) and the REER was overvalued most of the time except from 1992 to 1994 and from 2003 to 2005. Since 2002 REER started to become undervalued due to the continued lower inflation and occasional devaluations. However, during the initial stage of the floating regime (2004-2006), the taka remained competitive due to high depreciation of taka and US high domestic inflation. The REER overvaluation reached highest in 2019. However, in the last couple of years, currency misalignment became narrowed indicates that actual REER is closer to equilibrium REER (EREER) which is calculated based on economic fundamentals. In 2020, REER overvaluation was around 5% and in 2021 it was 7%. Although actual REER is continuously appreciating and stood at 115.76 in December 2021, the study finds that considering economic fundamentals Bangladeshi taka is slightly overvalued. Overvaluation in REER was somewhat compensated by the improvement in economic fundamentals such as productivity differential of Bangladesh during the pandemic.

This policy note may provide some insights to the policy makers. Since misalignment in case of both overvaluation and undervaluation is considered as harmful for economic performances, appropriate exchange rate policy should be maintained which can reduce the REER misalignment. To reduce the



magnitude of REER over valuation, Bangladesh either may allow some depreciation in nominal exchange rate or may take necessary measure to reduce domestic inflation. Maintenance of Purchasing Power Parity (PPP) is quite useful for maintaining trade competitiveness. This policy can help to prevent overvaluation of the currency too. Regular calculation of exchange rate misalignment may help to know the actual level of misalignment and take appropriate policy to maintain REER close to equilibrium level. A study on the impact of exchange rate misalignment on economic performance, for instance, export, economic growth should also be initiated to know the extent to which policy makers should response to currency misalignment.

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### Annexure

**Table-1. Unit Root Test**

	Level		First Difference		Level of Integration
	Constant & No Trend	Constant & Trend	Constant & No Trend	Constant & Trend	
LREER	-0.19 (0.93)	-1.34 (0.85)	-2.89 (0.05)	-3.23 (0.10)	I(1)
LPROD	7.29 (1.00)	1.92 (1.00)	-0.85 (0.79)	-3.79 (0.03)	I(1)
LGEXP	-2.14 (0.23)	-0.44 (0.98)	-3.33 (0.02)	-4.31 (0.01)	I(1)
NFA	-1.12 (0.69)	-1.96 (0.60)	-5.06 (0.0003)	-5.02 (0.002)	I(1)
LTOT	-1.59 (0.48)	-0.39 (0.98)	-4.70 (0.00)	-5.14 (0.002)	I(1)
LOPEN	-2.10 (0.25)	-0.42 (0.98)	-4.52 (0.00)	-5.12 (0.002)	I(1)
LM2	-1.32 (0.61)	-0.94 (0.94)	-3.65 (0.01)	-11.34 (0.00)	I(1)
LREM	-1.52 (0.51)	-0.58 (0.97)	-3.52 (0.01)	-3.68 (0.04)	I(1)