The Misalignment of the Real Exchange Rate with the Fundamentals: **Evidence from the Czech Republic, Hungary and Poland**

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The world economy has been going through severe turbulences over the last few years and so have the post-transitive economies of the Middle and Eastern Europe. The behavior of real exchange rate can bear some important information on the state of the economy; in the current context it is especially the information whether or not it has gone off its rails.[1]

There is a vast amount of both purely theoretical and empirical literature focused on the analysis and estimation of some equilibrium value of exchange rate. Rogoff [1996] and Taylor and Taylor [2004] present an overview of the behavior of exchange rate especially with respect to purchasing power parity condition where they also hint at the Balassa-Samuelson effect which is put to use in some of the models for the estimation of real equilibrium exchange rate as it is shown further on. Dornbusch [1989] and Sarno [2002], among others, paint a broader picture of theoretical approaches taken to exchange rate modelling, the latter covering dynamic intertemporal models. However, the approaches presented in those papers deal traditionally with the modelling and analysis of nominal exchange rates.

The analysis of real exchange rate and, especially, the estimation of real equilibrium exchange rate have gained popularity since the 90's. Driver and Westaway [2004] give a full taxonomy of the various real equilibrium exchange rate models. The fact is that the most frequent modelling strategies include behavioral equilibrium exchange rate (BEER), fundamental equilibrium exchange rate (FEER), Smidkova [1998] presents one of the earliest estimates of real equilibrium exchange rates in a post-transitive economy using this modelling strategy, and natural real exchange rate (NATREX). Egert and Halpern [2005] give an exhaustive account of the respective modelling strategies and discuss their implementation in detail.

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This paper exploits the BEER approach to modelling the real equilibrium exchange rate. This approach has one clear setback which is that it is not a structural model which would be explicitly built on derived relationships among the included variables, let alone microfundations as do the modern intertemporal models. The NATREX approach, see Stein [2001] and Belloc [2007] for the special treatment of the "rest of the world" part of the model, is the one with clear structural features, however, it is often estimated in reduced form using vector autoregression methods which wipes out almost all the positive features of the structural approach. Detken [2001] comes up with a mixture of structural and VAR approaches. On the other hand, the BEER approach has one advantage over the other two modelling strategies: it is the least sensitive to shorter time series which is a fact that must be taken into account considering the economies which will be used in the analysis.

The estimation of real equilibrium exchange rate serves two basic purposes regarding the case of post-transitive economies and current state of the world economy. First, it can detect possible fundamental misalignments within the economy and second it can be used to analyse the process of nominal convergence.

The paper is divided into five parts. The first part presents some basic facts on nominal convergence in the three countries: the Czech Republic, Hungary and Poland. The second part gives the standard derivation of the BEER approach and presents some examples of its usage. The third part describes the data used for the estimation and the fourth part presents both the estimates of the behavioral exchange rate for the three economies and also their analysis. The final part concludes.

1. Some stylized facts

The Czech Republic, Hungary and Poland entered the European Union in 2004 and rank among the most prosperous countries in the region of the Middle and Eastern Europe. This is also reflected by real convergence of the economies. In 2001 GDP per capita in Purchasing Power Standards (EU-27 = 100) reached 70.2; 58.9 and 47.6 in the Czech Republic, Hungary and Poland, respectively, while in 2008 it amounted to 80.4; 64.4 and 56.4, respectively.

Figures 1, 2 and 3 present quarterly changes in real exchange rate (RER) of the respective domestic currencies to euro (amount of domestic currency per unit of euro) together with the contributions of nominal exchange rate, domestic price level and foreign (eurozone) price level.

In the Czech Republic the average quarterly change from 2001 to the third quarter of 2009 in RER is negative: –0.90%, that is, it has appreciated on average. The key contribution comes from the change in nominal exchange rate: –0.90 percentage point. The contribution of domestic price level is also negative while the contribution of eurozone price level is positive. One can readily observe that the contributions of price levels almost cancel themselves out. There was a strong real appreciation between the third quarter of

2007 and the third quarter of 2008 followed by a sharp real depreciation in the last quarter of 2008 and the first quarter of 2009. The strong appreciation was boosted by nominal appreciation and rapidly increasing domestic price level while the sharp real depreciation was driven by the behavior of nominal exchange rate.

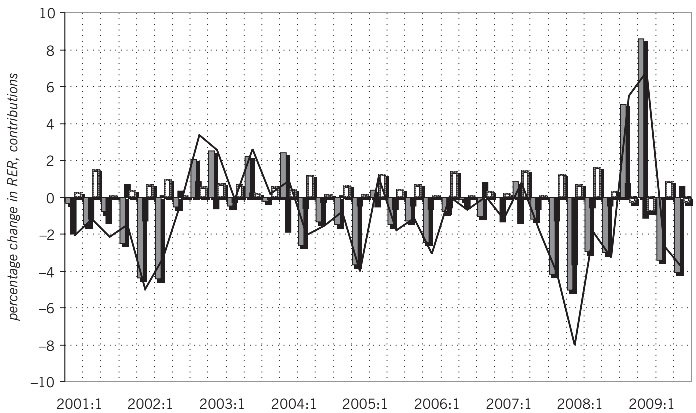

Figure 1:

Changes in RER and contributions, Czech Republic
Solid line: RER, grey column: nominal exchange rate contribution, black column: domestic price level contribution, white column: eurozone price level contribution

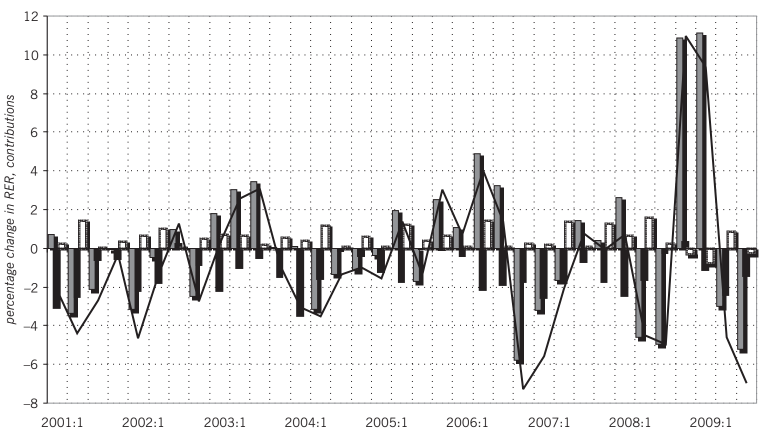

Figure 2:

Changes in RER and contributions, Hungary
Solid line: RER, grey column: nominal exchange rate contribution, black column: domestic price level contribution, white column: eurozone price level contribution.

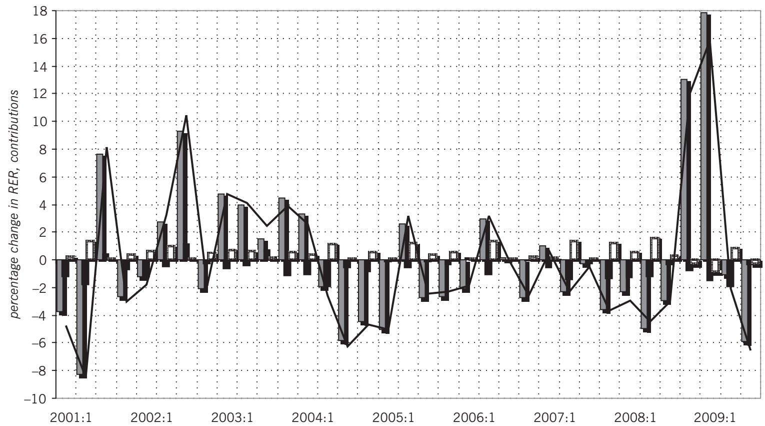

Figure 3:

Changes in RER and contributions, Poland

Solid line: RER, grey column: nominal exchange rate contribution, black column: domestic price level contribution, white column: eurozone price level contribution.

The pattern of the RER behavior in Poland bears some similarity to the one just described in the case of the Czech Republic. However, the average quarterly change in RER tends to zero: 0.03%. The much lower average change is due to the much higher volatility of the real exchange rate between the end of 2008 and beginning of 2009. However, the structure of the quarterly changes is very similar. The main contribution comes from the changes in nominal exchange rate: 0.18 percentage point while the contributions of domestic price level and eurozone price level almost cancel themselves out. There was a strong real appreciation in Poland between the second quarter of 2007 and the third quarter of 2008 followed by a sharp depreciation between the fourth quarter of 2008 and first quarter of 2009. Again the sharp appreciation was driven by both nominal exchange rate and domestic prices level while the real depreciation was boosted by the behavior of nominal exchange rate. All in all it is the nominal exchange rate which governs the behavior of the real exchange rate in the two countries.

In Hungary the average quarterly change in RER between 2001 and the third quarter of 2009 was also negative: –0.79%, however, the main driver of this change was the domestic price level. Its average contribution amount up to –1.37 percentage points while the contribution of nominal exchange rate is just 0.07 percentage point. This is in strike contrast with the cases of the Czech Republic and Poland. There were two sharp depreciation periods from 2005 on: from the fourth quarter of 2006 to the second quarter of 2007 and from the second quarter of 2008 to the third quarter of 2008. The main drivers were the behavior of nominal exchange rate and domestic price level. The last sharp appreciation was followed by a sudden depreciation from the fourth quarter of 2008 to the first quarter of 2009, nominal exchange rate being the key contributor.

All in all the three economies have lately been exposed to the same shocks which resulted in some strong real appreciation in 2007 and 2008 followed by a sudden depreciation. The pattern of RER behavior is very similar in the Czech Republic and Poland with RER driven by nominal exchange rate behavior while it is dominated by domestic price level behavior on average in Hungary.

2. The BEER

Following MacDonald [1997], the BEER approach may be derived as follows. The model builds on the uncovered interest rate parity condition, which states that the return on domestic assets must equal the expected return on foreign assets measured in the units of domestic currency:

$$1 + IR_t^D = E_t\left[\frac{S_{t+1}}{S_t}\left(1 + IR_t^F\right)\right] \quad ,(1)$$

where *IR* denotes interest rate, *S* denotes spot exchange rate, *E* denotes the expectation operator and superscripts *D* and *F* refer to domestic and foreign, respectively. Taking logarithms of both sides of (1), the condition may be expressed in more familiar terms:

$$E_t\left(s_{t+1} - s_t\right) = IR_t^D - IR_t^F \quad ,(2)$$

which means that the expected change in the spot exchange rate equals the interest rate differential. Substracting inflation differential from both sides of (2):

$$E_t\left(s_{t+1} - s_t\right) - E_t\left(\pi_{t+1}^D - \pi_{t+1}^F\right) = IR_t^D - IR_t^F - E\left(\pi_{t+1}^D - \pi_{t+1}^F\right) \quad ,(3)$$

where π refers to inflation rate, one obtains:

$$RER_t = E_t\left(RER_{t+1}\right) - \left(R_t^D - R_t^F\right) \quad ,(4)$$

where *RER* denotes real exchange rate and *R* refers to real interest rate.

Within the BEER approach the expectation of real exchange rate is considered to be the real equilibrium exchange rate which depends upon the fundamentals. Thus it can be concluded that real exchange rate depends on real equilibrium exchange rate (REER) and real interest rate differential:

$$RER_t = REER_t - \left(R_t^D - R_t^F\right) \quad .(5)$$

The key question is: which fundamentals should be considered as determinants of the real equilibrium exchange rate? There is no single way to approach this task and the actual models differ in this respect.

Clark [2000] considers just two determinants of the real equilibrium exchange rate: the relative price of traded and nontraded goods which should, according to Balassa-Samuelson hypothesis, be an important factor especially in the cases of converging economies and net foreign assets which are considered as a general measure of the economy's risk—higher net foreign debt means that investors require higher returns which can be achieved, given the interest rate differential, through depreciation.

However, the role of net foreign assets is ambiguous. First, as Egert and Halpern [2005] point out the effect may be quite the opposite in transitive economies. The reason is that, especially transitive economies, which suffer from low stock of domestic savings, may have a negative targeted stock of net foreign assets. While they converge toward that level, the additional inflows of foreign direct investment, which typically finances the negative foreign assets, tend to appreciate the real exchange rate. When the stock gets beyond the optimal (negative) level of net foreign assets, additional current account deficits will depreciate the real exchange rate. Second, Rogoff [1996] states that the supposed correlation between net foreign assets and real exchange rate tend will be detected at the lags between 5–10 years. However, the time series for the transitive economies may be too short to reveal such relationship when the method used does not estimate time-varying coefficients. As a result, an appreciating affect of larger negative stock of net foreign assets should not come as a surprise.

According to Balassa-Samuelson hypothesis the increase in domestic productivity should appreciate the real exchange rate as well as the rise of net foreign assets. The increase in real interest rate differential should depreciate the real exchange rate.

MacDonald [1997] uses a broader set of determinants of the real equilibrium exchange rate. Beside the factors just mentioned, many other determinants are included. He introduces the role of government spending in the sense that a larger share of government spending in total spending may induce faster increase in nontradable prices as government spending is often channelled into this sector. This may amplify the role of private sector in a growing economy when the income elasticity of demand for nontradable goods exceeds one.

Besides net foreign assets he also includes other measures of balances, namely: fiscal balance and personal savings. Higher fiscal surplus and personal savings should appreciate the real exchange rate.

He also adds an important determinant of terms of trade for small open economies, which is the real price of oil. Considering an importing economy, an increase in real price of oil should depreciate the real exchange rate.

Maeso-Fernandez et al. [2001] consider a broader interpretation of government spending as they realize that in longer term higher government spending may be accompanied by various distorting effects pushing down the economic growth and leading to depreciation.

In this paper I consider a basic model for each economy consisting of only the real interest rate differential and the role of productivity. These models are further extended by including the effect of real price of oil, net foreign assets, government spending and government debt.

The estimation procedure rests on using vector error correction models. Short introduction is presented below.

The principle of cointegration lies in the fact that a stationary linear combination of nonstationary series may exist, which is perceived as a long-run equilibrium towards which the dependent vector of series tends to return. A necessary condition for using cointegration technique is that the analyzed series have to be integrated of the same order. It is therefore necessary to test for the unit root in the levels of the series and check whether the same order of differencing stationarizes them.

Several tests to check for unit root behavior have been developed. It is important to note that testing the unit root behavior rests even in the simplest approaches on several choices: it has to be decided whether a constant or linear trend will be included or both and the lag of the regressor must be chosen. Also, the problem of low power of unit root tests is reported in the "exchange rate" literature, for example in Rogoff [1996]. In this paper augmented Dickey Fuller (ADF) test is used. The following regression is run to check for unit root behavior:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \ldots + \beta_p \Delta y_{t-p} + \varepsilon_t \qquad ,(6)$$

where y is the examined series, x represents the exogenous factors (constant, linear trend or nothing).

The null hypothesis of unit root and the alternative one are stated as follows:

$H_0: \alpha = 0$

$H_1: \alpha < 0.$

If the series meet the condition of being integrated of the same order, the cointegration test may be run to check for long-run relationships among the series. In this paper Johansen approach toward cointegration analysis is used.

First VAR model is set up for each problem:

$$\mathbf{y}_t = \mathbf{A}_1 \mathbf{y}_{t-1} + \ldots + \mathbf{A}_p \mathbf{y}_{t-p} + \mathbf{c} + \varepsilon_t \qquad ,(7)$$

where y is the vector of endogenous variables, A is a matrix of coefficients, c is a vector of constants and ε is a vector of innovations.

An important task is how to set the lag order of VAR model. A number of information criteria may be used, however, as noted in Lutkepohl [2007] when the out-of-sample forecasting is not the prime goal of the model, a direct attention should be turned to the behavior of residuals. The lag should be chosen so that residuals do not display serial correlation or remaining heteroskedasticity at an acceptable statistical level of significance and follow normal distribution. This is a common practice when using cointegration in economic papers focused on exchange rates, for example Hwang [2001] or Bjorland [2006] and will be adopted in this paper as well. The lag chosen amounts up to 13 in case of monthly data in these papers.

Two widespread tests are used: Portmonteau autocorrelation test which is based on Ljung-Box Q-statistic and Breusch-Godfrey (LM) test. When the number of lags at which the residuals are tested is relatively small, Breusch-Godfrey test is preferable, see Lutkepohl [2007].

After a VAR model is set up, the vector of endogenous variables may be checked for presence of cointegration. Two statistic criteria were used to test the presence and number of cointegrating vectors:

$$LR_{trace} = -T \sum_{i=r+1}^{k} \log(1-\lambda_i),$$
$$LR_{\lambda \max} = -T \log(1-\lambda_{r+1}),$$

where T is the number of observations, λ_i is the i-th largest eigenvalue of matrix Π (further below) and k is the number of endogenous variables.

The first statistic tests the null of r cointegrating vectors against an alternative of the number of cointegrating vectors being equal the number of endogenous variables. The second statistic tests the null of r cointegrating vectors against an alternative of $r + 1$ cointegrating vectors.

With the known number of cointegrating vectors, a vector error correction model is set up:

$$\Delta \mathbf{y}_t = \sum_{i=1}^{p-1} \mathbf{\Gamma}_i \Delta \mathbf{y}_{t-i} + \mathbf{\Pi}_i \mathbf{y}_{t-1} + \mathbf{c} + \varepsilon_t \quad ,(8)$$

where

$$\mathbf{\Gamma}_i = -\sum_{j=i+1}^{p} \mathbf{A}_j,$$
$$\mathbf{\Pi}_i = \sum_{i=1}^{p} \mathbf{A}_i - \mathbf{I}.$$

The Π matrix may be divided into two matrices: α and β so that $\Pi = \alpha * \beta'$. Each column of matrix β represents one cointegration vector while the coefficients of matrix α represent the adjustment coefficients (how fast the system moves toward equilibrium with respect to the particular variables).

3. Data

Data were drawn from Eurostat database. The variables mentioned above are defined as follows.

The real exchange rate is based on nominal exchange rate expressed as number of units of domestic currency per one unit of foreign currency (euro). The nominal exchange rate is then multiplied by a ratio of foreign (eurozone) and domestic price level.

The real interest rate differential (DIFF) was constructed by deducting the inflation differential based on average inflation rates from nominal interest rate differentials between the domestic country and eurozone based on bond yields which are used as convergence criterion.

Due to uneven access to the structure of value added data among the countries, the Balassa-Samuelson effect (PROD) was expressed as the ratio of the price level measured by CPI to the price level measured by PPI and this ratio was further related to the corresponding ratio for eurozone. This approach was applied in most of the mentioned papers mentioned above.

The real price of oil (OIL) was obtained by converting the price of Brent oil measured in euro into the domestic currency and deflating it by PPI.

Data on current account deficits and nominal GDP were retrieved from the database. Net foreign assets are computed cumulating current account deficits. The share of net foreign assets in nominal GDP was computed and the ratio of the share of the domestic country to the share of eurozone was calculated. This serves as a measure of net foreign assets (NFA). For the upcoming part of the paper it should be noted that net foreign assets are negative throughout the sample for all the three countries and even the benchmark. This means that increase in the ratio represents a relatively higher foreign indebtness of the examined countries.

The same approach was taken in the case of the variable of government spending (GOV). The share of government spending in nominal GDP was computed and a ratio of the share for a domestic country to the one of eurozone was expressed.

The shares of total debt in GDP (DEBT) were directly retrieved from the database. Ratios of domestic and eurozone shares were computed.

Even though some of the series have a longer history, the beginning of 2000 was set as a starting point for the estimation. Quarterly data were used.

For the use of VAR and VEC modelling, it is important to check the unit root behavior of the series. Except the real interest rate differentials, the series are in logs. The analysis of the unit root behavior is presented in the Appendix.

4. Estimates of REER

Only the final model for each economy will be presented below. As far as the real interest rate differential is concerned, it was not directly included in the cointegration equation. The approach toward this differs among the applications. Table 1 presents the estimated cointegrating vectors.

Table 1:

Cointegrating vectors

Czech Republic					
		lag	Trace Statistic		M-E Statistic
Cointegration equation		3	97.35522***		55.00079***
	$RER_{CZK/E\,UR}$	$PROD_{CZK/EUR}$	$NFA_{CZK/EUR}$	oil	$GOV_{CZK/EUR}$
coefficient (standard error)	1	–1.129329 (0.15153)	–0.064845 (0.00516)	0.315426 (0.03465)	1.309851 (0.17875)
Hungary					
		lag	Trace Statistic		M-E Statistic
Cointegration equation		3	57.59071***		36.80089***
	$RER_{HUF/EUR}$	$PROD_{HUF/EUR}$	$NFA_{HUF/EUR}$		$DEBT_{HUF/EUR}$
coefficient (standard error)	1	–1.797009 (0.09083)	–0.014733 (0.00444)		0.368324 (0.06592)
Poland					
		lag	Trace Statistic		M-E Statistic
Cointegration equation		4	84.50487***		44.29335***
	$RER_{PLN/EUR}$	PRODPPL/EUR	$NFA_{PPL/EUR}$		$DEBT_{PPL/EUR}$
coefficient (standard error)	1	–1.285748 (0.55000)	–0.278059 (0.03235)		2.59789 (0.37896)

*, **, *** denotes the rejection of the respective null on 10%, 5% and 1% level of significance, respectively.

The estimate for the Czech Republic includes four variables: productivity, net foreign assets, real price of oil and government spending. The estimated coefficients have the expected signs (rise in relative NFA appreciates real exchange rate) and are statistically significant. Two lags (VAR of three lags) were chosen to achieve a reasonable behavior of the residuals.

In the case of Hungary productivity, net foreign assets, and debt were used. The estimated coefficients have the expected signs and are statistically significant. As well as in the previous case, two lags were chosen (VAR of three legs).

The estimated cointegrating vector for Poland includes: productivity, net foreign assets and debt. The estimated coefficients have the expected signs and are statistically significant. Three lags were chosen (VAR of four lags).

Next I present the estimated vector correction models for the three cases. Here the real interest rate differential enters as an exogenous variable. I do not give the exact estimate for each economy, but the estimated coefficients have all expected (positive) signs and are statistically significant. The estimates and basic characteristic of the models are presented in table 2.

Table 2:

Estimated vector error correction models

Czech Republic		Poland	
Error Correction Term		Error Correction Term	
coefficient (standard error) [t-statistic]	–0.312302** (0.12525) [–2.49349]	coefficient (standard error) [t-statistic]	–0.715232*** (0.13041) [–5.484487]
Adj. R	0.630012	Adj. R	0.682272
F-statistic	3.405574	F-statistic	8.37482
AIC	–4.623542	AIC	–4.090841
Hungary			
Error Correction Term			
coefficient (standard error) [t-statistic]	–0.729811** (0.34709) [–2.10266]		
Adj. R	0.656588		
F-statistic	4.779895		
AIC	–4.142855		

The model for the Czech Republic explains app. 63% of the variability of the real exchange rate. The adjustment coefficient reaches app. 0.3 and is negative which is in line with the condition of stability of the model. The half-life of shock to the equilibrium is app. 2.2 quarters.

In the case of Hungary the model explains app 66% of the variability of the real exchange rate. The adjustment coefficient reaches app. –0.7. In this case this means that the half-life of a shock to the equilibrium is about 0.9 quarter.

The model for Poland explains app. 68% of the variability of the real exchange rate. The estimated adjustment coefficient is negative: app. –0.7. The half-life of a shock to the equilibrium is very similar as in the case of Hungary: about 1 quarter.

All in all the adjustment coefficients are all negative and in the cases of Hungary and Poland they imply quite a clear tendency of the real exchange rate to return to the equilibrium. The results are quite in line with the estimates given in, for example, MacDonald [1999], Clark [2000] or Maeso-Fernandez et al. [2001]. The explanatory power of the models is quite satisfactory as compared with those studies.

The estimates of the real equilibrium exchange (REER) rates together with the real exchange rate (RER) are captured in figures 4–6. The estimates run from the first quarter of 2001 up to the third quarter of 2009.

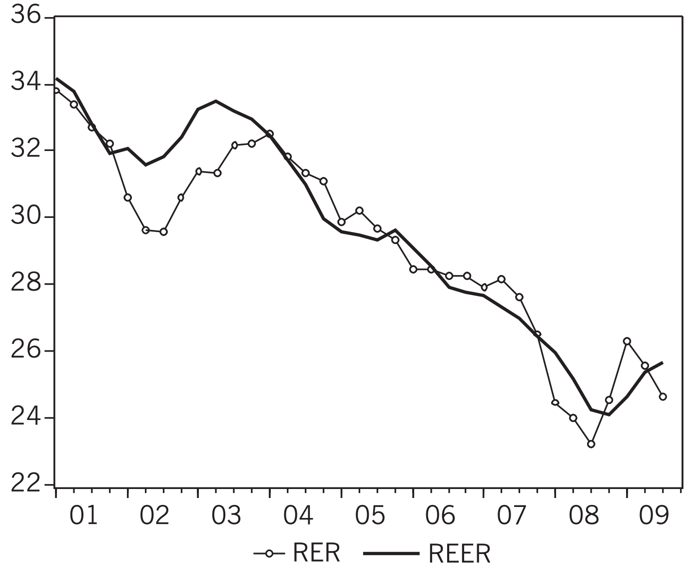

Figure 4:
Estimate of REER for the Czech Republic

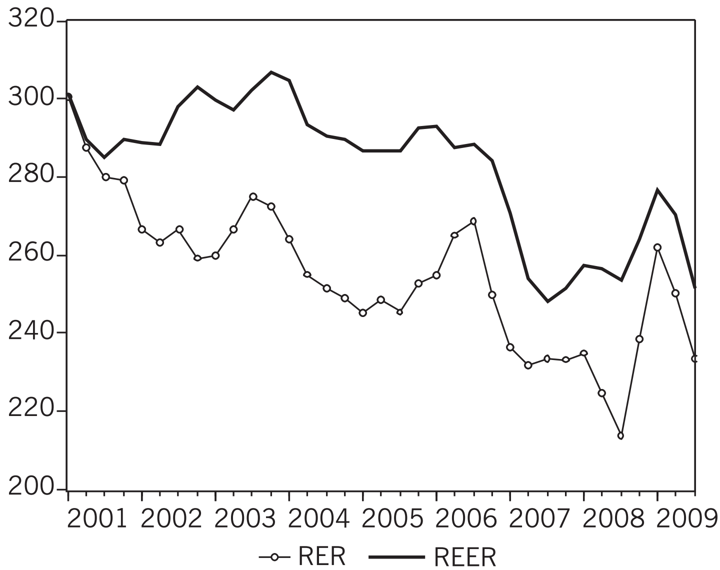

Figure 5:
Estimate of REER for Hungary

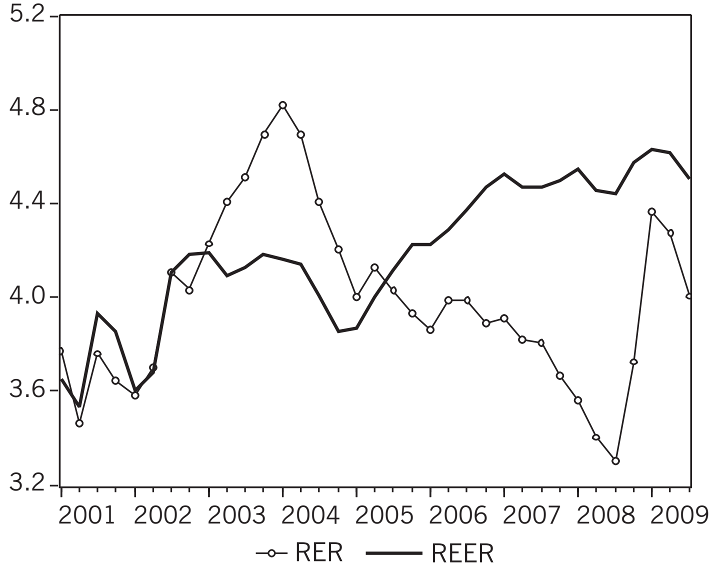

Figure 6:
Estimate of REER for Poland

From the estimate for the Czech Republic it is obvious that the real exchange rate began to departure from the equilibrium in 2007. The real exchange rate was overappreciated over the period of rapid growth of the whole region. The REER appreciated over the period. The main driver of REER appreciation was the productivity factor (Balassa-Samuleson effect), the effect of negative real interest rate differential, and also rising net foreign assets ratio. It is evident that the sharp depreciation of the Czech Koruna toward the end of the horizon led to overshooting the equilibrium and this was corrected by the subsequent nominal appreciation. One can also see the REER depreciated in the end of the sample. This is caused especially by the evolution of the three factors just mentioned.

The estimate for Hungary paints a strikingly different picture. First, most of the sample the real exchange rate seems to be overappreciated. The real equilibrium exchange trade does seem to follow any trend. There was a transitory sharp appreciation of REER in 2006 and a sharp depreciation in 2008. This was caused mainly by lower negative and finally positive real interest rate differential in 2008, significantly lowering relative NFA and increasing debt toward the end of the year. The financial crises seem to reconcile the behavior of real exchange rate and real equilibrium exchange rate, especially by the sharp depreciation of real exchange rate in 2008. However, still a significant discrepancy between the two remains.

Based on the estimate of REER for Poland there were two periods of significant misalignment in the sample. The second one was accompanied by a rather mild REER depreciation, especially in 2005 and 2006. According to the estimated model this was caused by decreasing relative net foreign assets in 2006, increase in relative debt and also increase in real interest rate differential in 2006. As in the previous cases the financial crises led to strong depreciation of real exchange rate, which brought the real exchange rate toward the fundamentals. This is similar to the case of Hungary. There seems to be a temporary depreciation of REER between 2008 and 2009 caused especially by decrease in relative productivity and relative net foreign assets and temporary increase in relative debt.

5. Conclusions

The analysis of the behavior of the real exchange rates and the estimates of the real equilibrium exchange rates using the BEER methodology bring out some similarities between the development of the Czech Republic, Poland and Hungary, but also point to severe differences, especially between the Czech Republic and Poland on one hand and Hungary on the other hand.

While there was an average quarterly appreciation in the Czech Republic and Hungary in Poland the average quarterly change in real exchange rate over the sample is close to zero. However, comparing the Czech Republic, Hungary and Poland, the driving factors are different. In the Czech Republic and Poland the real exchange rates are driven mainly by the behavior of nominal exchange rates. In the Czech Republic the contributions of changes in price levels are much lower in absolute terms than the contribution of nominal exchange rate while in Poland the relatively high contributions of price levels cancel themselves out. In Hungary the main factor behind the changes of the real exchange rate is the domestic price level.

The estimate of the real equilibrium exchange rates show that in all the three economies the real exchange rate was overappreciated toward the end of the sharp growth in economic performance of the whole region. The largest misalignment was detected in Poland (about 24%).

In all three cases the real exchange rates finally found its way toward the equilibrium which was achieved through sharp nominal (and real) depreciation toward the end of the horizon. While in Hungary and Poland nominal depreciations still left the real exchange rates overvalued as compared with the estimates of REER, in the case of the Czech Republic there was a mild overshooting of the equilibrium. The real exchange rate and REER seem to be very close in the case of the Czech Republic while especially in the case of Poland they might diverge after all.

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Appendix

Table 3:

Unit root tests: left column: in levels, right column: in first differences

Variable	t-statistic	Variable	t-statistic
real exchange rates		real exchange rates	
$RER_{CZK/EUR}$	–0.702169	$RER_{CZK/EUR}$	–3.886369***
$RER_{HUF/EUR}$	–1.568013	$RER_{HUF/EUR}$	–7.760401***
$RER_{PPL/EUR}$	–2.288725	$RER_{PPL/EUR}$	–5.741582***
interest rate differential		interest rate differential	
$DIFF_{CZK/EUR}$	–2.945842*	$DIFF_{CZK/EUR}$	–3.093697**
$DIFF_{HUF/EUR}$	–2.194477	$DIFF_{HUF/EUR}$	–3.527996**
$DIFF_{PPL/EUR}$	–2.411779	$DIFF_{PPL/EUR}$	–5.156451***
productivity differential		productivity differential	
$PROD_{CZK/EUR}$	–0.522134	$PROD_{CZK/EUR}$	–4.490471***
$PROD_{HUF/EUR}$	–1.344289	$PROD_{HUF/EUR}$	–7.741188***

Variable	t-statistic	Variable	t-statistic
$PROD_{PPL/EUR}$	–2.161751	$PROD_{PPL/EUR}$	–5.631687***
oil		oil	
OIL_{CZ}	–1.696055	OIL_{CZ}	–5.316223***
OIL_{HU}	0.979034	OIL_{HU}	–5.216728***
OIL_{PL}	–1.039083	OIL_{PL}	–5.393408***
net foreign assets		net foreign assets	
$NFA_{CZK/EUR}$	–1.877325	$NFA_{CZK/EUR}$	–2.946833**
$NFA_{HUF/EUR}$	–0.329430	$NFA_{HUF/EUR}$	–2.358298**
$NFA_{PPL/EUR}$	–1.549957	$NFA_{PPL/EUR}$	–4.133014**
government debt		government debt	
$DEBT_{CZK/EUR}$	–1.886058*	$DEBT_{CZK/EUR}$	–5.734680***
$DEBT_{HUF/EUR}$	–0.643549	$DEBT_{HUF/EUR}$	–5.667077***
$DEBT_{PPL/EUR}$	–1.679547	$DEBT_{PPL/EUR}$	–5.854159***
government spending		government spending	
$GOV_{CZK/EUR}$	–0.538912	$GOV_{CZK/EUR}$	–8.112253***
$GOV_{HUF/EUR}$	–1.681005*	$GOV_{HUF/EUR}$	–8.418632***
$GOV_{PPL/EUR}$	–0.230417	$GOV_{PPL/EUR}$	–7.939372***

*, **, *** denotes the rejection of the respective null on 10%, 5% and 1% level of significance, respectively.

Abstract

The Misalignment of the Real Exchange Rate with the Fundamentals: Evidence from the Czech Republic, Hungary and Poland

The paper examines the behavior of the real exchange rates in the Czech Republic, Hungary and Poland, analyzing its driving forces with the emphasis on the turbulences which have been lately seen in the economies. Real equilibrium exchange rates are estimated using the BEER methodology to serve as a benchmark to which the real exchange rates are compared. The gap between the estimated real equilibrium exchange rates and real exchange rates as well as the key determinants of the real equilibrium exchange rates are analyzed and compared in the three cases. While the Czech Republic and Poland have been relatively mildly hit by the current crisis which has been accompanied by a relatively acceptable misalignment of the real exchange rate with the fundamentals, clear long-run divergence of Hungarian real exchange rate from the market fundamentals has been detected in the analysis.