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Four currencies outside the eurozone

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Abstract

Purpose -*In the European Union only a few countries have remained outside the eurozone. Among these countries with independent monetary policies few pursue a floating exchange rate regime: the Czech Republic, Hungary, Poland and Romania (IMF, 2013). The purpose of the paper is to examine whether there is a cointegrating relationship between the same underlying economic fundamentals and the real and nominal exchange rate of these countries against the euro.*

Design/methodology/approach *– The quarterly data used for analysis for the period between 2000 and 2014 were provided by the Eurostat and European economy databases. After testing for unit root in the logarithmised data series Engel-Granger and Johansen tests are applied to discover the existence of long-run equilibrium relationships between the exchange rates and fundamentals explaining balance of payments equilibrium.*

Findings *–Based on a uniform behavioural exchange rate model cointegration can only be revealed in the case of the Polish nominal exchange rate data, though simple OLS estimations indicate a strong relationship between fundamentals and exchange rates in the case of all the four countries.*

Research limitations/implications *– The paper points out that it is difficult to prove the existence of any such relationship: making forecasts of the paths of equilibrium exchange rates is hampered by the lack of an adequate model, the short time series and the strong volatility of these currencies, especially the Hungarian forint and the Romanian leu. Another reason for the low explanatory value of various models can be frequent central bank intervention.*

Originality/value *– As Dick et al. (2015) reveals good exchange rate estimates rely on the forecasters ability to understand the relation between fundamentals and the exchange rates mostly in times when exchange rate more strongly deviate from their PPP value. Therefore, applying more approaches for exchange rate analysis helps us better observe this relationship.*

Keywords: exchange estimates, public debt, cointegration

JEL Classification: F31

1. Introduction

After all the Baltic countries have joined the eurozone and Slovenia and Slovakia chose the currency zone within five years of European Union membership currently six Eastern members of the EU are still outside the eurozone. The Czech Republic, Hungary, Poland and Romania today maintain a floating exchange rate and pursue inflation targeting as monetary policy, whereas Croatia has targeted the exchange rate within the framework of a less flexible exchange rate

system in the last fifteen years and Bulgaria conducts its monetary and exchange rate policy under a currency board regime. As floating rates are naturally more set out to market forces, for an examination of how domestic currencies move against the euro countries with flexible exchange rates are the most adequate sample. In the current analysis the exchange rates of the Czech Republic, Hungary, Poland and Romania are estimated with the help of macroeconomic fundamentals in the period between 2000 and 2014.

The Czech Republic shifted to floating exchange regime as early as in May 1997 and since then the monetary authority has not announced explicit exchange rate bands. The managed float system adopted by the Czech Republic restricts the use of interventions in case of extreme fluctuations. The Czech National Bank has from time to time been intervening in the foreign currency markets lately to prevent a notable appreciation of the koruna. The aim is to maintain the exchange rate of the koruna against the euro close to CZK 27/EUR in accordance with the Bank Board's decision. Since the end of 2013 the Czech National Bank therefore uses the exchange rate as monetary policy instrument and intervenes to keep its "one-sided commitment" (only appreciation is avoided) to the exchange rate. Hungary introduced a fixed exchange rate system with a ±15% band in 2001 and irrevocably switched over to a floating system at the beginning of 2008. From time to time the Central Bank of Hungary also intervenes but it does not follow any declared explicit or implicit target exchange rate, though the exchange rate is an important indicator for achieving the inflation target. Poland introduced a floating regime in spring 2000 after a five-year period of crawling band system. It is important to note that Poland is the least – though increasingly – open economy among the four countries under examination and thus it is the least vulnerable to currency fluctuations as regards trade balance. Romania was gradually converging to managed float by applying different intermediate systems until 2004. Romania also manages external shocks by currency intervention if economic conditions make it necessary. Taking account of the introduction of flexible exchange rates at the beginning of the years 2000 the fifteen-year period promises to be adequate for examining the influence of market forces on the price of the currencies of the four selected countries. All of them have to face the fixing of their currencies against the euro within ERM II sooner or later which necessitates the setting of the right exchange rate for the later introduction of the euro.

In the following we use the model and methodology suggested by MacDonald (2000) and Chen and MacDonald (2010) – drawing on the results of the Central European research papers as well – with a slight modification. Instead of using the net foreign asset variable, we apply the debt-to-GDP ratio as one of the variables influencing investors' motive to purchase assets in an emerging economy. Public debt has become a very important benchmark variable of countries since the financial crisis which underpins the selection of this variable. The sharply increasing public debt in Central Europe was often financed from foreign currency credit and accompanied by the accumulation of foreign currency reserves which is another reason for including this variable. In addition, Vámos (2014) used an equation including public-debt-to-GDP to regress the Hungarian forint and Polish zloty nominal exchange rate and Vámos (2013) also applied a model relying on productivity dynamics, interest differentials and public debt for a panel regression encompassing 15 Central and South Eastern European countries.Égert et al. (2005) found that net foreign assets accumulation can have a dubious effect on exchange rates depending on whether it means foreign direct investment or a higher foreign debt service for the emerging economies, whereas public consumption usually goes together with currency appreciation in the CEECs. The research thus builds upon previous empirical

findings and discusses whether the same model can be applied for countries at different levels of economic development, openness and debt characteristics.

2. Background literature

In an equation based on balance of payments equilibrium MacDonald (2000) suggests that the productivity differential (explaining the trade balance), the interest rate differential (determining capital flows) of the two countries whose currency is compared and the net foreign assets are a good starting point of any equilibrium exchange rate estimations. To explain the deviation of the exchange rate from its long-run path (marked by the purchasing power parity or in case of comparing a less developed and a more developed country by the Balassa-Samuelson effect or simply by different productivity dynamics) a lot of models have been developed in the last some twenty years. The group of those which do not have a normative equilibrium framework but use macroeconomic variables which might well explain the exchange rate are called behavioural equilibrium exchange rate theories.

To gauge the impact of the Balassa-Samuelson effect and the misalignment of the currency from its equilibrium path a lot of research was conducted in the Central and Eastern European countries with the help of the behavioural equilibrium exchange rate approach and other estimation methods. Borowski et al. (2003) used fundamental and behavioural equilibrium exchange calculations to define the equilibrium level of the Polish zloty and forecast the expected real appreciation of the Polish currency until the introduction of the euro. Bęza-Bojanowska (2009) carried out behavioural equilibrium exchange rate and permanent exchange rate analysis in which terms of trade, Balassa-Samuelson-effect, foreign reserves, risk premium and the long-term differential of interest rates and budgetary deficit turned out to have significant explanatory power. Égert et al. (2005) question the Balassa-Samuelson effect but conclude that dual (tradable and non-tradable) productivity differential – similarly to terms of trade and public consumption with less explanatory power – cause currency appreciation in the CEECs. They found that some variables such as openness and net foreign assets can have contradictory effects on exchange rates. Dumitrescu and Dedu (2009) made a behavioural equilibrium exchange estimate by approximating the real effective exchange rate of the Romanian currency with productivity differential in terms of the non-tradable and tradable sector, total consumption, net foreign assets and degree of openness. The modell building was based on both internal and external macroeconomic equilibrium. Komárek and Moti (2012) estimate the Czech Koruna exchange rate (both nominal and real) with the help of productivity differential, real investment to GDP, net foreign assets and net export and find that the strong appreciation of the Czech Koruna against the euro came to a hault in 2009 as a consequence of slowing productivity dynamics in the Czech Republic.

3. The variables of the model

We use the quarterly time series of the nominal and CPI based real domestic/EUR exchange rate of the four countries covered in this paper and investigate their relationship with the productivity (y/emp) and interest rate differential (i-i*) against the eurozone, public debt-to-GDP (debt) and terms of trade (tot). Productivity was captured by GDP per employed person, the interest rate differentials were calculated from three-month interest rates in the selected countries and the eurozone. The data used for estimations is quarterly and collected from the Eurostat and Ameco databases except the terms of trade indices which are annual OECD data. The variables are indexed to 2005 (as 100%) and logarithmised before testing their statistical characteristics.

The basic equation we consider to be adequate for approximating the nominal and real exchange rates of the Czech koruna,

Hungarian forint, Polish zloty and Romanian leu is represented by equation (1):

$$s_t = \alpha_0 + \alpha_1(s_{t-1}) + \beta_1(y/emp_t) - \beta_2(y/emp_t^*) + \gamma_1(i_t - i_t^*) + \gamma_2(debt) + \gamma_3(tot_t) + u_t \quad (1)$$

As we use the euro exchange rate as units of the domestic currency (depreciation means higher values) and the real exchange rate in contrast showing an increase when appreciating, the expected coefficients of the variables will be opposite for the estimation of the nominal and real variables. (Therefore we depicted the change in nominal exchange rates in reverse order in the diagrams.)

First we start by comparing the path of the real and nominal exchange rates and then depicting the variables one by one with both.

Figure 1. Nominal (rhs) and real exchange rate (2000-2014) in Hungary

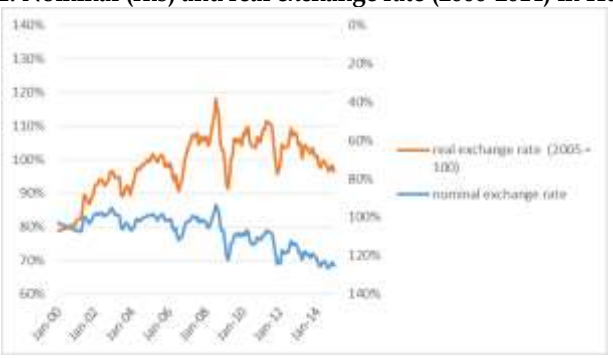


Figure 2. Productivity differential and real exchange rate in Hungary

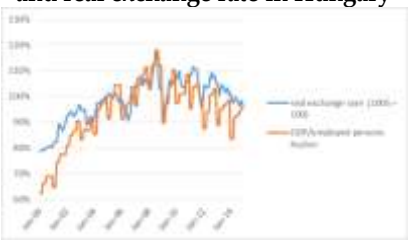
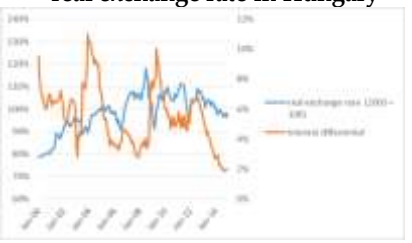


Figure 3. Interest rate differential and real exchange rate in Hungary



Source: Eurostat, European economy, own figure

Figure 4. Nominal (rhs) and real exchange rate (2000-2014) in the Czech Republic

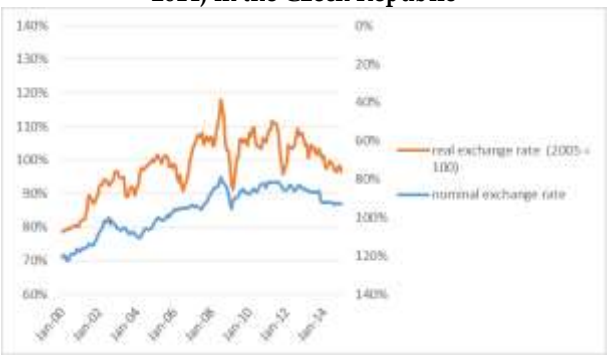


Figure 5. Productivity differential and real exchange rate in the Czech Republic

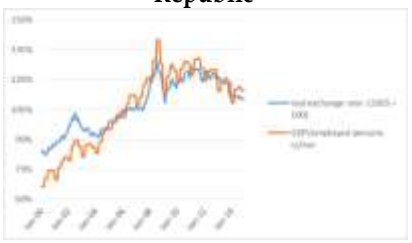
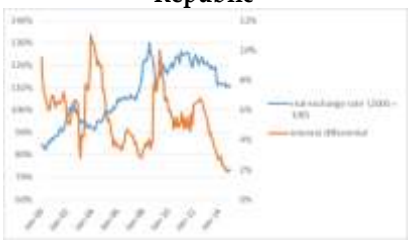


Figure 6. Interest rate differential and real exchange rate in the Czech Republic



Source: Eurostat, European economy, own figure

Figure 7. Nominal (rhs) and real exchange rate (2000-2014) in Poland

Figure 8. Productivity differential and real exchange rate in Poland

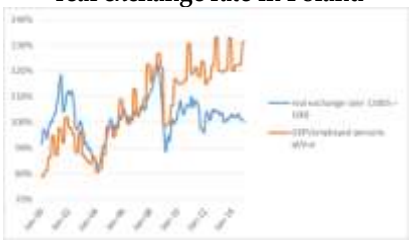
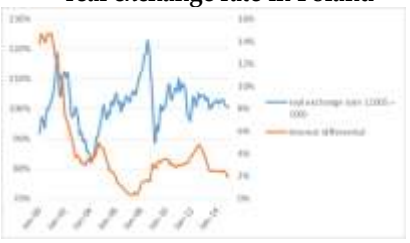
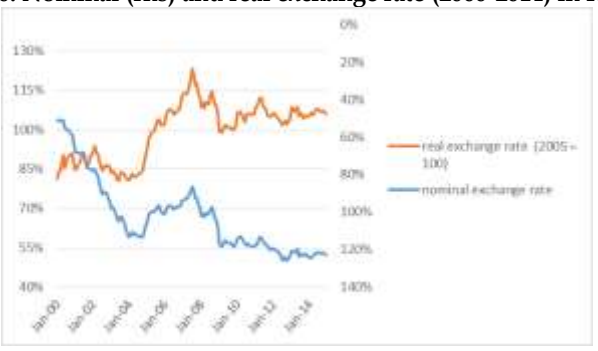


Figure 9. Interest rate differential and real exchange rate in Poland



Source: Eurostat, European economy, own figure

Figure 10. Nominal (rhs) and real exchange rate (2000-2014) in Romania



Source: Eurostat, European economy, own figure

Figure 11. Productivity differential and real exchange rate in Romania

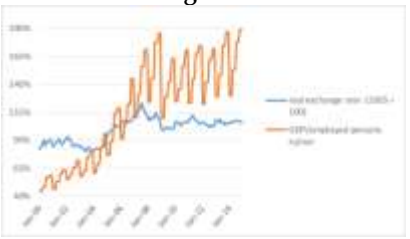
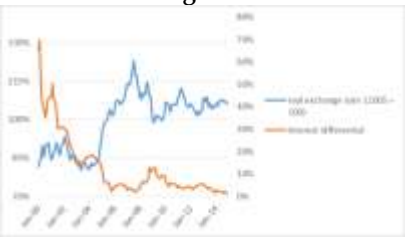


Figure 12. Interest rate differential and real exchange rate in Romania



In the case of three countries out of the four nominal and real exchange rates follow very similar paths. In Romania, however, the two variables start with a very different trend probably due to the more rigid exchange regime in Romania at the beginning of the 2000s as Romania was gradually moving from a fixed exchange rate through intermediate regimes and finally to managed float.

Whereas productivity and real exchange rate move strongly together in all of the countries in the majority of the examined period under analysis, there is no evident relationship (either positive or negative) between interest rate differentials and real exchange rates (the same holds for the debt-to-GDP ratio). The difference in interest rates between 2000 and 2002 was more significant in all the four countries. The continuously decreasing difference (except Romania) can be well observed in three countries out of the four. Between 2002 and 2004 the interest rate differentials moved together with the real exchange rate and a similar tendency evolved in the period after 2012 as can be seen in all the four diagrams. It can be presumed that behind the strong comovement investors' risk avoiding behaviour played a significant role beside the low interest level. In the interim period the interest rate differential and the real exchange rate show opposite cyclicality which is an expected long term phenomenon.

4. Unit root and cointegration tests

To reveal possible stationarity in the dataset the logarithmised variables were submit to ADF and KPSS unit-root tests. The first one is based on the hypothesis of unit root, the second on the stationarity of data. (See results in Appendix A1 and A2.) Most of the variables seem to follow an I(1) process but some variables are likely to be stationary before differencing them (e.g. the nominal exchange rate in Romania and the interest rate differential in the Czech Republic, Poland and Romania on the basis of the ADF test, real productivity in the eurozone /with trend/, nominal and real exchange rate in Poland in KPSS test statistics).

The data are suitable for cointegration tests but first we checked the relationship between the exchange rates of the various countries and the explanatory variables with the help of simple OLS regression estimations. In the case of all countries the regression estimates revealed a strong influence of almost all explanatory variables on the dependent variable, especially the productivity differential a simplified representation of the Balassa-Samuelson effect. In the case of Hungary, the change of the interest rate differential, in the Czech Republic the one-period lagged value of the same proved to be statistically significant. The debt-to-GDP variable was exceptional in the sense that it had almost nil explanatory power in the Czech Republic, whereas it contributed to the depreciation of the currency in the case of Poland and Romania with high explanatory power. In Hungary the variable was significant but the sign of the variable was unreliable as it seemed to depreciate the nominal and appreciate the real exchange rate. The terms of trade of the domestic economy of most of the countriesproved to be less significant than the equivalent eurozone statistics for both the nominal and real exchange rate estimations. (It is interesting to

note that the interest differentials usually contributed to the depreciation of the currency at time t and to appreciation at t-1).

The presence of cointegration was tested by both Engel and Granger and Johansen tests. Instead of inserting the productivity of the domestic and the foreign sector separately the logarithm of the productivity ratio was inserted in the models to avoid collinearity. The Johansen cointegration test is a vector autoregression based test used amongst others in equilibrium exchange estimations to determine the long-run relationship between the real exchange rate and the fundamentals.

The cointegration tests produced contradictory results. Each variable selected proved to be significant in the case of Poland especially for the nominal exchange rate as dependent variable. The coefficients also show economically justifiable relations: the productivity, the interest rate differential and public debt depreciate the currency in the long run whereas improvement of terms of trade compared to the eurozone appreciates the currency. The Czech data are also close to be significant but the coefficients contradict the economic rationale and the regression results. For Hungary and Romania, the two cointegration tests show paradoxical results for the real exchange rate estimates, the one supports the existence of cointegration, the other refuses the same and the signs of the coefficients seem not to reflect economic relations as expected.

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Table 1: Engel-Granger and Johansen cointegration tests on nominal exchange rates (quarterly time series, number of lags=2)

	Poland		**Czech Republic**	
Engel-Granger	test st.	p value	test st.	p value
constant	-4,39195	0,0001	-2,49483	0,1167
Johansen	test st.	p value	test st.	p value
rank=1	60,329	0,6198	39,172	0,3381
estimated coefficients	normalised beta			
nominal exchange rate	1		1	
productivity diff.	-0,73213		0,47644	
government debt	-0,60614		0,18173	
interest diff.	-0,89437		-6,1612	
terms of trade-domestic	-5,7449		-	
terms of trade_eur	3,1882		0,019325	

Table 2: Engel-Granger and Johansen cointegration tests on real exchange rates (quarterly time series, number of lags=2)

	Hungary		**Romania**	
Engel-Granger	test st.	p value	test st.	p value
constant	-4,79916	0,005903	-3,43088	0,3589
Johansen	test st.	p value	test st.	p value
rank=1	22,033	0,3461	39,172	0,6620
estimated coefficients	normalised beta			
nominal exchange rate	1		1	
productivity diff.	-0,56092		-3,0203	
government debt	-		-0,093186	
interest diff.	-0,53595		-6,1612	
terms of trade_eur	1,1147		0,019325	

The tested model does not seem to be capable of forecasting equilibrium exchange rates in a simple cointegration framework, and a much more refined statistical approach is needed to assess the long-term equilibrium values of the four currencies. In international literature it is an often raised problem that government expenditure and debt-to-GDP ratio as well as interest rate differentials have a dissimilar impact in the short and the long run. (Public debt can increase productivity if it finances fixed capital investment but can crowd out private investment and increase CDS premia at a time). Chen and MacDonald (2010) therefore suggest the application of unobserved component model and separate the permanent and temporary effects of the same variables.This methodology does not neccesitate the existence of a cointegrating relationship for defining permanent equilibrium exchange rates. In addition to the methodological problems it is also to be taken into consideration that Romania and the Czech Republic often use foreign currency intervention which might distort the effect of economic fundamentals on the exchange rate and the reliability of data is sometimes questionable as well (mostly Romanian labour productivity statistics.) In addition to the aforementioned, the global economic crisis brought a one-off sharp devaluation of all the four currencies which might distort test results as well.

5. Conclusion

In case of a cointegrating relationship of strongly related economic fundamentals it is possible to separate permanent and temporary components of exchange fluctuations and detect the presence of currency misalignment. However, Central European currencies undergo great fluctuations which are often counterbalanced by currency market interventions. In the current study encompassing a fifteen-year time interval no cointegrating relationship could be unequivocally established in the case of three out of four Central European currencies with the exception of Poland. Therefore, the adoption of an unobserved component framework and the use of dummies for periods with extreme fluctuations and central bank intervention could help further develop the model comprising productivity dynamics, interest rate differentials, terms of trade and public debt-to-GDP to make it capable of forecasting equilibrium exchange rates.

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Appendix -A1: ADF tests

Hungary

test with constant	level			diff		
	estimated value of (a - 1)	test statistic: tau_c(1)	asymptotic p-value	estimated value of (a - 1)	test statistic: tau_c(1)	asymptotic p-value
nominal exchange rate	-0,105567	-1,55235	0,5004	-1,64834	-6,39862	1,24E-08
GDP/employed persons_hu	-0,142191	-2,68039	0,07742	-2,662	-10,6611	2,43E-21
GDP/employed persons_eur	-0,0395634	-1,4536	0,5573	-2,96378	-12,7637	3,468E-28
public debt/GDP	-0,0273035	-0,87461	0,7896	-1,0283	-7,65896	1,18E-08
interest differential	-0,184684	-2,43835	0,1312	-0,839632	-6,37863	9,01E-07
terms of trade hu	-0,0430725	-1,10574	0,708	-1,00529	-7,52298	1,84E-08
terms of trade eur	-0,0836567	-1,55005	0,5015	-1,00069	-7,4885	2,058E-08
real exchange rate (2005 = 100)	-0,167632	-2,82125	0,06141	-1,24826	-6,71961	1,85E-09
real productivity hu	-0,185608	-2,31292	0,1679	-3,59035	-21,7849	4,34E-50
real productivity eur	-0,105315	-1,34872	0,6089	-2,34435	-8,95792	6,447E-16
GDP/employed persons hu/eur						
real productivity hu/eur						

Czech Republic

test with constant	level			diff		
	estimated value of (a - 1)	test statistic: tau_c(1)	asymptotic p-value	estimated value of (a - 1)	test statistic: tau_c(1)	asymptotic p-value
nominal exchange rate	-0,059447	-1,98417	0,2929	-0,967015	-7,25422	4,46E-08
GDP/employed persons cz	-0,0666037	-2,25522	0,1869	-2,37521	-9,13926	1,76E-16
GDP/employed persons_eur	-0,0395634	-1,4536	0,5573	-2,96378	-12,7637	3,47E-28
public debt/GDP	-0,0467494	-2,57574	0,09804	-0,474435	2,90596	0,04465
interest differential	-0,195154	-2,77273	0,06223	-0,818422	-6,46263	6,72E-07
terms of trade cz	-0,119455	-2,18112	0,2152	-1,00453	-7,51732	1,87E-08
terms of trade eur	-0,0836567	-1,55005	0,5015	-1,00069	-7,4885	2,06E-08
real exchange rate (2005 = 100)	-0,0581685	-1,97736	0,2958	-0,925455	-6,94994	1,25E-07
real productivity cz	-0,103199	-1,81494	0,3736	-3,38676	-17,0422	7,24E-41
real productivity eur	-0,105315	-1,34872	0,6089	-2,34435	-8,95792	6,45E-16
GDP/employed persons cz/eur	-0,0763618	-2,51849	0,111	-1,56448	-9,41243	2,46E-17
real productivity cz/eur	-0,0920689	-1,71237	0,425	-3,4804	-18,823	4,45E-45

Poland

test with constant	level			diff		
	estimated value of (a - 1)	test statistic: tau_c(1)	asymptotic p-value	estimated value of (a - 1)	test statistic: tau_c(1)	asymptotic p-value
nominal exchange rate	-0,227106	-2,68967	0,08184	-0,970341	-7,33478	3,41E-08
GDP/employed persons pl	-0,0725415	-1,44747	0,5604	-2,28987	-9,00576	4,58E-16
GDP/employed persons_eur	-0,0395634	-1,4536	0,5573	-2,96378	-12,7637	3,468E-28
public debt/GDP	-0,0587048	-1,56548	0,4937	-0,932235	-6,97824	1,13E-07
interest differential	-0,0855486	-4,39195	0,0001	-0,319108	-2,65336	0,08238
terms of trade pl	-0,0656937	-1,39638	0,5781	-1,01378	-7,58715	1,49E-08
terms of trade eur	-0,0836567	-1,55005	0,5015	-1,00069	-7,4885	2,058E-08
real exchange rate (2005 = 100)	-0,242882	-2,82136	0,06139	-0,978019	-7,36264	3,11E-08
real productivity pl	-0,158536	-1,60312	0,481	-3,88002	-36,1091	1,12E-33
real productivity eur	-0,105315	-1,34872	0,6089	-2,34435	-8,95792	6,447E-16
GDP/employed persons pl/eur	-0,131745	-2,13293	0,2329	-2,00296	-7,63293	5,77E-12
real productivity pl/eur	-0,130555	-1,26551	0,6478	-3,89631	-34,9042	3,05E-37

Romania

test with constant	level			diff		
	estimated value of (a - 1)	test statistic: tau_c(1)	asymptotic p-value	estimated value of (a - 1)	test statistic: tau_c(1)	asymptotic p-value
nominal exchange rate	-0,0964132	-4,59711	0,0004114	-0,52724	-3,01672	0,03338
GDP/employed persons_ro	-0,0678421	-1,37945	0,5941	-3,51418	-18,9247	2,71E-45
GDP/employed persons_eur	-0,0395634	-1,4536	0,5573	-2,96378	-12,7637	3,468E-28
public debt/GDP	-0,0202016	-0,938446	0,7765	-0,416193	-2,86081	0,05007
interest differential	-0,0841565	-3,58574	0,00607	-0,800946	-5,912	1,95E-07
terms of trade ro						
terms of trade eur	-0,0836567	-1,55005	0,5015	-1,00069	-7,4885	2,058E-08
real exchange rate (2005 = 100)	-0,0602786	-1,53796	0,5076	-1,01712	-7,60862	1,39E-08
real productivity ro	-0,131884	-1,82753	0,3674	-3,79848	-29,6223	5,10E-49
real productivity eur	-0,105315	-1,34872	0,6089	-2,34435	-8,95792	6,447E-16
GDP/employed persons ro/eur	-0,0709837	-1,38973	0,589	-3,46081	-17,6103	2,69E-42
real productivity ro/eur	-0,110467	-1,88334	0,3405	-3,67219	-23,0989	2,09E-51

A2: KPSS tests

Hungary

	level		level_tred		diff		diff_tred	
	test statistic	P-value	test statistic	P-value	test statistic	P-value	test statistic	P-value
nominal exchange rate	1,55798	0,010	0,292052	0,010	0,077761	0,100	0,020775	0,100
GDP/employed persons_hu	1,62773	0,010	0,455834	0,010	0,228279	0,100	0,031906	0,100
GDP/employed persons_eur	2,06137	0,010	0,256884	0,010	0,051292	0,100	0,02476	0,100
public debt/GDP	1,9206	0,010	0,170139	0,037	0,119163	0,100	0,119681	0,100
interest differential	0,47321	0,048	0,081777	0,100	0,050365	0,100	0,041669	0,100
terms of trade hu	1,60673	0,010	0,138533	0,068	0,102031	0,100	0,102041	0,100
terms of trade eur	1,24032	0,010	0,131231	0,081	0,082854	0,100	0,073525	0,100
real exchange rate (2005 = 100)	1,27067	0,010	0,347424	0,010	0,206956	0,100	0,021855	0,100
real productivity hu	1,63147	0,010	0,458042	0,010	0,086807	0,100	0,032375	0,100
real productivity eur	1,68237	0,010	0,116824	0,100	0,022145	0,100	0,021793	0,100
GDP/employed persons hu/eur								
real productivity hu/eur								

Czech Republic

	level		level_tred		diff		diff_tred	
	test statistic	P-value	test statistic	P-value	test statistic	P-value	test statistic	P-value
nominal exchange rate	1,72314	0,010	0,335595	0,010	0,291479	0,100	0,054162	0,100
GDP/employed persons cz	1,92263	0,010	0,452653	0,010	0,353081	0,099	0,027456	0,100
GDP/employed persons_eur	2,06137	0,010	0,256884	0,010	0,051292	0,100	0,02476	0,100
public debt/GDP	1,75209	0,010	0,162208	0,042	0,345216	0,100	0,16566	0,039
interest differential	0,257836	0,010	0,245678	0,010	0,128675	0,100	0,046839	0,100
terms of trade cz	0,498074	0,045	0,228183	0,010	0,222624	0,100	0,132408	0,079
terms of trade eur	1,24032	0,010	0,131231	0,081	0,082854	0,100	0,073525	0,100
real exchange rate (2005 = 100)	1,74545	0,010	0,282707	0,010	0,261269	0,100	0,060415	0,100
real productivity cz	1,84834	0,010	0,439807	0,010	0,113891	0,100	0,027131	0,100
real productivity eur	1,68237	0,010	0,116824	0,100	0,022145	0,100	0,021793	0,100
GDP/employed persons cz/eur	1,76968	0,010	0,454592	0,010	0,459675	0,051	0,037026	0,100
real productivity cz/eur	1,81506	0,010	0,479297	0,010	0,180517	0,100	0,029566	0,100

Poland

	level		level_tred		diff		diff_tred	
	test statistic	P-value	test statistic	P-value	test statistic	P-value	test statistic	P-value
nominal exchange rate	0,19742	0,100	0,103106	0,100	0,036435	0,100	0,035639	0,100
GDP/employed persons pl	1,97976	0,010	0,107796	0,100	0,042098	0,100	0,030351	0,100
GDP/employed persons_eur	2,06137	0,010	0,256884	0,010	0,051292	0,100	0,02476	0,100
public debt/GDP	1,52592	0,010	0,12035	0,100	0,104524	0,100	0,059387	0,100
interest differential	0,931001	0,010	0,388534	0,010	0,535522	0,039	0,139822	0,066
terms of trade pl	1,3244	0,010	0,283153	0,010	0,063117	0,100	0,062641	0,100
terms of trade eur	1,24032	0,010	0,131231	0,081	0,082854	0,100	0,073525	0,100
real exchange rate (2005 = 100)	0,180693	0,100	0,092848	0,100	0,038402	0,100	0,035831	0,100
real productivity pl	1,76882	0,010	0,061949	0,100	0,032549	0,100	0,032201	0,100
real productivity eur	1,68237	0,010	0,116824	0,100	0,022145	0,100	0,021793	0,100
GDP/employed persons pl/eur	1,79915	0,010	0,097367	0,100	0,038966	0,100	0,032835	0,100
real productivity pl/eur	1,77675	0,01	0,093996	0,1	0,035887	0,1	0,033621	0,1

Romania

	level		level_tred		diff		diff_tred	
	test statistic	P-value	test statistic	P-value	test statistic	P-value	test statistic	P-value
nominal exchange rate	1,43403	0,010	0,222569	0,010	0,600409	0,029	0,197133	0,020
GDP/employed persons_ro	1,95251	0,010	0,418164	0,010	0,075855	0,100	0,031325	0,100
GDP/employed persons_eur	2,06137	0,010	0,256884	0,010	0,051292	0,100	0,02476	0,100
public debt/GDP	0,782272	0,010	0,447821	0,010	0,447304	0,057	0,161732	0,042
interest differential	1,44103	0,010	0,407264	0,010	0,584761	0,031	0,120019	0,100
terms of trade ro								
terms of trade eur	1,24032	0,010	0,131231	0,081	0,082854	0,100	0,073525	0,100
real exchange rate (2005 = 100)	1,30326	0,010	0,264342	0,010	0,120649	0,100	0,074887	0,100
real productivity ro	1,83962	0,010	0,339276	0,010	0,04949	0,100	0,034358	0,100
real productivity eur	1,68237	0,010	0,116824	0,100	0,022145	0,100	0,021793	0,100
GDP/employed persons ro/eur	1,9015	0,010	0,418327	0,010	0,07597	0,100	0,033149	0,100
real productivity ro/eur	1,81273	0,01	0,333049	0,01	0,050715	0,1	0,034695	0,1