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Equilibrium Exchange Rates in Central and Eastern Europe on the Eve of the Euro: New Insights from Meta-Analysis

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Equilibrium Exchange Rates in Central and Eastern Europe on the Eve of the Euro:

New Insights from Meta-Analysis[1]

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ABSTRACT

The aim of this paper is to investigate equilibrium exchange rates in the new EU member states of Central and Eastern Europe. Our analysis rests on a meta-regression analysis. On the basis of the available literature, we seek to shed new light on whether or not the estimated real misalignments depend on the underlying theoretical approach (Balassa-Samuelson, Behavioural Equilibrium Exchange Rate, Fundamental Equilibrium Exchange Rate) and on the characteristics of the estimations. In addition to this, we also study the determinants of the econometric estimations. More specifically, we ask the question whether we can gain more insight from the literature regarding what determines the size of the estimated coefficient of the productivity variable and of other variables commonly included in real exchange rate determination equations like net foreign assets, openness, the real interest rate differential and public expenditures.

JEL: C15, E31, F31, O11, P17.
Keywords: equilibrium exchange rate, real exchange rate, transition, EU enlargement, euro area, Balassa-Samuelson effect, productivity, meta-analysis

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I. Introduction

Equilibrium exchange rates have been constantly in the limelight of both academic researchers and policy-makers in industrialised countries for the last decade.[2] This is all the more true for the economies of Central and Eastern Europe, which started their transformation process from plan to market at the late 1980s and early 1990s. At the beginning of the transition process, an intriguing question was the choice of exchange rate regime and whether the exchange rate was fairly valued at a given point in time.[3] Especially, the observed trend appreciation of the real exchange rate in these countries raised the issue of whether this real appreciation reflected adjustment towards equilibrium because of initial undervaluation, or whether it corresponded to an equilibrium appreciation. If neither scenarios can be validated, the currencies became overvalued. Overvaluation should in fact be of great concern in these economies because of their high openness in terms of exports and imports to GDP and because of their export-led economic catching-up process.

The prospect and the eventually accomplished entry of the formal transition economies of Central and Eastern Europe into the European Union has revived interest in equilibrium exchange rate and has given a fillip to economic research aimed at estimating equilibrium exchange rates in light of future entry into the ERM-II and of the adoption of the euro. In this respect, not only overvaluation but also a possible undervaluation may have a negative economic impact. An undervalued currency may ignite inflation through the prices of imported goods coupled with an overheating economy fuelled by booming exports, which in turn would prohibit the fulfilment of the Maastricht criterion on price stability.

A straightforward way to analyse the increasing literature on equilibrium exchange rates in Central and Eastern Europe is to have recourse to conventional literature surveys.[4] However, traditional literature surveys usually contain a great deal of subjectivity as pointed out in Stanley (2001) and Florax et al. (2002). Instead, a meta-analysis of the existing literature may provide a less narrative and more statistical interpretation of the existing body of the literature. According to Weichselbaumer and Winter-Ebmer (2003), "a meta-study (…) allows a quantitative assessment of the literature in a way an econometrican would write a survey". Meta-analysis is indeed an econometric analysis of an ensemble of existing papers.[5] It allows to formulate and subsequently to test hypotheses related for example to the size of a coefficient estimate. The explanatory variables in a meta-regression analysis are structural characteristics and methodological features of the studies considered like the estimation method and features of the dataset.

Meta-analysis has been for long used in medicine. Recently, it has been gaining more popularity in economics. Labour economics, industrial organisation, transportation economics are typical examples for areas where meta-analysis has been used extensively. However, there are only few studies concentrating on macroeconomic issues.[6] The lack appears to be even bigger for exchange rate and transition economics. To our knowledge, our paper is the first meta-regression study in the field of both exchange rate economics and transition economics.[7]

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[2] See e.g. Williamson (1994), MacDonald (1995, 2004), Stein (1995, 2002) and Driver and Wren-Lewis (2004).

[3] For papers investigating the early 1990s, see e.g. Halpern and Wyplosz (1997) and Krajnyák and Zettelmeyer (1998).

[4] For a recent example, see Égert (2003).

[5] For a meta-analysis of meta-analyses, see Stix (2004).

[6] For instance, Knell and Stix (2003) and Stix (2004) analyse the robustness of money demand function estimates. Rose (2004) applies meta-analysis to study the trade creation effect of monetary unions.

[7] Djankov and Murrell (2002) analyse entreprise restructuring in transition economic in a quantitative way. Nonetheless, they do not perform proper meta-regression analysis.

On the basis of the meta-regression approach sketched out above, we set out to torture our dataset to obtain answers to a series of questions highly relevant for both academic research and policy-making. The first set of questions we raise is related to the size and the sign of the estimated real misalignments. In particular, the issues to be answered are these: (1) Are the estimated real misalignment figures dependent on the underlying theoretical background? (2) Can the use of time series, cross-sectional, or in-sample and out-of-sample data systematically influence the estimation results? The second set of questions concerns the parameter estimates of variables most frequently used in real exchange rate determination equation for the CEE economies. In fact, we seek to identify the factors that have a significant influence on the point estimates of the productivity, net foreign assets, openness, real interest differential and public expenditure variables.

The remainder of the paper is structured in the following way. Section 2 presents the major theoretical approaches to the equilibrium exchange rate of transition economies. This is followed by Section 3 aimed at describing our dataset and the meta-analytical approach adopted in the paper. Section 4 investigates the structural determinants of real misalignment estimates. Section 5 analyses the determinants of the size and the sign of the variables usually used in real exchange rate determination equations like productivity, net foreign assets, openness, the real interest differential and public expenditures. Finally, Section 6 provides some concluding remarks.

II. Equilibrium Exchange Rates in Central and Eastern European Economies

II.A. Theoretical Concepts[8]

Trend Appreciation of the Equilibrium Exchange Rate

In the long run, catching-up economies like the transition economies of Central and Eastern Europe are expected to experience an appreciation of their currencies in real terms. The trend appreciation of the equilibrium exchanger rate can be decomposed into three major components. The first factor driving trend appreciation is the well-known Balassa-Samuelson effect. If productivity increases faster in the open sector relative to that in the closed sector, wages in the open sector can rise without changes in prices. Assuming wages to equalise across sectors, this would lead to price increases in the closed sector, which, by the end of the day, causes overall inflation to rise and the real exchange rate to appreciate. Beside the Balassa-Samuelson effect, the trend appreciation can also occur if the real exchange rate of the tradable sector appreciates. This is indeed observed in CEECs and can be associated with increased non-price competitiveness of the economies and an inappropriate handling of changes in quality.[9] Finally, a salient feature of transition economies is that prices of administered and regulated items have risen faster than the rest of the CPI. Part of such increases is due to transition specific factors, which are expected to persist even in the longer run. Hence, positive inflation differential due to regulated price inflation can also lead to a real appreciation of the home currency.[10]

Behavioural and Permanent Equilibrium Exchange Rates

[8] For a more in depth description of the concepts, for how they are connected with each other and for a graphical representation, see Égert (2003).

[9] For more detail, see e.g. Égert and Lommatzsch (2003).

[10] Zavoico (1995), Égert and Lommatzsch, Égert (2004) and MacDonald and Wójcik (2004) investigated the effect of regulated price increases on the real exchange rate.

The concept of the Behavioural Equilibrium Exchange Rate (BEER) was popularised by MacDonald (1997) and Clark and MacDonald (1998). Although it may be traced back on the uncovered interest rate parity, it can be viewed in practice as an extension of the trend appreciation. In addition to the productivity variable, a set of other fundamentals like openness, public expenditures, real interest differentials can be also added to the equation. The computation of the real misalignment necessitates two steps. First, long-term values for the fundamentals have to be calculated. Then, the fitted value of the equation based on the long-term values of the fundamentals is compared with the observed real exchange rate. A variant of BEER is the Permanent Equilibrium Exchange Rate (PEER)[11], which derives the estimated equilibrium exchange rate by decomposing the cointegrating vector connecting real exchange rate and fundamentals into permanent and transitory components. The permanent component is then construed as the estimated equilibrium real exchange rate.

The inclusion of the productivity variable would imply the BEER and PEER approaches to be a long-term approach, as we will see below, the real time horizon will crucially depend on whether the estimations are performed on the basis of times series or panel data.

Fundamental Equilibrium Exchange Rates

The Fundamental Equilibrium Exchange Rate (FEER) is based on the notions of internal and external balances. Internal balance is defined in terms of NAIRU, while the external balance is determined by current account sustainability. The FEER is the real exchange rate that moves the current account balance to its medium-term sustainable level. Such computation are based either on a whole scale macromodel or a partial trade block of a given economy. This approach is a medium term concept. For this reason, it may be that also the equilibrium exchange rate undergoes a trend appreciation in the long run, it depreciates in the medium run because of current account considerations.

The Macroeconomic Balance approach is a variant of FEER, which determines current account sustainability on the basis of the investment-saving balances. Investment and savings are regressed, usually in a panel setting, on their determinants. The long-term current account position is then derived using fitted values of investment and savings.

Smidkova et al. (2002) and Smidkova and Bulir (2004) make a step further by completing current account sustainability with imposing an explicit long-term target for the external debt. This variant of the FEER is coined the Fundamental Real Exchange Rate (FRER).

The Natural Rate of Exchange (NATREX)

The Natural rate of exchange, which came to be known as the NATREX approach, is developed by Stein (1995, 2002). NATREX makes the explicit distinction between the medium-run and the long-run equilibrium real exchange rates. The medium-run equilibrium real exchange rate is given if internal and external balances are achieved simultaneously. In the medium term, the stock of capital and the stock of net foreign debt are taken at their current values. However, in the long-run, the stock of capital and the stock of foreign debt are assumed to have been stabilised at their long-term steady-state level. Actually, NATREX shows us the trajectory of the real exchange rate from medium-term equilibrium towards long-term equilibrium.

II.B. Estimation methods

BEER and PEER estimations rest on a single equation, which connects the real exchange rate on the one hand, and the fundamentals, on the other hand. Such a specification can be

[11] See Clark and MacDonald (2000).

estimated using (a) time series (b) panel data and (c) cross sectional data. If there exists a long-term cointegration relationship between the real exchange rate and the fundamentals, real misalignments derived from time series estimates should show short- and medium-term deviation from the long-term relationship. When using panel data, the estimated deviation of the equilibrium exchange rate from the observed exchange rate may be larger because panel data may be construed as referring to longer time horizons. The use of in-sample panel data implies that the estimated coefficients reflect some kind of average in function of the imposed homogeneity for a group of transition economies. Thus, the computed real misalignment should be viewed as medium- to long-term deviation. Out-of-sample data may include either a group of industrialised countries[12] or a possibly all (market) economies[13] in the world. Using the former dataset implies that the equilibrium exchange rate of transition economies behaves like those in industrialised countries (with which transition economies effort to catch-up in the long term), whereas employing the latter dataset rests on the assumption that all market economies behave similarly in the (very) long run, and so do equilibrium exchange rates. Either way, real misalignments derived from out-of-sample estimates reflect (very) long-run misalignments.

Cross section estimates usually relate the real exchange rate to the dual productivity differential. In such a setting, all variables are expressed in levels rather than indices commonly used in other BEER estimations[14]. Such a bivariate setting is capable of answering the question of how far the real exchange rate is from the real exchange rate that would be given the relative productivity levels.

II.C The Sign of the Variables

Although the sign on the productivity variable is unambiguous from a theoretical viewpoint, the coefficient of the openness variable and especially that of net foreign assets may switch sign as a function of the time horizon considered. According to the conventional view, an increase in openness is associated with trade liberalisation, which, in the medium term, should be reflected in a deterioration of the current account position calling for a depreciation of the real exchange rate. However, in the event an increase in the openness variable signals improved export capacities and productivity gains, the real exchange rate may appreciate.

Regarding net foreign assets, in the long run, an increase should lead to an appreciation of the real exchange rate. Increased net foreign assets imply higher revenues on interest payments, which, through capital inflows, tend to appreciate the real exchange rate. By the same token, a decrease in net foreign assets causes the real exchange rate to depreciate given that capital flows out of the home economy by servicing the increased foreign debt. However, in the medium run, even a decrease in net foreign assets, i.e. an increase in net foreign liabilities could result in a real appreciation of the home currency. According to the stock-flow approach of the real exchange rate, each economy has a desired level of net foreign assets.[15] In the event that the desired level is negative as can be the case of transition economies, net foreign assets has to converge towards the negative level. This implies capital inflows that cause the real exchange rate to appreciate. However, once the desired level is attained, the home economy has to start servicing the foreign debt. Hence, any further increase in net foreign liabilities leads to a depreciation of the real exchange rate.

III. Data Issues

[12] Examples are Maeso-Fernandez et al. (2004) and Égert et al. (2004).
[13] Examples are Hlapern and Wyplosz (1997) and Krajnyák and Zettelmeyer (1998).
[14] An exception is Maeso-Fernandez et al. (2004) who use level data in a panel setting.
[15] Alberola et al. (1999, 2002).

Because we seek to address several questions related to the literature, an appropriate database is to be constructed. Our dataset is built upon the papers cited in Égert (2003) completed with a couple of others, which have become available since then. The advantage of our paper relative to other meta-analyses is that we have the whole sample of papers from the mid-1990s onwards rather than a representative sample of the literature.[16]

The first issue to be investigated is related to the real misalignment. Thus, our data is composed of observations regarding point estimates of real misalignments. If a range of misalignment is given in a study, the mean of the band is taken. The whole sample includes 33 studies, which provide us with a total of 180 observations for real misalignments from 1990 to 2002.[17]

Table 1 indicates that more than half of the observations, i.e. 88 observations are concentrated for 2001 and 2002. It gives us the opportunity to build a sub-sample comprising data only for 2001 and 2002. It is reasonable to think that real misalignments obtained for two consecutive years are more comparable than those for the whole sample.

To capture year-specific and country-specific misalignments, time and country dummies are used. A number of other dummy variables are used so as to reveal structural factors that can affect systematically the estimated real misalignments:[18]

- The first group of variables concerns the theoretical background of the studies. The theoretical backgrounds employed are the Balassa-Samuelson effect, the Behavioural Equilibrium Exchange Rate, the Permanent Equilibrium Exchange Rate and two variants of the Fundamental Equilibrium Exchange Rate (FEER and FRER). Because only one single observation is at hand for the NATREX model and the Macroeconomic Balance approach, we decided to ignore them.
- The second group regards the estimation method used in the studies.
- The third group of variables is composed of dummy variables aimed at capturing the role different proxies for the productivity variable may play when deriving the real misalignment.
- The fourth class of dummy variables is employed to analyse whether differences in the time and cross-sectional dimension of the estimations have an impact. More specifically, are time series, in-sample and out-of-sample estimates and estimates based on cross-sectional data structurally different?
- The fifth set of dummies is concerned with the construction of the real exchange rate. The question to be answered here is whether the use of the real effective exchange rate, the real exchange rate vis-à-vis the euro area (or a proxy of it like Germany or Austria) or the US may alter the results. By the same token, one may ask whether or not the real exchange rates based on the CPI and the PPI and the real exchange rate proxied with real dollar wages are equivalent.
- The next ensemble of dummy variables is used to study publication bias. Are real misalignments issued from published papers systematically higher or lower than those

[16] Florax et al. (2002) point out that a common problem with studies using meta-analysis is to construct a representative sample of the literature. We do not have to tackle this issue.

[17] Note that if a paper provides more than one observation, i.e. observations for several countries, or observation for a given country derived on the basis of different methods, then all these observations are collected. Stanley and Jarrell (1998) take only one observation per study. Weichselbaumer and Winter-Ebmer (2003) argue that this may involve a large degree of discretion and advocate including all observations available in a given study.

[18] For a detailed definition of the variables, see Appendix A.

obtained in unpublished papers? In this regard, four categories are determined: (a) papers published in international peer-reviewed journal, (b) papers published in non-English peer-reviewed journal, (c) papers published as working paper, in a book or conference volume; (d) and unpublished (mimeo) or conference papers.

- Finally, we also control for data frequency (yearly, quarterly or monthly) and for the number of years, observations and countries used for the estimations.

Beside the issue of the size of the real misalignments, we also would like to deal with the point estimates of the variables usually included into real exchange rate determination equations of the following form:

$$Q = f(\overline{X}) \tag{1}$$

where Q is the real exchange rate and $\overline{X}$ is the vector of explanatory variables.

Although the overview of the literature indicates that nearly 20 different variables are used in different studies, it turns out that only for five variables can we collect a sufficient number of observations to conduct meta-analysis.

Central to all econometric estimations is the productivity variable. Our dataset contains 41 studies with 218 point estimates of the productivity variable or of a proxy of it.[19] The usual way to construct the productivity variable is to take the productivity of the open sector relative to that in the closed sector, which is often called the productivity differential and than to compare it to the corresponding foreign productivity differential.[20] The difference between the home and foreign economies is also termed the dual productivity differential. As far as the explanatory variables are concerned, in addition to the relevant ones already mentioned for the real misalignments, three extensions are made. First, dummies are introduced to decompose the benchmark country "euro area and its proxies" into "euro area" properly said, Germany and Austria. Second, a variable is employed that measures the number of explanatory variables included in the estimated equation. Alternatively, we also use 5 dummies that take the value of 1 if the estimated equation contains 1,2,..,5 explanatory variables, respectively. Finally, more attention is devoted to the labour productivity variable. We construct 8 dummies that stand for different classifications of the sectors into open and closed sectors.

For the variables net foreign assets, openness, public expenditures as % of GDP and real interest differentials, our dataset comprises 72, 40, 38 and 24 observations, respectively. In addition to the aforementioned variables, a dummy variable is used for net foreign assets, which distinguishes between estimates based on net foreign assets of the banking sector and on the cumulated balances of net foreign assets. For the real interest rate differential, a dummy captures the maturity (short term versus medium term) and another one that accounts for whether the real interest differential or only the real world interest rate is used.

IV. Determinants of Real Misalignments

IV. A. A Preliminary Look at the Data

[19] The reason why the number of observations is higher for productivity than for real misalignment is that a core of studies report only estimations of the real exchange rate equation but do not derive the real misalignments.

[20] We do not consider the estimates that use separately productivity in the open sector in the home country relative to that in the foreign country and productivity in the closed sector in the home country relative to that in the foreign country.

In accordance with Table 1 in Appendix B, which presents summary statistics for the real misalignments, the maximum and minimum real misalignments are larger in the whole sample than for the sub-sample. Although both samples have more overvaluations than undervaluations, for the whole sample, the mean shows an average undervaluation and the median is equal to zero. Both figures indicate overvaluation for the sub-period from 2001 to 2002. Regarding the country specific composition of the data, the two samples are quasi balanced. The Czech Republic, Hungary, Poland and Estonia represent 15% to 20% of the observations each. Roughly 10% of the observations go to Slovenia and Latvia. Lithuania and Slovakia are the countries with the fewest observations.

As shown in Table 2 of Appendix B, both samples are dominated by BEER-type estimates (around 50%). While estimations based on the bivariate B-S specification have a share of about 30% in the whole sample, PEERs and macromodel-based estimates have a share of 10%. This changes significantly in the sub-sample in which the share of the former drops to 5% whereas the share of the latters increases to approximately 20%.

According to Table 3 of Appendix B, 40% of the observations are related to time series studies in the whole sample, and panel and cross-section estimates make up slightly more than 20% of total observations. By contrast, the sub-sample is more focused on time series (70%). This is also reflected in the distribution across observations based on yearly, quarterly and monthly data. Given the higher presence of panel and cross-section estimates, the share of yearly data is considerably higher in the whole sample when compared to the sub-period.

As far as the estimation methods are concerned, Table 3 clearly indicates that the Engle-Granger and Johansen methods are much more often used than any other time series techniques. Whereas the panel techniques are more or less equally distributed for the whole sample, only panel DOLS is used for the sub-sample.

IV. B. Estimation Results

In this section, we ask six questions for which the data may or may not give an appropriate answer.

1. The underlying theoretical concept

The estimation results reported in Tables 1 and 2 lend support to the hypothesis that the underlying theoretical approach does have an impact on the real misalignment. By comparing the different approaches to the BEER approach[21], it turns out that FEER is significantly different for the whole sample. Regarding the sub-sample, in addition to FEER, also PEER becomes significantly different from BEER. It should be noted that these results are based on the adjusted samples.[22] For the unadjusted data sample, the FRER approach appears to be different.[23] In general, FEER, FRER and PEER yield higher misalignment figures than BEER.

2. Cross-sectional, time series, in-sample and out-of-sample data

As shown in Table 1 and 2, there is some evidence that the answer to this question is yes. For the whole sample, the unadjusted data indicate that real misalignments derived on the basis of

[21] It is always convenient to code the alternative approaches relative to the one with most of the observations. Recall that BEER has a relative share of about 50%.

[22] When investigating the determinants of the real misalignments, two equations are estimated. The first one is based on the full sample, whereas the second one is adjusted for possible outliers by trimming the upper and lower three percentiles. It should also be noted that year-specific and country-specific dummies are always included in the estimated equations.

[23] A reason why FRER becomes insignificant in the adjusted sample is that its higher values fall in the trimmed upper or lower three percentiles.

cross-section and out-of-sample estimations result in higher misalignments than time series estimations. When adjusting for outliers, in-sample estimations appear to yield significantly lower real misalignments than estimations based on time series. The results obtained for the sub-sample 2001 and 2002 should be taken with care, because as we have seen earlier, the share of cross-sectional and panel observations is rather limited there. Yet, we can find some evidence in favour of the fact that in-sample panel estimations provide significantly lower real misalignments than time series estimations.

3. Different proxies for the productivity variable

The fundamental issue here is whether the CPI-to-PPI ratio, the service prices to PPI ratio, GDP per capita or per employment and real wages often taken in the literature as a proxy for the dual productivity differential do a similar job than the dual productivity differential. For the whole sample, the service prices to PPI ratio is found to be significantly different than the dual labour productivity, on the basis of both the adjusted and unadjusted sample. For the sub-sample 2001 and 2002, the CPI-to-PPI ratio appears to be significant for the adjusted sample. In all cases, the relative price ratios tend to lead to higher real misalignments.

4. Publication bias

What the data tells us about publication bias is that the real misalignments are usually lower for studies published in peer-reviewed journals when compared to papers published as working paper, in a book or conference volume. It is also interesting to see that this bias is actually limited to non-English refereed journals. This holds true for the whole sample. Regarding the sub-sample, the evidence is, once again, in favour of publication bias. Mimeo and conference papers tend to produce lower real misalignment figures for the unadjusted sample. Overall, it appears that working papers and other non-refereed published papers report significantly higher misalignment figures than published and mimeo papers.

5. The construction of the real exchange rate

We expect answers for the following questions: (a) Does the use of the euro area result in significantly different misalignments than the effective foreign benchmark or the US economy? (b) Are misalignments different when the PPI-based real exchange rate or real dollar wages are used instead of the CPI-deflated real exchange rate? On the basis of the whole sample, it can be stated that taking the US economy as the foreign benchmark may lead to significantly lower real misalignments, whereas there appears to be no significant difference between the real effective exchange rate and the real exchange rate vis-à-vis the euro area. For the sub-sample, even differences against the US economy vanish. As for the second question, if the real exchange rate based on the PPI is used rather than the CPI-based real exchange rate, real misalignments are found to be significantly lower. This holds true independently whether the whole or sub-sample or the adjusted or unadjusted samples are considered. The use of real dollar wages can be also associated with statistically significantly lower real misalignments.[24]

6. The econometric estimation method

Some pieces of evidence can be found on the basis of the estimation results regarding estimation bias. When looking at the whole sample, the panel random effect OLS and to a lesser extent cross-section OLS estimations seem to provide significantly lower misalignment estimates than the Engle-Granger estimation method.[25] However, these results may make us think that the difference lies in the cross-sectional and the panel dimension of the results and

[24] Note that the sub-sample 2001 to 2002 does not contain observations for real dollar wages.
[25] The Engle-Granger method is used as a common denominator in the rest of the paper to ensure comparability.

not exclusively in alternative econometric estimations. A sign for estimation bias is provided by estimations performed for the sub-sample 2001 and 2002 because this sample is dominated by time series studies. The results show that studies using the maximum likelihood estimator of Johansen obtain significantly higher misalignments than those using the Engle-Granger method.

Table 1. Estimation results for the whole sample

Variable	Full	Adj	Full	Adj	Full	Adj	Full	Adj	Full	Adj
C	10.741***	4.836**	3.201	-9.557	10.141***	6.342***	10.781***	5.717**	4.262	0.539
BS	2.983	1.941								
PEER	1.038	0.692								
FEER	7.891	10.203**			12.361*	10.089**				
FRER	5.327	1.130			4.048	0.420				
COUNTR			0.158	0.145*					0.074*	0.092***
NUMYEAR			0.914*	0.664*						
QUARTER			-2.022	8.076						
MONTH			-0.014	17.009						
CROSS					14.125**	0.962				
INSMPL					-0.025	-9.632**				
OUTSMPL					19.118**	-0.527				
CAPITA							-0.771	-3.707		
CPIPPI							0.477	-1.424		
SERVPPI							42.197***	24.611*		
RWAGE							10.625	10.905		
GDPEMPL							-4.196	-5.025		
JOHANSEN									3.106	2.191
OLS_CR									-10.711	-12.882**
DOLS									3.890	7.158
ARDL									3.404	5.749
FE_OLS									-8.077	-7.737
RE_OLS									-45.393***	-27.378***
GLS									-7.629	-10.400
PDOLS									8.182	-2.945
PMGE									0.859	-4.947
REER	-2.262	-0.600	-1.228	-0.871	-0.292	-1.293	-1.695	-0.856		
RER_USD	-2.030	-0.204	-20.321**	-9.789	-11.019*	-0.433	-0.915	2.184		
RER_PPI	-8.336*	-7.719**	-7.203	-7.694**	-7.017	-8.322**	-7.482	-7.440**		
RER_W	-20.030***	-10.164*	-24.633***	-11.236*	-18.463***	-8.253	0.460	0.175		
PUBLI_NAT	-15.554***	-11.934***	-12.259	-4.586	-19.382***	-11.736***	-11.845**	-6.802*		
PUBLI_INT	-7.270	3.127	-3.720	3.637	-1.738	4.464	-39.265***	-19.710*		
PUBLI_NO	-5.338	-3.576	-4.877	-3.053	-5.965*	-3.877	-4.951	-3.270		
No: Obs	170	139	155	128	170	139	155	121	155	121
R2	0.716	0.622	0.720	0.628	0.728	0.638	0.731	0.535	0.708	0.475
R2 Adj	0.662	0.531	0.660	0.528	0.674	0.545	0.671	0.394	0.648	0.330

Note: *,** and *** indicate that the variable is significant at the 10%, 5% and 1% level, respectively.

Table 2. Estimation results for the sub-sample

	Full	Adj	Full	Adj	Full	Adj	Full	Adj
C	7.783***	4.584***	5.307**	5.404***	5.291**	4.219***	0.251	1.471
BS	2.812	0.026						
PEER	2.213	3.981***	-1.707	-1.305				
FEER	9.794	7.643*	7.428**	0.776				
FRER	7.136**	3.210						
CROSS			1.772	0.472				
PANEL			3.297	-5.925*				
CAPITA					-0.821	3.331		
CPIPPI					3.509	2.471*		
SERVPPI					2.264	-0.147		
GDPEMPL					2.896	-7.420*		
OLS_CR							3.049	-0.912
DOLS							5.230	3.807
ARDL							4.744	3.320
JOHANSEN							4.862*	4.600***
PDOLS							7.646	-1.521
REER	-2.204	-2.041			-3.453	-0.888		
RER_USD	-5.686	-0.155			-2.684	-7.771		
RER_PPI	-8.784**	-4.035*			-12.278***	-5.191**		
PUBLI_NAT	-12.596	-7.020						
PUBLI_INT	1.353	4.952						
PUBLI_NO	-5.373**	-0.185						
No. Obs	88	69	88	69	73	54	73	54
R2	0.511	0.524	0.322	0.405	0.481	0.459	0.320	0.441
R2 adj	0.384	0.353	0.213	0.277	0.344	0.246	0.170	0.260

Note: *,** and *** indicate that the variable is significant at the 10%, 5% and 1% level, respectively.

V. Real Exchange Rate Determination

V. A. A Preliminary Look

As already set out in the section on data description, our dataset has a high number of observations for the productivity variable, whereas the available observations are considerably lower for the other four most commonly used variables. Table 3 reports summary statistics for the five variables. The point estimates for the productivity variable ranges from –0.09 to 3.11. The mean of the point estimates is 0.93 and the median point estimate is 0.87, which are close to 1. The confidence intervals give a band of 0.90 to 0.95 around the mean implying that the productivity coefficient is slightly lower than 1.

As far as the other variables are concerned, the minimum and maximum values of observed point estimates take, without exception, negative and positive values. This suggests that the sign on net foreign assets, openness, real interest differentials and public expenditures as % of GDP is ambiguous. However, looking at the mean, median and the confidence intervals, the sign is negative for net foreign assets and openness whilst for the real interest rate differential and public expenditure it turns out to be positive.

Table 3. Summary statistics for selected variables

	Productivity	Net foreign assets	Openness	Real interest differential	Public expenditure
N. Obs	218	72	40	38	24
Mean	0.93	-0.06	-0.34	0.0433	0.28
Median	0.87	-0.12	-0.37	0.0045	0.22
Maximum	**3.11**	**1.43**	**0.95**	**2.2210**	**3.59**
Minimum	**-0.09**	**-0.91**	**-1.22**	**-0.2300**	**-0.54**
Std. Dev.	0.58	0.40	0.38	0.3669	0.79
Conf. Interval	0.03	0.03	0.04	0.11	0.04
-CI	**0.90**	**-0.10**	**-0.38**	**0.17**	**0.00**
+CI	**0.95**	**-0.03**	**-0.30**	**0.39**	**0.08**

V. B. The Productivity Variable

Like for the real misalignments, it is possible to formulate precise questions as regards point estimates for the five exogenous variables the most often used in real exchange rate determination equations for CEE economies.

1. The number of exogenous variables

It may be argued that the point estimates for the productivity variable is biased upwards if there are no "control" variables included in the estimated equation. Put differently, point estimates for the Balassa-Samuelson framework should be higher than those obtained from specification containing not only productivity but also other explanatory variables. In more general terms, it may also be that specifications including a different number of regressors may yield different point estimates for productivity.

To test this issue, the dummy "BS" is employed. If it is significant, the two-variable specification is biased vis-à-vis the other specifications. However, as reported in column 2 and 3 of Table 4, the BS term is not significant. At the same time, the variable "number of variables" is statistically significant and is negatively signed. Hence, the higher the number of exogenous variables used, the lower the point estimate of the productivity variable. We now move one step forward to investigate whether it is possible to identify the number of exogenous variables that is substantially different from the other specifications. For this purpose, dummy variables capturing specifications with 1 to 5 exogenous variables are employed. According to columns 5 and 6 of Table 4, they all turn out to be insignificant.

2. The role of the proxies of labour productivity and sectoral classification

Let us now analyse whether the following variables produce point estimates for the productivity variable comparable to the dual labour productivity differential: GDP per capita, GDP per employment, the CPI-to-PPI ratio, the service prices to PPI ratio, real wages and total factor productivity in the whole economy. Results reported in columns 7 and 8 of Table 4 strongly support the view that the GDP per capita, GDP per employment and the CPI-to-PPI ratio result in systematically higher coefficient estimates relative to average labour productivity.

Next, average labour productivity is divided into two classes: (a) coefficient estimates based on average labour productivity derived from industrial production data; and (b) coefficient estimates based on average labour productivity calculated on the basis of national account data. The results, once again, confirm that the GDP per capita, GDP per employment and the CPI-to-PPI ratio yield significantly higher coefficient estimates relative to average labour productivity. At the same time, the use of labour productivity computed on the basis of industrial production appears to have no significant impact on the coefficients.

Finally, 7 dummies (SNA_1,…,SNA_8) are employed to study how the classification of sectors into open and closed sectors influence the estimation results. As shown in Table 4, the classification does appear to play a significant role regarding the size of the estimated coefficient.

3. The econometric estimation method

The econometric technique used appears to have an impact on the size of the estimated coefficient of the productivity variable. As can be seen from Table 5, not only the time series-based DOLS and ARDL estimators can be associated with higher point estimates when compared with the Engle-Granger method, this is also the case for the panel DOLS estimator in the case the unadjusted sample is investigated. When the sample is adjusted for outliers by trimming the upper and lower 3 percentiles, the PMGE is found to lead to significantly lower point estimates.

4. Cross-sectional, time series, in-sample and out-of-sample data

Although in the simplest specification (see columns 2 and 3 in Table 4) both the in-sample panel and cross-sectional estimates appear negative and significant, they are not robust for the inclusion of additional variables.

5. The construction of the real exchange rate

In a first step, we investigate to what extent the real effective exchange rate and the real exchange rate vis-à-vis the dollar are different from the real exchange rate vis-à-vis the euro (and its proxies). The estimation results indicate no differences. However, when decomposing the real exchange rate vis-à-vis the euro (and its proxies) into the real exchange rate vis-à-vis the euro, the German mark and the Austrian shilling, it becomes evident that point estimates of the productivity variable obtained on the basis of the real exchange rate against the Austrian currency are systematically lower as compared to estimates based on the euro. Note that this finding is robust for alternative specifications.

In a second step, the real exchange rate based on the PPI and proxied by real dollar wages iscompared to the CPI-deflated real exchange rate. The PPI-based real exchange rate is found to result in lower point estimates of the productivity variable for all alternative specifications. The real dollar wage also turns out to be negatively signed and statistically significant in several cases.

6. Publication bias

Of the three variables aimed at capturing publication bias, the variable representing published papers in international peer-reviewed journal appear mostly significant, especially when the estimated equations include variables for sectoral classification. Also, the variable standing for unpublished studies is found to be statistically significant on a number of occasions. Both variables have a positive sign implying that published and unpublished studies report higher coefficients than studies appeared as working papers or published in a book or conference volume.

Table 4. Overall results for productivity

	Full	Adj	Full	Adj	Full	Adj	Full	Adj	Full	Adj	Full	Adj
C	1.601***	1.211***	1.373***	1.287***	0.867***	1.074***	0.871***	1.027***	0.924***	1.017***	1.505***	1.136***
Bs	-0.186	0.067	-0.469**	-0.139			-0.325	-0.084	-0.245	-0.106	-0.582***	-0.191
Reer	0.006	0.049	0.138	-0.040	0.181	-0.029	0.218	-0.039	0.215	-0.044	-0.096	-0.015
Rer_De			0.247	-0.076	0.288*	-0.053	0.363**	-0.021	0.379**	-0.037	0.096	0.068
Rer_At			-0.701**	-0.559**	-0.577*	-0.534**	-0.552*	-0.603**	-0.653**	-0.578**	0.020	0.093
Rer_Usd	0.019	-0.016	0.120	-0.118	0.200	-0.092	0.060	-0.167	0.064	-0.175	-0.169	-0.121
Rer_W	-0.381	-0.152	-0.685*	-0.350	-0.401	-0.274	-0.743**	-0.492**	-0.751**	-0.486**	-0.858**	-0.708**
Rer_Ppi	-0.384***	-0.192**	-0.402***	-0.203***	-0.406***	-0.199***	-0.343***	-0.211***	-0.348***	-0.209***	-0.325***	-0.197**
Publi_Int	0.080	-0.034	0.413**	0.189	0.297	0.176	0.565***	0.341**	0.615***	0.323**	0.540**	0.454**
Publi_Nat	0.192	0.278	-0.018	0.176	0.031	0.182	-0.039	0.096	-0.056	0.102	0.089	0.161
Publi_No	0.086	0.145	0.156	0.147	0.165	0.137	0.239*	0.179*	0.232*	0.184*	0.407**	0.223
In_Smpl	-0.324**	-0.165	-0.164	-0.128	-0.165	-0.131	-0.251*	-0.119	-0.321**	-0.098	-0.142	-0.194
Out_Smpl	-0.291	-0.204	-0.059	-0.128	-0.197	-0.176	-0.318	-0.145	-0.399	-0.116	-0.203	-0.270
Cross	-0.674**	-0.607***	-0.102	-0.309	-0.266	-0.335	-0.373	-0.434*	-0.453	-0.412	-0.413	-0.721**
Nb_Obs	0.125	-0.289**	0.384**	-0.191	0.330*	-0.193	0.667***	0.022	0.720***	-0.006	0.858***	0.097
Nb_Var	-0.119*	-0.079*	-0.121**	-0.076*			-0.033	-0.024	-0.009	-0.031	-0.126*	-0.060
Nb_Years	0.000	0.000	0.000*	0.000	0.000	0.000	0.000*	0.000*	0.000*	0.000*	0.000	0.000
Var2					0.191	0.052						
Var3					0.088	-0.046						
Var4					0.000	-0.098						
Var5					-0.229	-0.286						
Var6					-0.067	-0.048						
Capita							0.482***	0.320***	0.412***	0.341***	0.307*	0.451***
Gdpempl							0.489***	0.337***	0.437***	0.352***	0.216	0.438***
Cpippi							0.635***	0.463***	0.595***	0.477***	0.329*	0.471***
Servppi							-0.073	-0.038	-0.268	0.022	-0.148	-0.208*
R_Wage							-0.970**	-0.344	-1.154**	-0.276	-1.235***	-0.475
Tfp							-0.020	-0.223	-0.142	-0.191	-0.330	-0.232
Lp_Ip									-0.208	0.065		
Sna_1											-0.479***	-0.115
Sna_2											0.255	0.190
Sna_3											-0.204	-0.091
Sna_5											-0.228	0.056
Sna_6											-1.083*	-0.894*
Sna_7											0.500	0.957**
Sna_8											-0.706*	-0.333
No. Obs	218	171	218	171	218	171	218	171	218	171	218	199
R2	0.245	0.235	0.306	0.269	0.297	0.271	0.439	0.400	0.446	0.401	0.510	0.494
R2 Adj	0.165	0.127	0.224	0.154	0.202	0.139	0.352	0.276	0.357	0.273	0.413	0.382

Note: *,** and *** indicate that the variable is significant at the 10%, 5% and 1% level, respectively.

Table 5. Econometric methods

C	0.680***	0.963***
FMOLS	0.210	-0.233
DOLS	0.453*	0.193
ARDL	0.632**	-0.026
JOHANSEN	0.389	0.011
POLS	0.702***	0.128
FE_OLS	0.055	-0.193
RE_OLS	0.263	-0.024
GLS	-0.029	-0.312
PFMOLS	0.181	-0.102
PDOLS	0.295	-0.072
PMGE	-0.145	-0.360**
MGE	0.182	-0.101
No. Obs	218	171
R2	0.211	0.219
R2 Adj	0.136	0.121

Note: *,** and *** indicate that the variable is significant at the 10%, 5% and 1% level, respectively.

V. C. Further Estimation Results

Net foreign assets

The net foreign assets, as it is in the dataset allows us to raise three questions. The first one addresses the issue of whether or not the use of net foreign assets of the banking sector instead of net foreign assets for the economy as a whole (proxied with cumulated current account balances) does matter for the estimated coefficient. According to estimation results displayed in Table 6, it does matter because the use of net foreign assets of the banking sector leads to a systematic increase in the coefficient estimate.

The second question relates to the use of time series, in-sample and out-of-sample estimations. Employing time series as the common denominator indicates that in-sample estimates yield significantly lower point estimates compared to time series estimates, whereas out-of-sample estimates do not. Let us now ask the question differently: Are in-sample estimates comparable to time series and out-of-sample estimates? As shown in Table 6, time series and out-of-sample estimates provide us with higher coefficient estimates. Turning once again on the question, we may also use out-of-sample estimates as the common denominator. On this occasion, both time series and in-sample estimates yield significantly lower point estimates. To summarise, it appears that in-sample estimates yield the lowest and out-of-sample estimates the highest coefficient estimates with time series estimates being situated somewhere in between.

Finally, there appears to be an estimation bias because some of the estimation methods cause the point estimates to be significantly higher than the Engle-Granger method.

Table 6. Net foreign assets

	Full	Adj	Full	Adj	Full	Adj	Full	Adj	Full	Adj
C	0.281**	0.025	-0.365***	-0.322***	0.117	0.117*	0.538**	0.408**	-0.139	-0.139
Nfa_Bank	0.376***	0.340***	0.376***	0.340***	0.376***	0.340***	0.477**	0.369***		
Timeser			0.646***	0.263***	0.164	-0.176*	0.399	0.046		
Out_Smpl	-0.164	0.092	0.482***	0.439***						
In_Smpl	-0.646***	-0.347***			-0.482***	-0.439***	-0.322	-0.246		
Nb_Var							-0.055	-0.010		
Nb_Years							0.000	0.000		
Nb_Obs							-0.482	-0.486**		
Johansen									0.409**	0.101
Pols									0.442**	0.211
Fe_Ols									0.759**	0.759***
Gls									-0.200	-0.100
Pdols									0.459	0.459*
Mge									-0.098	-0.098
No Obs.	72	66	72	66	72	66	72	66	72	66
R2	0.525	0.576	0.525	0.627	0.525	0.627	0.560	0.687	0.452	0.469
R2 Adj	0.456	0.524	0.456	0.574	0.456	0.574	0.471	0.623	0.340	0.373

Note: *,** and *** indicate that the variable is significant at the 10%, 5% and 1% level, respectively.

Openness

According to figures shown in Table 7, there are very few variables that are significant if the unadjusted sample is used. However, once the sample is trimmed by 3 percentile on both sides, several interesting features of the data are uncovered.

First, in-sample and out-of-sample estimations are found to lead to systematically higher coefficient estimates.

Second, the construction of the real exchange rate does matter. Point estimates based on real effective exchange rate and the real exchange rate against the dollar are significantly lower than those obtained using the real exchange rate vis-à-vis the euro. At the same time, employing the PPI-based real exchange rate results in higher coefficient estimates when compared to the CPI-deflated real exchange rate.

Finally, some evidence can be found regarding estimation bias given that GLS estimates turn out to be associated with higher point estimates than those provided by the Engle-Granger method.

Table 7. Openness

	Full	Adj	Full	Adj	Full	Adj
C	-1.016	-0.724**	-0.462	-0.349	-0.286*	-0.392***
Timeser			-0.554	-0.376**		
In_Smpl	0.554	0.376**				
Out_Smpl	0.563	0.625**	0.009	0.250		
Nb_Years	0.088	0.032	0.088	0.032		
Nb_Var	-0.020	0.007	-0.020	0.007		
Nb_Obs	-0.003	-0.001	-0.003	-0.001		
Reer	-0.034	-0.273***	-0.034	-0.273***		
Rer_Usd	0.043	-0.254*	0.043	-0.254*		
Rer_W	-0.644	0.091	-0.644	0.091		
Rer_Ppi	0.115	0.195***	0.115	0.195***		
Johansen					-0.120	-0.049
Fe_Ols					-0.084	0.022
Gls					0.386	0.492*
Pfmols					-0.249	-0.143
Pdols					0.082	0.188
Pmge					-0.177	-0.071
Mge					-0.544*	-0.258
No. Obs	40	36	40	36	40	36
R2	0.400	0.765	0.400	0.765	0.388	0.503
R2 Adj	0.099	0.643	0.099	0.643	0.148	0.305

Note: *,** and *** indicate that the variable is significant at the 10%, 5% and 1% level, respectively.

Real interest rate differentials

Although the estimation results reported in Table 8 indicate a number of variables that could have an influence regarding the size of the estimated coefficient of the real interest differential, getting rid of the outliers, which reduces the sample from 38 to 34 observations leaves only one variable statistically significant. This is indeed the variable that distinguishes between the real interest differential and the real world interest rate. Unsurprisingly, the estimated coefficient on the real world interest rate is estimated to be significantly lower than the coefficient estimate of the real interest differential. Regarding estimation bias, it can be read from Table 8 that it exists. Both fixed effect OLS and PMGE are found to give significantly lower estimates than the Engle-Granger method.

Table 8. Real interest differential

	Full	Adj	Full	Adj
C	-0.917**	0.006	0.067	-0.004
D_Riw	-0.842***	-0.042**		
Rir_Short	0.754***	-0.020		
Publi_Inter	-0.691***	0.024		
Publi_No	-0.078	0.013		
Reer	1.028***	-0.015		
Rer_Ppi	-0.101	0.005		
Panel	0.021	-0.004		
Nb_Var	0.223**	0.000		
Dols			-0.057	0.014
Ardl			-0.058	0.014
Johansen			0.584**	0.013
Fe_Ols			-0.187	-0.049***
Pdols			-0.063	0.008
Pmge			-0.127	-0.056***
No. Obs	38	34	38	34
R2	0.679	0.828	0.295	0.802
R2 Adj	0.525	0.729	0.034	0.716

Note: *,** and *** indicate that the variable is significant at the 10%, 5% and 1% level, respectively.

Public expenditures

The number of point estimates for public expenditures expressed as % of GDP is fairly limited. Therefore, we do not proceed with trimming the sample as reported earlier and we remove only one single outlier. As shown in Table 9, the coefficient estimates obtained on the basis of panel estimates is significantly higher than those estimated using time series. At the same time, the Engle-Granger estimation technique turns out to deliver significantly lower estimates when compared to the other estimation methods.

Table 9. Public expenditures as % of GDP

	Full	Full	Full
C	0.089	0.277	-0.313***
In_Smpl	0.822***	0.740***	
Out_Smpl	0.908	0.697***	
Nb_Var	-0.175	-0.196*	
Nb_Obs	-0.001*		
Nb_Years	0.019		
Fe_Ols			0.773***
Gls			0.769***
Pfmols			0.527***
Pdols			0.424**
Pmge			0.650***
Mge			0.398**
No. Obs.	23	23	23
R2	0.831	0.781	0.836
R2 Adj	0.768	0.733	0.760

Note: *,** and *** indicate that the variable is significant at the 10%, 5% and 1% level, respectively.

VI. Concluding Remarks

In this study, we undertook meta-regression analysis to address a number of crucial questions related to the estimated real misalignment and the point estimates of determinants of real exchange rate estimates obtained for new EU member states from Central and Eastern Europe. Despite the fact that the literature on equilibrium exchange rates in those countries cannot be viewed as fully mature, our estimation results revealed interesting features of the literature.[26] First of all, as far as real misalignment estimates are concerned, we showed that the underlying theoretical background does matter. BEER and FEER estimates are found to be significantly different. Also, a variant of BEER, namely PEER also appears to differ from standard BEER estimates. Second, there is also evidence in favour of the fact that time series and panel estimates yield systematically different misalignment figures. Third, the econometric estimation method may also play a role and there may be a publication bias because working papers and other not refereed publications tend to report higher misalignment figures than the rest of the literature.

Coming now to the point estimates of determinants of real exchange rate determination models, the first thing to mention is that there is a number of factors that have a significant impact on the size of the coefficient estimate of the productivity variable. The number of variables included in the estimated equation, the use of different proxies for labour productivity, the way sectors are classified into open and closed sectors when constructing the dual productivity variable, the econometric estimation method, the construction of the real exchange rate series and whether or not a study is published all have a major impact on the size of the coefficient estimate. As for net foreign assets, openness, public expenditure and the real interest differential, the meta-regressions indicate that estimation characteristics like the econometric techniques and the time series versus panel dimension of the data play an important role in determining the size of the point estimates.

To summarise, we found important structural differences for real misalignment estimates obtained on the basis of different methods and estimation characteristics and for point estimates of determinants of the real exchange rate. The implication of this finding is twofold. First, if one may wish to assess the equilibrium exchange rate of a given economy, a wide range of estimations should be used. Second, when interpreting the results, the features and the meaning the features causing different estimates should be carefully analysed.

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DEPENDENT VARIABLES

Size_misalignment	= the point estimate of the real misalignment
PRODUCTIVITY	= the point estimate of the productivity variable
NET FOREIGN ASSETS	= the point estimate of the net foreign assets variable
OPENNESS	= the point estimate of the openness variable
RIR	= the point estimate of the real interest (differential) variable
PUBLIC EXPENDITURES	= the point estimate of public expenditures as % of GDP

INDEPENDENT VARIABLES

Publication record

PUBLI	=1 if a study is published in a peer-reviewed journal
PUBLI_INT	=1 if a study is published in an international peer-reviewed journal
PUBLI_NAT	=1 if a study is published in a non-English peer-reviewed journal
PUBLI_WP	=1 if a study appeared as a working paper, is published in a book, conference volume or in a not refereed journal
PUBLI_NO	=1 if a study is a mimeo or conference paper

Theoretical background

BS	=1 if a study uses the Balassa-Samuelson framework
BEER	=1 if a study draws on the Behavourial Equilibrium Exchange Rate approach
MACROMODEL	=1 if a study uses a macromodel
FEER	=1 if a study draws in the Fundamental Equilibrium Exchange Rate approach
FRER	=1 if a study draws on the Fundamental Real Equilibrium Exchange Rate

Data frequency

YEAR	=1 if a study uses annual data
QUARTER	=1 if a study uses quarterly data
MONTH	=1 if a study uses monthly data

Estimation methods

OLS_CR	=1 if a study uses OLS for cross sectional data
EG	=1 if a study uses the Engle-Granger method
FMOLS	=1 if a study uses fully modified OLS
DOLS	=1 if a study uses Dynamic OLS
ARDL	=1 if a study uses Autoregressive Distributed Lags
JOHANSEN	=1 if a study uses the Maximum Likelihood estimator of Johansen
POLS	=1 if a study uses pooled OLS
FE_OLS	=1 if a study uses fixed effect OLS
RE_OLS	=1 if a study uses random effect OLS
GLS	=1 if a study uses generalised least squares
PFMOLS	=1 if a study uses panel fully modified OLS
PDOLS	=1 if a study uses panel dynamic OLS
PMGE	=1 if a study uses the pooled mean group estimator
MGE	=1 if a study uses the mean group estimator

Time series and cross-sectional dimension

TIMESER	=1 if a study uses times series
PANEL	=1 if a study uses panel data
IN_SAMPLE	=1 if a study uses in-sample panel data
OUT_SAMPLE	=1 if a study uses out-of-sample panel data
CROSS	=1 if a study uses cross sectional data

Real exchange rates

REER	=1 if a study uses real effective exchange rate
RER_EURO	=1 if a study uses real exchange rate vis-à-vis a proxy of the euro area
RER_E	=1 if a study uses real exchange rate vis-à-vis the euro area
RER_DE	=1 if a study uses real exchange rate vis-à-vis Germany

RER_AT	=1 if a study uses real exchange rate vis-à-vis Austria
RER_USD	=1 if a study uses real exchange rate vis-à-vis the US
RER_CPI	=1 if a study uses CPI-deflated real exchange rate
RER_PPI	=1 if a study uses PPI-deflated real exchange rate
RER_W	=1 if a study uses dollar wage as a proxy for the real exchange rate

Proxies for productivity

CAPITA	=1 if a study uses per capita GDP
GDPEMPL	=1 if a study uses GDP per employment
CPIPPI	=1 if a study uses the CPI-to-PPI ratio
SERVPPI	=1 if a study uses the services to PPI ratio
RWAGE	=1 if a study uses real wages as a proxy for productivity
TFP	=1 if a study uses total factor productivity
LP_IP	=1 if a study uses industrial production
LP_SNA	=1 if a study uses labour productivity obtained from national accounts

Other variables

NB_VAR	= the number of independent variables used for the estimations
NB_YEAR	= the number of years used for the estimations
NB_OBS	= the number of observations used for the estimations
COUNTRY	= the number of countries

Variables for NFA

NFA_BANK	=1 if a study uses net foreign assets of the banking sector
NFA_CA	=1 if a study uses net foreign assets for the economy as a whole (cumulated current account balances)

Variables for the real interest rate

RIW	=1 if a study uses the real world interest rate
RIR	=1 if a study uses the real interest differential
RIR_SHORT	=1 if a study uses short-term interest rates (less than one year)
RIR_MEDIUM	=1 if a study uses medium-term interest rates (equal or higher than one year)

Sectoral classification

SNA_1	=1 if sector D is the open sector and the closed sector is set to zero
SNA_2	=1 if sector D is open sector, and the rest is the closed sector
SNA_3	=1 if sectors CDF are the open sector, and the rest excluding agriculture are the closed sector
SNA_4	=1 if sectors CD are the open sector and the closed sector is set to zero
SNA_5	=1 if sectors CD are the open sector and the rest excluding agriculture are the closed sector
SNA_6	=1 if sectors ABCDI are the open sector and the rest is the closed sector
SNA_7	=1 if sectors ABD are the open sector and the rest is the closed sector
SNA_8	=1 if sectors ABDHI are the open sector and the rest is the closed sector

A= agriculture, hunting, forestry, B= fishing, C= mining and quarrying, D= manufacturing, E= electricity, gas and water supply, F= construction, G= wholesale and retail trade, H= hotels and restaurants, I= transport, storage, telecommunication, J= financial intermediation, K= real estate, renting and business activities, L= public administration and defence, compulsory social security, M= education, N= health and social work, O= other community, social and personal services activities

Appendix B. Summary Statistics

Table 1. Summary Statistics for real misalignments

	1990_2003	2001_2002		1990_2003	2001_2002		1990_2003	2001_2002
N. Obs	170	88	mis1990	1.76%	--	CZ	15.88%	18.18%
Mean	-4.64	4.16	mis1993	9.41%	--	HU	18.24%	19.32%
Median	0.00	3.75	mis1995	4.12%	--	PL	16.47%	18.18%
Max	40.70	30.00	mis1996	3.53%	--	SK	8.82%	2.27%
Min	-79.00	-29.00	mis1997	5.88%	--	SI	10.59%	10.23%
Std. Dev.	19.86	9.21	mis1998	0.59%	--	EE	14.71%	14.77%
Overv.	44.71%	63.64%	mis1999	17.65%	--	LAT	10.00%	12.50%
Underv.	35.29%	18.18%	mis2000	5.29%	--	LIT	5.29%	4.55%
Fairly v.	20.00%	18.18%	mis2001	12.35%	23.86%	Total	**100.00%**	**100.00%**
Total	**100.00%**	**100.00%**	mis2002	39.41%	76.14%	Publi	30.59%	11.36%
Total_mis	94.71%	94.32%	Total	**100.00%**	**100.00%**	Publi_WP	57.06%	65.91%
Actual_mis	5.29%	5.68%				Publi_mimeo	12.35%	22.73%
Total	**100.00%**	**100.00%**				Total	**100.00%**	**100.00%**

Table 2. Theoretical background for real misalignments

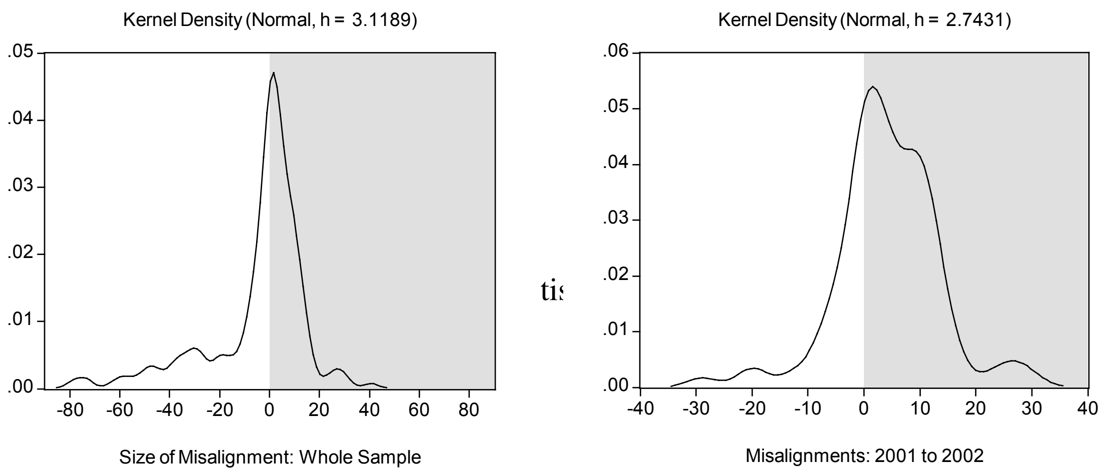
	1990_2003	2001_2002
BS	28.24%	5.68%
BEER	52.35%	56.82%
PEER	10.59%	20.45%
Macromodel	8.82%	17.05%
Of which		
FEER	3.53%	6.82%
FRER	5.29%	10.23%

Table 3. Estimation methods for real misalignments

	1990_2003	2001_2002		1990_2003	2001_2002
OLS	27.06%	3.41%	Times.	41.76%	73.86%
EG	14.71%	22.73%	Panel	22.35%	5.68%
DOLS	1.76%	3.41%	Cross	27.06%	3.41%
ARDL	1.76%	3.41%	In_smpl	11.18%	5.68%
JOHANSEN	23.53%	44.32%	Out_smpl	11.18%	0.00%
FE_OLS	2.35%	--	Total	**91.18%**	**82.95%**
RE_OLS	8.24%	--	Yearly	46.47%	3.41%
GLS	3.53%	--	Quarterly	42.94%	79.55%
PDOLS	2.94%	5.68%	Monthly	1.76%	--
PMGE	5.29%	--	Total	**91.18%**	**82.95%**
Total	**91.18%**	**82.95%**			

Note: The figures do not sum up to 100% because 8.82% and 17.05% of the observations are macromodel-based estimates for the whole sample and the sub-sample, respectively.

Figure 1. Kernel density estimates of real misalignments

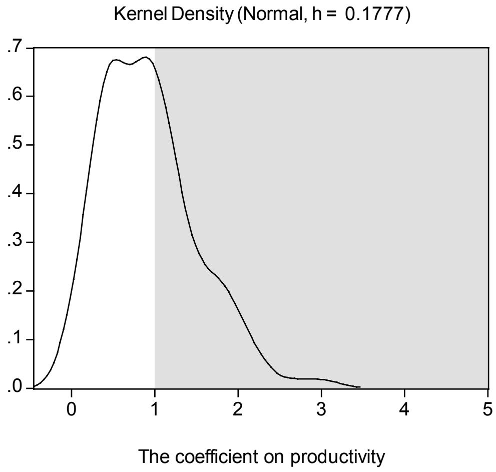


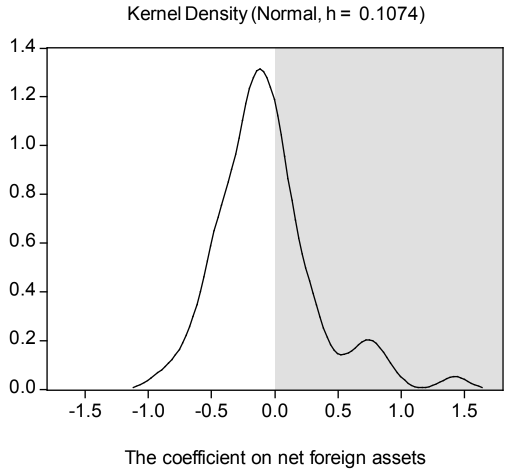
	Productivity	Net foreign assets	openness	Real interest differential	Public expenditure
CZ	13.89%	5.56%	--	5.26%	--
HU	10.56%	8.33%	20.00%	7.89%	4.17%
PL	12.78%	5.56%	17.50%	26.32%	--
SK	3.33%	0.00%	5.00%	--	8.33%
SI	5.56%	1.39%	--	2.63%	--
EE	6.11%	6.94%	--	--	--
LAT	5.56%	6.94%	15.00%	5.26%	16.67%
LIT	1.67%	2.78%	2.50%	2.63%	--
Total	**59.44%**	**37.50%**	**60.00%**	**50.00%**	**29.17%**
reer	37.22%	76.39%	35.00%	23.68%	54.17%
rer_e	56.11%	19.44%	55.00%	76.32%	29.17%
rer_euro	10.56%	6.94%	5.00%	7.89%	12.50%
rer_de	41.11%	6.94%	50.00%	57.89%	12.50%
rer_at	4.44%	5.56%	--	10.53%	4.17%
rer_usd	6.67%	4.17%	10.00%	--	16.67%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
rer_w	3.89%	4.17%	2.50%	--	4.17%
rer_cpi	78.33%	59.72%	65.00%	63.16%	83.33%
rer_ppi	17.78%	36.11%	32.50%	36.84%	12.50%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
VAR1	41.11%	--	--	--	--
VAR2	16.67%	73.61%	2.50%	10.53%	54.17%
VAR3	24.44%	16.67%	45.00%	31.58%	45.83%
VAR4	16.11%	8.33%	47.50%	50.00%	--
VAR5	1.11%	--	5.00%	5.26%	--
VAR6	0.56%	1.39%	--	2.63%	--
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
timeseries	59.44%	37.50%	60.00%	50.00%	29.17%
panel	32.78%	62.50%	40.00%	50.00%	70.83%
crosssection	7.78%	0.00%	--	--	--
insmpl	25.56%	48.61%	12.50%	50.00%	29.17%
outsmpl	7.22%	13.89%	27.50%	--	41.67%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
Yearly	22.78%	4.17%	30.00%	5.26%	58.33%
Quarterly	70.00%	95.83%	62.50%	94.74%	33.33%
Monthly	7.22%	--	7.50%	--	8.33%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
Publi_inter	32.78%	8.33%	--	10.53%	8.33%
Publi_nat	6.11%	0.00%	--	--	--
Publi_WP	50.00%	69.44%	95.00%	73.68%	91.67%
Publi_no	11.11%	22.22%	5.00%	15.79%	--
Total	100%	100%	100%	100%	100%

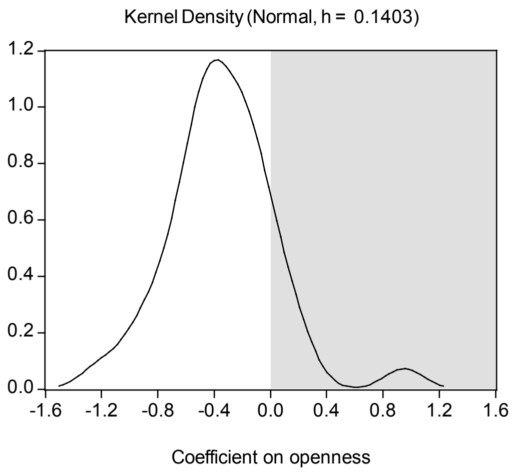
Table 4b. Summary statistics for different variables

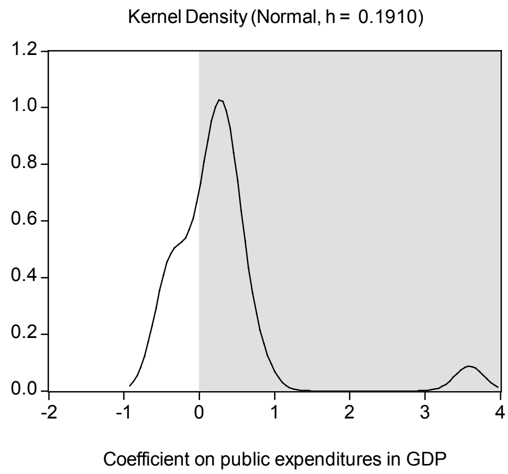
	PRODUCTIVITY	NFA	OPENNESS	PUBEXP	RIR
EG	16.67%	16.67%	27.50%	25.00%	28.95%
FMOLS	11.11%	--	--	--	--
DOLS	3.89%	--	10.00%	--	5.26%
ARDL	3.33%	--	10.00%	--	5.26%
Johansen	24.44%	20.83%	12.50%	4.17%	10.53%
POLS	8.33%	1.39%	--	--	--
FE_OLS	7.78%	22.22%	5.00%	20.83%	13.16%
RE_OLS	1.11%	--	--	--	--
GLS	1.67%	1.39%	2.50%	8.33%	--
PFMOLS	6.11%	--	7.50%	12.50%	--
PDOLS	8.89%	26.39%	12.50%	8.33%	31.58%
PMGE	5.56%	--	7.50%	12.50%	5.26%
MGE	1.11%	11.11%	5.00%	8.33%	--
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

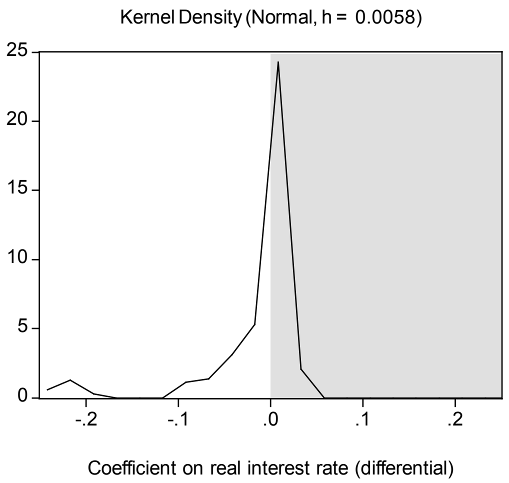
	PRODUCTIVITY		NFA		RIR
capita	18.33%	Cum_CA	88.89%	D_RIW	18.42%
gdpempl	8.89%	Banking	11.11%	D_RIR	81.58%
cpippi	6.67%		**100.00%**	RIR_short	36.84%
servppi	13.89%			RIR_medium	44.74%
labprod	50.00%				
rwage	1.11%				
tfp	1.11%				
lp	50.00%				
lp_sna	22.78%				
lp_ip	27.22%				
lp_1sided	2.22%				
sna_1	9.44%				
sna_2	2.22%				
sna_3	1.67%				
sna_4	25.56%				
sna_5	3.89%				
sna_6	3.89%				
sna_7	1.67%				
sna_8	1.67%				
	50.00%				


Kernel Density (Normal, h = 0.1777)
.7
.6
.5
.4
.3
.2
.1
.0
0
1
2
3
4
5
The coefficient on productivity


Kernel Density (Normal, h = 0.1074)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
The coefficient on net foreign assets


Kernel Density (Normal, h = 0.1403)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-1.6
-1.2
-0.8
-0.4
0.0
0.4
0.8
1.2
1.6
Coefficient on openness


Kernel Density (Normal, h = 0.1910)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-2
-1
0
1
2
3
4
Coefficient on public expenditures in GDP


Kernel Density (Normal, h = 0.0058)
25
20
15
10
5
0
-.2
-.1
.0
.1
.2
Coefficient on real interest rate (differential)