The Stock-Flow Approach to the Real Exchange Rate of CEE Transition Economies:

In-Sample vs. Out-Of-Sample Estimates

Balázs Égert[%#], Amina Lahrèche-Révil[&], and Kirsten Lommatzsch[§]

Abstract

In this paper, we use asset models of the equilibrium exchange rate as proposed by Faruqee (1995), Aglietta et al. (1997) and Alberola et al. (1999, 2002) to derive equilibrium exchange rates for EU acceding countries. We extend this approach by completing the Balassa-Samuelson effect with the appreciation of the tradable price-deflated real exchange rate and the effect of regulated prices. On the basis of four panels ((1) small, open OECD countries (2) emerging economies of Asia and the Americas (3) transition countries from Central and Eastern Europe (4) all countries put together), we show that although the B-S effect may be a common feature to all economies, the tradable price-based real appreciation is a distinct feature of transition and emerging economies. Furthermore, we propose a solution to the so-called net foreign asset puzzle according to which a decrease in net foreign assets usually leads to an appreciation of the real exchange rate of transition countries, instead of the depreciation predicted by theory. Finally, we compare in-sample and out-of-sample estimates of equilibrium exchange rates to judge whether out-of-sample panel estimates are superior to in-sample panel estimates for transition economies (Maeso-Fernandez et al., 2004).

[%] Corresponding author.
[#] Oesterreichsiche Nationalbank; MODEM, University of Paris X-Nanterre and William Davidson Institute. Balazs.egert@oenb.at; begert@u-paris10.fr
[&] CEPII and TEAM, University of Paris I; lahreche@cepii.fr
[§] DIW-Berlin; klommatzsch@diw.de
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1 Introduction

Transition economies in Central and Eastern Europe have experienced a rather substantial real appreciation of their currencies, which could make meeting the nominal convergence criteria difficult. Often the sizeable real appreciation is related to the Balassa-Samuelson effect of rising prices of non-tradable goods during the catch-up process (e.g. Halpern and Wyplosz 2001, Backé et al 2002), although its importance for the price level convergence of transition economies has been questioned lately (Coricelli and Jazbec, 2001; Égert 2002, Égert et al. 2003, Mihajlek and Klau 2003). In addition, numerous attempts have already been made for assessing determinants of the real exchange rate based on models of the macroeconomic balance and reduced form estimations. In addition to productivity, a wide range of other determinants is considered, such as foreign debt or net foreign assets, terms of trade, government debt and regulated prices (e.g. Csajbók 2003, Alberola 2003, Rawdanowicz 2003, Égert and Lommatzsch 2003). A major problem for assessing the factors driving equilibrium rates for transition countries is the lack of long time series providing sufficient numbers of observation for econometric testing. Time series estimations may not be robust enough to establish reliably long-term determinants of the real exchange rate. Therefore, panel estimations have gained popularity (Kim Korhonen 2002, Crespo-Cuaresma et al 2003). However, a question arises as to whether it is more appropriate to make use of out-of-sample or in-sample estimations. Maeso-Fernandez et al. (2004) argue that out-of-sample panel estimates may be superior to in-sample panel estimates for transition economies because in the presence of initial undervaluation, in-sample panels produce biased estimates. However, a major drawback of out-of-sample estimates is that it cannot account for possible differences between transition countries and the more developed countries e.g. in the OECD regarding net foreign assets and productivity. The catch up process may, at an early stage, justify an increase in foreign liabilities because foreign savings are needed for the growth potential to materialise. Also, rapid changes in supply capacities and technology may imply that productivity impacts on the real exchange rate through different channels than in industrialised countries already at the technological frontier.

In this paper, we make a further step in comparing panel estimates from out-of sample forecasts and in-sample tests. As a background, we use the stock-flow approach as set out in e.g. Faruqee (1995), Aglietta et al. (1997) and Alberola et al. (1999, 2002). This approach views the equilibrium real exchange rate as being determined by the stock and flow of assets between countries. Any country has a desired stock of net foreign assets which it aims to achieve in the long run. The equilibrium real exchange rate prevails at a current account position consistent with the income flows from the desired stock of foreign assets. In view of the large current account deficits that most of the transition countries[1] of Central and Eastern Europe have been experiencing, the question of the impact of net foreign assets on the real exchange rate and external equilibrium is highly relevant. Beside net foreign assets, we also consider labour productivity. The productivity variable is usually interpreted with reference to the Balassa-Samuelson (B-S) effect, which causes the real exchange rate to appreciate via an increase in the relative price of non-tradable goods. However, we view productivity also as a channel through which changes in the tradable price-based real exchange rate can occur. In particular, productivity is expected to reflect non-price competitiveness in transition economies and hence to lead to an appreciation of the real exchange rate. Using medium-size panels for different groups of countries: (1) small, open OECD countries (2) emerging economies of Asia and the Americas (3) transition countries from Central and Eastern Europe (4) all countries put together, it is found that the tradable price-based appreciation is present in transition and emerging market economies, contrary to the more developed OECD

[1] The term “transition economy” is used throughout the paper instead of “acceding countries” or “new EU Member States” because for most of the period used for the estimations, the countries from Central and Eastern Europe can be viewed as transition economies.

countries. The use of different proxies for productivity allows us to show that the CPI-to-PPI ratio so often used in the literature as a proxy for productivity vehicles other type of information as well and is an imperfect substitute for productivity. Increase in net foreign liabilities is often found to lead to an appreciation of the equilibrium real exchange rate of the transition countries. This is in contrast to what theory would suggest, i.e. a rise in net foreign liabilities should cause the real exchange rate to depreciate. The solution to this conundrum seems to be linked to different time horizons and the movement towards the desired level of foreign assets or liabilities.

The paper is organised as follows: Section 2 presents the theoretical model. Section 3 describes the data and the estimation methods. Section 4 provides results for real exchange rate determination. Section 5 reports the calculated misalignment for the acceding countries. Finally, Section 6 concludes.

2 Theoretical framework

Real exchange rate decomposition

It is useful to start with the decomposition of the real exchange rate, which shows that the price of some goods included in the consumer price index (CPI) does not necessarily affect the international competitiveness of a given economy. Considering the CPI composed of tradable and non-tradable goods with α and (1-α) being the respective share of tradable and non-tradable goods in the CPI, the real exchange rate can be split into three components: (1) the nominal exchange rate[2], (2) the ratio of foreign to domestic tradable prices, (3) and the ratio of domestic to foreign relative price of non-tradable goods as shown below[3]:

$$q = \underbrace{e + p^{*T} - p^{T}}_{\substack{\text{real exchange rate for} \\ \text{the tradable sector}}} - \left(\underbrace{(1-\alpha)\overbrace{\left(p^{NT} - p^{T}\right)}^{\substack{\text{Internal real exchange rate}}} - (1-\alpha^{*})\left(p^{*NT} - p^{/T}\right)}_{\substack{\text{ratio of the domestic to the foreign relative price of} \\ \text{non-traded goods}}} \right) \qquad (1)$$

The first term represents the real exchange rate of the open sector. The second term shows the difference between the domestic and foreign relative price of non-tradable goods. This term shows how the real exchange rate changes if prices of non-tradable goods develop differently when compared to prices of tradable goods. This decomposition makes it possible to separate factors that influence the real exchange rate of the open sector (and hence the current account via the trade balance), and factors that are related to the development of prices of non-tradable goods.

Internal and external balances

The separation of the real exchange rate of the open sector and the relative price of non-tradables is useful because the latter need not affect international competitiveness, and hence the current account position and changes in net foreign assets[4]. According to asset models of the real exchange rate[5], in the long run, the current account is driven by the adjustment of net foreign assets towards their desired position. The equilibrium real exchange rate of the open sector is affected by this adjustment, and can thus deviate from the level given by Purchasing Power Parity (PPP).

Similarly to other models based on macroeconomic balances, the equilibrium real exchange rate is defined as the real exchange rate that leads simultaneously to internal and external balances. Internal balance requires a cleared domestic goods market (related to an output

[2] The exchange rate is defined as units of domestic currency per unit of foreign currency. Thus, an increase (decrease) in the exchange rate denote a depreciation (appreciation).
[3] Asterisk denotes foreign country.
[4] It need not, but it can if non-tradables are inputs for the production of tradables, and their increase implies cost pressure on the tradablegoods prices.
[5] Frenkel and Mussa (1985), Faruqee (1995), Aglietta et al. (1997), Alberola et al. (1999) and Lane and Miletti (2002).

based on non-inflationary labour input, i.e. full capacity output). External balance refers to current account sustainability, whichimplies that, in the long run, the current account is balanced and net foreign assets have converged to their steady state. The long-run equilibrium real exchange rate secures the trade balance deficit (surplus) to correspond to the income payments received (made) by the country. In the medium term, external balance is characterized by the convergence of net foreign assets towards their desired level, i.e. current account deficits or surpluses are connected with sustainable capital flows. Following Frenkel and Mussa (1985), the medium-run adjustment can be defined as the convergence of net foreign assets towards their desired level and as the difference between short and long-run interest rates.

A model of the real exchange rate of the open sector

Our analysis is based on a model close to that of Faruqee (1995) or Aglietta et al. (1997). Internal balance is assumed to be reached independently. Consequently, only determinants of the external balance are studied here. Because we focus on the determinants of the equilibrium real exchange rate, abstraction is made from short-term factors like business cycle or short-term capital flows, and only those variables are considered that enter, in accordance with the model, the long-term relationship.

The starting point of the analysis focuses on determinants of debt or asset creation. A change in net foreign assets occurs if the current account is not balanced:

$$CA = \Delta NFA = \varphi(\underbrace{Q + NPC - (\Delta Y - \Delta Y^*)}_{trade\_account}) + \underbrace{r^* \cdot NFA}_{income\_payment\_from\_NFA} \qquad (2)$$

The term $\varphi(Q, NPC, (\Delta Y - \Delta Y^*))$ represents the trade balance and its determinants, i.e. the real exchange rate (Q), non-price competitiveness (NPC) and difference between the home and foreign economies' real GDP growth $(\Delta \mathrm{Y} - \Delta \mathrm{Y}^*)$. A depreciation of the real exchange rate works towards an improvement of the trade balance, as does the improvement in non-price competitivess[6]. According to standard models of open economies, with given import elasticities, if growth is higher in the domestic economy than in the foreign economy, the trade balance worsens. The second term in equation (2), namely $r^* \cdot NFA$, represents income payments from net foreign assets, with r^* being the real interest rate prevailing on the world market.

Because of the abstraction made from short-term factors, the capital account side is driven by the accumulation of the desired stock of foreign assets in the domestic economy. The path of foreign assets towards their desired level depends on (1) the desired stock of foreign assets, and (2) the real interest differential:

$$\Delta NFA^d = \mu(NFA^d - NFA) - \lambda(r - r^*) \qquad (3)$$

In any period, the domestic economy seeks to move towards its desired stock of net foreign assets. At the same time, when the domestic real interest rate exceeds the one given by world markets, the accumulation of foreign assets is reduced. In sum, convergence towards the desired stock of foreign assets is related to an unbalanced current account and a real exchange rate that yields this current account position.

Uncovered interest parity suggests that the difference between domestic and foreign interest rates equals the expected change in the nominal exchange rate. Uncovered real interest parity implies that the difference between real interest rates equals the expected change in the real exchange rate:

[6] A formal model of how an increase in non-price competitiveness (e.g. by more advanced technology and higher quality) improves the trade balance is developed in Égert and Lommatzsch (2003).

$$r - r^* = E(\Delta Q) \quad (4)$$

Inserting equations (2)-(4) into the (medium-term) equilibrium condition given by $\Delta \text{NFA}^d = \Delta \text{NFA}$ where ΔNFA^d is the change in the capital account and ΔNFA is the change of the current account, leads to equation (5)[7]:

$$\lambda E(\Delta Q) = \mu(NFA^d - NFA) - \varphi(Q + NPC - (\Delta Y - \Delta Y^*)) - r^* \cdot NFA \quad (5)$$

According to equation (5), the real exchange rate that prevails when the economy is moving towards the desired stock of foreign assets is determined by the difference between the actual and the desired net foreign assets position, the trade account ($\varphi(Q, NPC, (\Delta Y - \Delta Y^*))$), and payments for net foreign assets.

The long-term equilibrium real exchange rate is the real exchange rate when net foreign assets reach their desired level, i.e. $\Delta \text{NFA} = 0$. Restating equation (2) as in equation (6) and solving for the real interest rate yields equation (7):

$$\Delta NFA = 0 = \varphi \cdot Q + \varphi \cdot NPC - \varphi \cdot (\Delta Y - \Delta Y^*) + r^* \cdot NFA \quad (6)$$

$$Q^{lt} = NPC^{lt} - (\Delta Y - \Delta Y^*)^{lt} + \frac{r^*}{\varphi \cdot NFA^{lt}} \quad (7)$$

where ^{lt} denotes long-term values of the concerned variables. This model of stock-flow adjustment suggests a long-term relationship between the real exchange rate and determinants of the trade account, and the development of net foreign assets. An increase in non-price competitiveness leads to an appreciation of the equilibrium real exchange rate. Higher growth impacts negatively on the real exchange rate if this implies that imports increase more than exports. The sign of net foreign assets in the long-term equilibrium is positive, because higher net foreign assets mean higher flows of income. During the adjustment process towards equilibrium the sign is, however, not clear-cut. If the desired stock of net foreign assets is negative (because the higher expected growth or returns in the domestic economy make the use of foreign savings desirable), the economy will be moving to a desired foreign debt position, which, in turn, implies current account deficits and a real appreciation of the exchange rate. Therefore, the effect of income payments for the foreign debt (requiring a real depreciation) may dominate the exchange rate determination only at a later point when the desired level of foreign debt or negative foreign assets was achieved.

3 Estimation

3.1 Reduced form equations

On the basis of the theoretical framework described in the previous section, several relationships are tested for. The baseline scenario considers the real exchange rate deflated using the CPI on the one hand, and productivity and net foreign assets on the other, given in equation (8):

$$Q^{CPI} = f(\overset{+}{PROD}, \overset{+/-}{NFA}) \quad (8)$$

Productivity in industry can be used as a proxy for the Balassa-Samuelson (B-S) effect[8]. In this case, productivity gains are transmitted onto the real exchange rate through a rise of the relative price of non-tradables. However, the productivity variable can also serve as a proxy

[7] $\mu(NFA^d - NFA) - \lambda(r - r^*) = \varphi(Q + NPC - (\Delta Y - \Delta Y^*)) + r^* \cdot NFA$

$\mu(NFA^d - NFA) - \lambda \cdot E(\Delta Q) = \varphi(Q + NPC - (\Delta Y - \Delta Y^*)) + r^* \cdot NFA$

[8] In so doing, it is implicitly assumed that productivity in the non-tradable sector develops similarly in all countries, and that the transmission mechanism from higher productivity in the traded goods sector to higher prices of non-tradables is stable.

for higher non-price competitiveness. In the transition countries of Central and Eastern Europe, the transformation and catch-up processes entail a rather rapid shift to a supply of goods of higher quality and technological content. An increase in productivity not only reflects larger quantities of manufactured goods, but can also reflect the production of goods of higher value added.[9] While this mechanism is present in all economies, in transition economies, this process seems to be more pronounced and can even lead to real appreciation, as put forward in Égert and Lommatzsch (2003). Contrary to the traditional B-S effect, this phenomenon affects the overall real exchange rate via the real exchange rate of the open sector. Overall, an increase (decrease) in the productivity variable is expected to cause the real exchange rate to appreciation (depreciate) if it stands for higher non-price competitiveness. To distinguish between the two channels through which productivity affects the real exchange rate, not only the CPI-based real exchange rate, but the producer price index (PPI)-deflated (as a proxy for tradable goods) real exchange rate is also regressed on productivity and net foreign assets:

$$Q^{PPI} = f(\overset{+}{PROD}, \overset{+/-}{NFA}) \qquad (9)$$

Because of comparison reasons, we also perform the estimations using the relative price ratio:

$$Q^{CPI} = f(\overset{+}{REL}, \overset{+/-}{NFA}) \qquad (8')$$

$$Q^{PPI} = f(\overset{+}{REL}, \overset{+/-}{NFA}) \qquad (9')$$

It is common practice in the literature to use the CPI-to-PPI ratio as a proxy for productivity to account for the B-S effect. There are two problem with this. First, productivity gains can affect the real exchange rate, especially in transition countries via different channels (see Figure 1.). Second, the CPI-to-PPI ratio is not a proper proxy for the relative price of market non-tradables through which productivity gains feed into the real exchange rate because it also measures the impact of the following factors:

(a) higher demand for non-tradable goods because of higher income;

(b) indirect taxes (which are included in the calculation of the CPI, but not in the calculation of the PPI, which refers to producer prices before adding indirect taxes);

(c) the adjustment of regulated prices (which concerns most often non-tradables); and

(d) more difficulties in adjustment for quality changes of non-tradables than tradables.

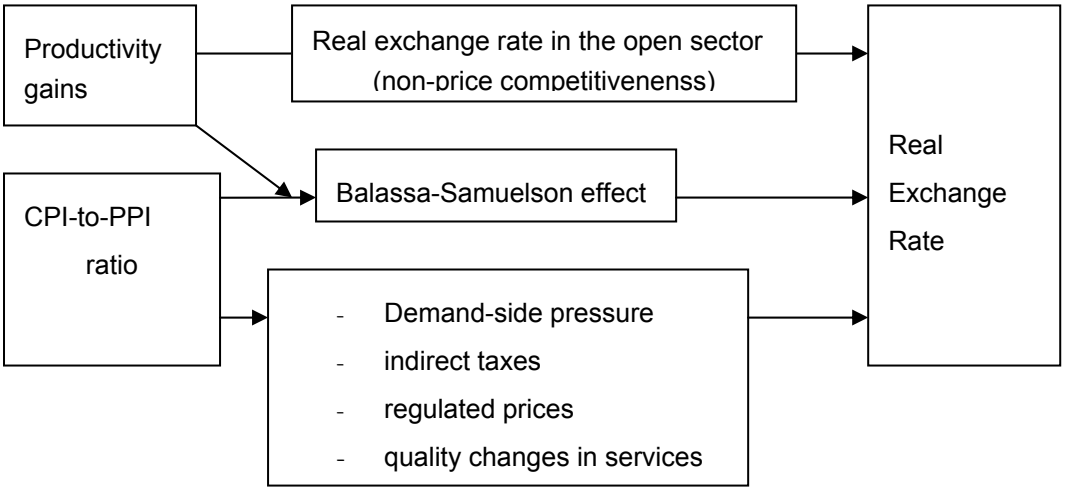
The sign of net foreign assets is ambiguous as described earlier. A decrease in net foreign assets results in an appreciation of the real exchange rate if the desired stock of net foreign assets is negative. The relationship is positive if the desired level is reached.

Finally, in a further extension, net foreign assets, the relative prices and productivity are all considered in one specification to see whether the productivity variable and the relative price variable vehicle a different set of information. If they were to enter significantly into the equation, productivity in industry would describe the effect of higher productivity and the non-price-competition aspect on tradables' prices, whereas the CPI-to-PPI ratio would stand for the above-mentioned four factors and the Balassa-Samuelson effect as depicted below:

$$Q^{CPI} = f(\overset{+}{PROD}, \overset{+}{REL}, \overset{+/-}{NFA}) \qquad (10)$$

[9] The new theory of international trade also accounts for such a possibility. According to Krugman (1989), growth may be associated to an increase in the variety of tradable goods produced in the domestic economy. The resulting decrease in the relative price elasticity of demand for exports allows for an appreciation of the real exchange rate of the tradable goods.

Figure 1. The transmission of productivity and the CPI-to-PPI ratio to the real exchange rate



3.2 Data sources and definitions

The dataset used in the paper covers 35 countries, of which 15 are small, open, industrialised OECD economies[10], 8 emerging market economies from Asia and the Americas[11], and 11 transition economies from Central and Eastern Europe[12]. Cyprus is also included in the dataset. On the basis of the 35 countries, the following panels were built: (1) OECD countries, (2) emerging countries of Asia and the Americas, (3) transition economies from Central and Eastern Europe. Because we are concerned primarily with equilibrium exchange rates for the acceding countries, we further divided the panel of 11 transition economies in order to account for possibly significant differences between the transition countries. For example, Bulgaria and Romania are less advanced in their reforms than the new EU member states, and together with the Baltic countries they have experienced higher real appreciations compared with the rest. Therefore, two further panels were formed: (4) CEEC5 plus the 3 Baltic countries and (5) only CEEC5. Panel (6) contains all mentioned countries. Finally, panel (7) contains all countries plus Cyprus, which was difficult to put into any of the specific panels. The period spans from 1970 to 2002 for panel (1) and Cyprus. However, for some of the countries, some of the series begin later. For panel (2), time series usually begin between 1980 and 1990 and end in 2002. Regarding transition economies, the datasets span from 1992/1993 to 2002.[13]

Table 1. Overview of panels

Panel1	15 OECD countries
Panel2	8 emerging countries

[10]Austria, Australia, Belgium, Denmark, Netherlands, Sweden, Canada, Finland, Greece, Ireland, Portugal, Spain, New Zealand, South Africa and South Korea. Although South Africa is not an OECD country, its economic structure may be considered for the most part of the sample as rather similar to that of Australia and New Zealand.

[11]Brazil, Chile, Mexico, Indonesia, Malaysia, Singapore, Thailand, Turkey

[12] Bulgaria, Croatia, Czech Republic, Hungary, Poland, Slovakia, Slovenia, Estonia, Latvia, Lithuania, Romania.

[13] For more details on data sources and available time periods, see Appendix 1.

Panel3	11 CEE transition countries
Panel4	8 transition countries (CEEC5+B3)
Panel5	CEEC5
Panel6	*Panel1+ Panel2+ Panel3*
Panel7	*Panel6*+Cyprus

The real effective exchange rate is a weighted average of the real exchange rate vis-à-vis the US economy and the euro area. Germany and France are taken as a proxy for the euro area, where the weights correspond to the relative size of French and German GDP (40 and 60 per cent, respectively). The weights allocated to the US and the euro area are given by the trade patterns of the given economy.

Table 2. Share of EU15 and US in AC total trade (in %), 1996-2001 average

	EU 15	US	Total
Czech Rep.	0.66	0.02	0.68
Estonia	0.63	0.04	0.67
Hungary	0.69	0.04	0.73
Latvia	0.55	0.05	0.60
Lithuania	0.47	0.02	0.49
Poland	0.68	0.02	0.70
Slovakia	0.52	0.01	0.53
Slovenia	0.70	0.02	0.72

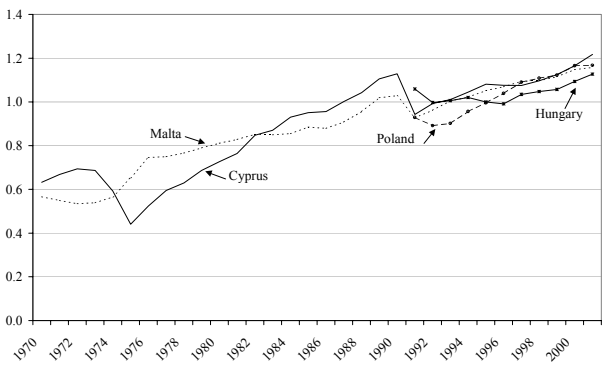
Source: Chelem-Cepii database.

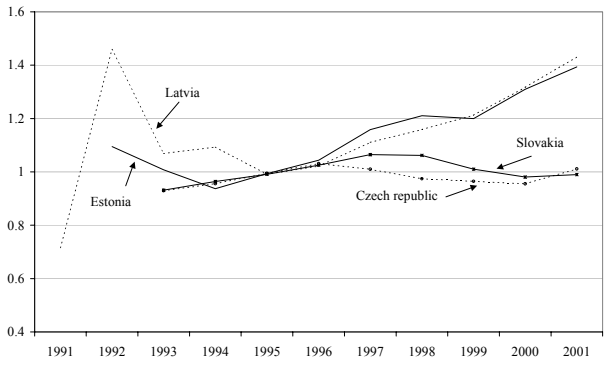
The other series are calculated as follows:

(a) average labour productivity in industry is computed as industrial production to employment in industry,

(b) the relative price of non-tradables to tradables is approximated by the CPI to PPI ratio. All variables are calculated as the domestic to foreign series ratio.

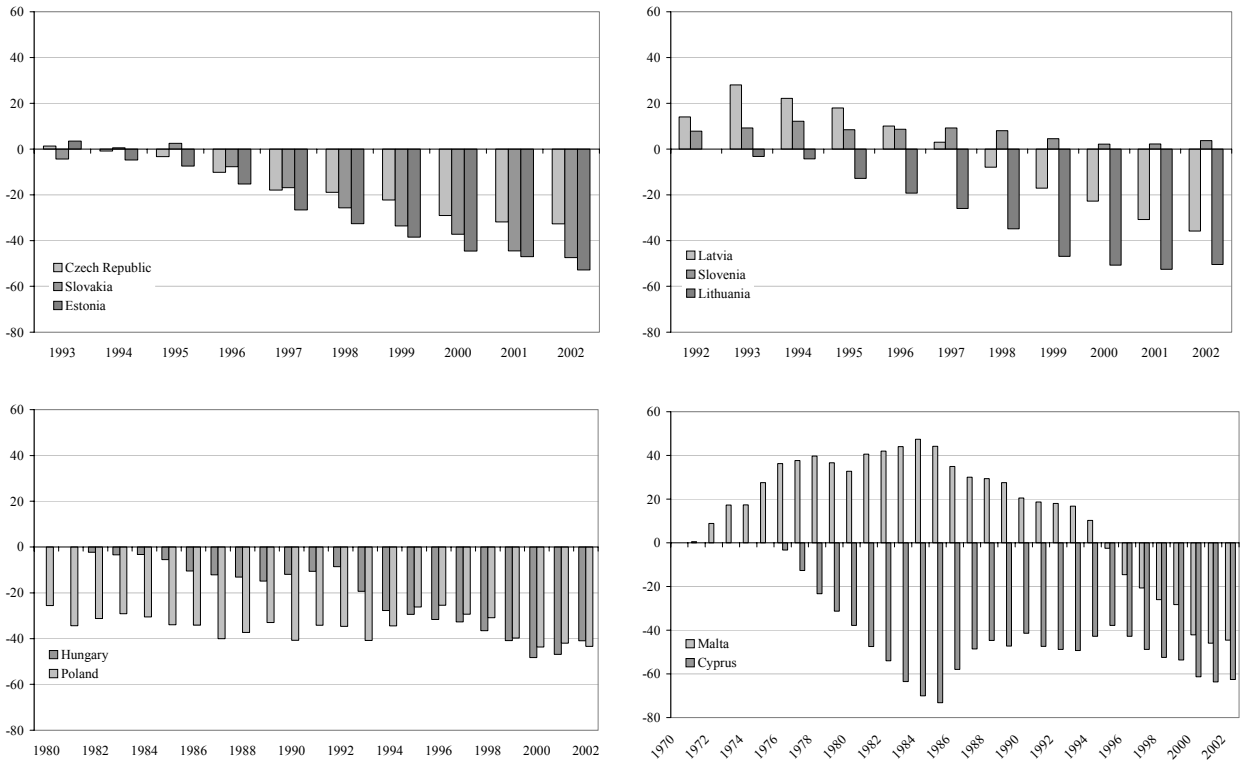
Table 3. Total productivity, compared to the EU/US weighted average





Net foreign assets are constructed as cumulated current account deficits/surpluses expressed in terms of GDP. All variables are taken in natural logarithms and are interpolated from yearly to quarterly frequency. Net foreign assets are transformed so as to keep observations non-negative (ln(1+((NFA/GDP)/100))). All data are quarterly ; the definition of variables and data source is given in the Appendix.

Table 4., Net foreign assets in % of GDP.



3.3 Econometric issues

a.) Panel unit root tests

The first step of the cointegration analysis is to ascertain that the series are non-stationary in level. For this purpose, the panel unit root test proposed by Im et al (2003) (IPS test henceforth) is used. The advantage of the IPS test is that it allows for heterogeneity in the autoregressive coefficient across the countries of the panel. Consider the following equation assuming a trend and a constant term:

$$\Delta y_{i,t} = \pi_i \cdot y_{i,t-1} + \sum_{t=1}^{n-1} b_i \cdot \Delta y_{i,t-1} + \mu_i + \gamma_i \cdot t + \varepsilon_{i,t}, i = 1,2,...,N; t = 1,2,...,T, \qquad (11)$$

The null of $H_0 : \pi_i = 0$ for each i is tested against the alternative hypothesis of $H_1 : \pi_i < 0, i = 1,2,...,N$. The t-bar statistics is determined as the mean of individual ADF statistics, and is then compared with a set of critical values provided in Im et al (2003).

b.) Panel cointegration tests

To determine whether the variables are cointegrated, the panel cointegration tests proposed by Pedroni are used. The null hypothesis of no cointegration is tested against the alternative hypothesis of cointegration using the residuals obtained from the cointegrating regression given in equation (12):

$$\bar{y}_{i,t} = \alpha_i + \beta_i \cdot \bar{x}_{i,t} + \delta_i \cdot t + \varepsilon_{i,t}, i = 1,2,...,N; t = 1,2,...,T \qquad (12)$$

Pedroni proposes seven panel cointegration statistics, of which we prefer the so-called group mean statistics. They not only permit heterogeneity in the slope coefficients, the constant term and the trend, but also allow for heterogeneous autoregressive coefficient in the residuals. The group mean panel cointegration statistics test the null hypothesis of $H_0 : \pi_i = 0$ against the alternative hypothesis of $H_1 : \pi_i < 0, i = 1,2,...,N$ where π_i denotes the autoregressive coefficient of the residuals. Pedroni (1999) shows that for small samples the group ADF-statistic is the most powerful.

In addition to the Pedroni cointegration tests, the error correction terms obtained from the mean group and pooled mean group estimators proposed by Pesaran et al. (1999) are also used as tests for cointegration. A negative and statistically significant error correction term is taken as evidence for the presence of cointegration.

c.) Coefficient Estimates

The coefficients of the long-term relationships are derived by using (1) fixed effect OLS, (2) the mean group of individual dynamic OLS estimates, (3) mean group of individual estimates based on the error-correction specification of the ARDL process proposed by Pesaran et al. (1999), and (4) the pooled mean group estimator based on the ARDL.

The dynamic OLS can be written for each member of the panel as follows:

$$Y_t = \beta_0 + \sum_{i=1}^{n} \beta_n X_{i,t} + \sum_{i=1}^{n} \sum_{j=-k_1}^{k_2} \gamma_{i,j} \Delta X_{i,t-j} + \varepsilon_t \qquad (13)$$

with *k1* and *k2* denoting respectively leads and lags for panel member i.

The error correction form of the ARDL model is given for panel member i as shown in equation (14) where the dependent variable in first differences is regressed on the lagged values of the dependent and independent variables in levels and first differences:

$$\Delta Y_t = \beta_0 + \rho(Y_{t-1} + \sum_{i=1}^{n} \beta_n X_{i,t-1}) + \sum_{j=1}^{l_1} \eta_j \Delta Y_{t-j} + \sum_{i=1}^{n} \sum_{j=0}^{l_2} \gamma_{i,j} \Delta X_{i,t-j} + \varepsilon_t \qquad (14)$$

where l1 and l2 are the maximum lags. The pooled mean group estimator (PMGE) is first estimated with the short-term dynamic terms restricted across the members of the panels, and then with unrestricted short-run terms across panel members. In addition, the ARDL mean group estimator is also employed.

4 Real exchange rate determination

4.1 The CPI-based real effective exchange rate

The IPS panel unit root tests indicate that most series are non-stationary in level, but differentiation renders them stationary. Thus, the panel cointegration techniques can be applied to the data. Equations (8) and (8') are estimated for the 7 panels described earlier.[14] For the panel including OECD countries, the tests are carried out for 7 periods so as to check for stability of the estimation results. The periods 1970-2002, 1975-2002, 1980-2002 and 1970-1990 yields very similar results, and therefore only those for 1975 to 2002 are reported here.

In general, there appears to be a great deal of heterogeneity across countries of the sub-panels because the fixed effect OLS and the PMGE, which impose homogeneity on the long-run coefficients, appear to be of poor quality. In a number of cases, the error correction terms for the PMGE turn out to be statistically insignificant and/or to have a positive sign, indicating the absence of an error correction mechanism towards long-run equilibrium. By contrast, the DOLS and ARDL mean group estimators seem to confirm our expectations both in terms of significance, signs and the error correction term. Given this, we will concentrate on the interpretation of the estimates obtained on the basis of the panel DOLS and MG estimators. Results for tests based on the CPI-based real exchange rate are displayed in Table 5.

Tests can establish cointegration for the specifications with the productivity series and the CPI-to-PPI price ratio. For the group of OECD countries, productivity in industry has the expected negative sign, meaning that an increase in productivity causes the real exchange

[14] Three lag structures are used for the mean group DOLS and ARDL. First, we impose 1 lag and 1 lead for panel DOLS and 1 lag for ARDL. Then, lags and leads are chosen on the basis of Akaike and Schwartz information criteria.

rate to appreciate. Although the CPI-to-PPI ratio also has a negative sign, the size of it is considerably higher in absolute terms (-0.7 to –1.2) than that of the two productivity variables (-0.16 to –0.2). This is a first indication that the variables may convey different information. Net foreign assets are also correctly (negatively) signed and are statistically significant except when the CPI-to-PPI ratio is used. Thus, an increase in net foreign assets leads to an appreciation of the real exchange rate. It should be noted that results obtained using DOLS are in general of better quality as those based on MGE because in a number of cases, some variables are not significant using the MGE.

With regard to the group of emerging countries from Asia and South America, the two productivity variables and the CPI-to-PPI ratio bear the correct sign, i.e. an increase (decrease) leads to an appreciation (depreciation) of the real effective exchange rate. However, the absolute size of the variables is higher than for the OECD panel (1.2 to 1.5 for productivity in industry and the CPI to PPI ratio). By contrast, net foreign assets turn out insignificant in most cases, and when they are statistically significant, their sign differs.

Coming to the transition economies, we observe a high significance of the productivity variables. Similar to the OECD countries, the size of the CPI-to-PPI variable is much higher than the one of productivity in industry. Comparing the three panels (11 transition economies, CEEC5+B5, CEEC5), the elimination of Bulgaria, Croatia and Romania, and then the three Baltic countries leads to a decrease in the size of the CPI-to-PPI variable and to a rise in the size of productivity in industry. In contrast to the group of emerging countries, the net foreign assets variable is mostly significant at standard significance levels. However, the sign of this variable is always positive.

Finally, the estimation results are very similar for the last two panels. This means that the inclusion of Cyprus to the other countries does not affect the overall results. For this reason, we only report results for the panel including the OECD, emerging and transition countries and Cyprus (panel(7)). The results are something of a mixture of the three panels analysed above. The productivity variables are significant and correctly signed with a size somewhere between those obtained for the OECD panel, on the one hand, and for the emerging and transition economies, on the other hand. The net foreign assets variable turns out to be positive as in the transition countries panel. This is probably because in the emerging market panel some countries may also have recorded appreciation alongside foreign debt growth. In addition, higher net foreign assets may also be connected with depreciation, if the movements towards a higher net foreign assets position dominates the effect of income flows, which may be the case in some of the countries in the OECD panel.

4.2 The sign on net foreign assets for transition economies

The increasing literature on equilibrium exchange rates is not conclusive regarding the sign of net foreign assets relative to the real exchange rate. For instance, Burgess et al. (2003) find a positive sign between NFA and the real exchange rate for the three Baltic states: a decrease (increase) in the NFA position causes the real exchange rate to appreciate (depreciate). Alonso-Gamo et al. (2002) and Lommatzsch and Tober (2002) come to the same conclusion for Lithuania, and for the Czech Republic, Hungary and Poland, respectively, as Alberola (2003) does for the case of the Czech Republic. By contrast, results by Hinnosar et al. (2003) for Estonia and by Rahn (2003) for Czech Republic, Estonia, Hungary, Poland and Slovenia show that the sign is negative, i.e. a decrease (increase) in the NFA position causes the real exchange rate to depreciate (appreciate). Alberola (2003) comes to the same conclusion for Hungary and Poland. Csajbók (2003), Darvas (2001), Rubaszek (2003) and Bitans and Tillars (2003) confirm these findings. Using a small panel of transition countries, MacDonald and Wojcik (2002) suggest that the sign changes in function of the estimated equation.

Our results indicates that net foreign assets have a very robust positive link to the real exchange rate for transition economies, and to a lesser extent for emerging countries. In contrast with this finding is the observation that NFA bear a strong negative tie to the real exchange rate for a set of small, open OECD countries. This appears to be a major piece of

evidence for the explanation provided in Égert (2003), according to which in the medium to long term, NFA may be positively linked to the real exchange rate, but the direction of this link changes in the longer run. Within the framework of the stock-flow asset model of the real exchange rate shown earlier, this can be explained by the fact that in the medium run, transition economies are moving towards their desired stock of foreign assets because the higher growth potential cannot be financed by domestic savings only and the use of foreign savings implies the accumulation of foreign liabilities. However, in the long run, the desired level of foreign assets is achieved, and payments on the existing stock of foreign liabilities would reverse the relationship: the higher the stock of foreign liabilities, the higher the need for real exchange rate depreciation to service the debt through an improved trade account, and vice versa. This is exactly what we observe for the average of the OECD countries.

Table 5. The CPI-based REER and the fundamentals

	OLS	DOLS	DOLS_AIC	DOLS_SIC	MGE	MGE_AIC	MGE_SIC	PMGE	PMGE_un	TOT Obs
OECD										
Coint	0.035				-0.043***	-0.041***	-0.042***	0.003***	0.018	1554
prod	-0.021	-0.165***	-0.166***	-0.160***	0.083	-0.140	0.124			
Nfa	-0.027***	-0.076***	-0.075***	-0.074***	-0.224***	-0.236***	-0.235***			
Coint	0.017				-0.054***	-0.051***	-0.052***	0.000***	-0.022***	1590
rel	-0.904***	-0.745***	-0.760***	-0.763***	-1.132***	-1.214***	-0.744***		-0.667***	
nfa	0.030***	0.037	0.035	0.035	-0.495	-0.513*	-0.088		-0.018	
Emerging countries										
coint	0.045				-0.034***	-0.036***	-0.033***	-0.018*	-0.015	564
prod	-0.166***	-1.481***	-1.486***	-1.217***	-1.841***	-1.769***	-1.858*	-1.040*		
Nfa	-0.034	-0.359	-0.361	-0.340	-0.078	0.049	0.063	-0.552***		
Coint	0.081				-0.054***	-0.054***	-0.054***	-0.005	-0.018***	704
rel	-1.672***	-1.443***	-1.450***	-1.449***	-1.479***	-1.479***	-1.479***		-1.732***	
nfa	0.119***	-0.205	-0.209	-0.192	-0.276	-0.276	-0.276		-0.072	
CEEC11										
Coint	0.015				-0.138***	-0.148***	-0.148***	-0.071***	-0.028**	423
prod	-0.344***	-0.455***	-0.471***	-0.437***	-0.045*	-0.017***	-0.024***	-0.673***	-0.681**	
Nfa	0.742***	0.627***	0.631***	0.569***	0.343***	0.379***	0.540***	-0.141	0.114	
Coint	0.020				-0.103***	-0.086***	-0.088***	0.043	-0.027	427
Rel	-1.809***	-1.479***	-1.656***	-1.663***	-1.161***	-0.476***	-0.510***			
Nfa	0.493***	0.437***	0.374***	0.376***	0.202***	0.294***	0.243***			
CEEC8										
coint	0.022				-0.130***	-0.145***	-0.143***	-0.103***	-0.031***	308
prod	-0.191***	-0.417***	-0.431***	-0.430***	-0.289*	-0.183***	-0.133***	-0.668***	-0.639***	
Nfa	0.905***	0.535***	0.541***	0.544***	0.119*	0.158*	0.131	0.037	0.038	
Coint	0.024				-0.101***	-0.085***	-0.088***	-0.098	-0.056***	308
rel	-2.279***	-2.042***	-2.009***	-2.035***	-1.676***	-1.310***	-1.355***		-1.608***	
Nfa	0.404***	0.274***	0.265***	0.266***	0.077*	0.174	0.104		0.158	
CEEC5										
coint	0.011				-0.174***	-0.199***	-0.197***	-0.019***	-0.027**	197
prod	-0.589***	-0.780***	-0.736***	-0.736***	-0.760***	-0.824***	-0.790***	-1.506***	-0.732**	
Nfa	0.256***	0.121***	0.172***	0.176***	0.150**	0.115	0.156	-0.152	0.105	
Coint	0.031				-0.100***	-0.086***	-0.089***	0.010	-0.014	197
Rel	-2.185***	-0.949***	-0.994***	-1.036***	-1.046**	-1.128***	-1.216***			
Nfa	0.195***	0.423***	0.397***	0.398***	0.124***	0.246*	0.125			
ALL (including Cyprus)										
coint	0.015				-0.070***	-0.073***	-0.073***	0.027**		2646
prod	-0.196***	-0.570***	-0.573***	-0.498***	-0.394*	-0.450***	-0.465***			

Nfa	0.064***	0.084***	0.086***	0.071***	0.103	0.026	0.080			
Coint	0.012				-0.068***	-0.062***	-0.063***	-0.011		2826
rel	-1.541***	-1.090***	-1.153***	-1.156***	-1.169***	-0.979***	-0.788***			
Nfa	0.117***	0.105***	0.084***	0.088***	0.215	-0.193	-0.027			

Notes: DOLS, DOLS_AIC, and DOLS_SIC are the DOLS estimates obtained on the basis of fixed lags and leads, and the ones chosen using the Akaike and Schwarz information criterion. The same applies to the mean group estimators (MGE, MGE_AIC, MGE_SIC). *,*** and *** denote respectively statistical significance at the 10%, 5% and 1% levels. In the row "coint" under the column OLS are reported p-values for the Pedroni group ADF panel cointegration test. In the same line under MGE, MGE_AIC, MGE_SIC, PMGE and PMGE_unr are shown the error correction terms.

4.3 The PPI-based real effective exchange rate

In a second step, equations (9) and (9') are used which connect the real effective exchange rate deflated by the PPI as a proxy for tradable goods prices to productivity/the CPI-to-PPI ratio and net foreign assets. This is because we would like to see whether and to what extent productivity impacts on the real exchange rate of the open sector.

For the OECD countries, the productivity variables switch sign and become positive, but remain statistically significant. Both an increase in average labour productivity and the CPI-to-PPI ratio leads to a depreciation of the tradable price-deflated real exchange rate. Connected with the result of the test with the CPI-based real exchange rate, a possible explanation for this finding is that higher productivity in industry eventually leads to an increase in the relative price of non-tradables (e.g. via the Balassa-Samuelson effect). However, as long as this primarily implies higher growth of the entire economy and higher import demand, a depreciation in the price of tradable goods would be required to maintain external equilibrium (Lommatzsch and Tober(2004)).

In contrast to the OECD panel, for the transition and emerging countries both average productivity and the CPI-to-PPI ratio have the same effect on the real exchange rate of the open sector as for the CPI based real exchange rate: an increase (decrease) in the productivity and relative price variables leads to an appreciation (depreciation) of the tradable price-based real exchange rate. This confirms largely the hypothesis that – at least in the catching-up process – the labour productivity variable is a proxy for increasing non-price competitiveness.

The sign of net foreign assets is in all panels the same as the one determined for the CPI-based real exchange rates: leading to appreciation in the OECD countries and depreciation in the transition countries.

Table 6. The PPI-based REER and the fundamentals

	OLS	DOLS	DOLS_AIC	DOLS_SIC	MGE	MGE_AIC	MGE_SIC	PMGE	PMGE_un	TOT Obs
OECD										
Coint	0.041				-0.063***	-0.061***	-0.061***	0.010***	0.024***	1534
prod	0.089***	0.015***	0.021***	0.013***	0.013***	0.043***	0.023***			
Nfa	-0.010	-0.124***	-0.125***	-0.120***	-0.203***	-0.207***	-0.194***			
Coint					-0.054***	-0.052***	-0.053***	0.001***	0.022*	1590
Rel	0.094***	0.253***	0.239***	0.234***	0.057***	0.541***	0.012***			
Nfa	0.027***	-0.030	-0.028	-0.028	-0.226	-0.771**	-0.217*			
Emerging countries										
Coint	0.054				-0.056***	-0.057***	-0.056***	-0.026***	-0.026	564
prod	-0.037	-1.159***	-1.121***	-1.087***	-1.182***	-1.267***	-1.271***	-0.829***		
Nfa	0.076***	0.257**	0.239**	0.219*	0.950	0.783	0.784	-0.302**		
Coint	0.064				-0.054***	-0.054***	-0.054***	-0.005	-0.018***	704
rel	-0.680***	-0.446***	-0.453***	-0.452***	-0.472***	-0.472***	-0.472***		-0.736***	
Nfa	0.118***	-0.206	-0.210	-0.193*	-0.278	-0.278	-0.278		-0.073	
CEEC11										
Coint	0.023				-0.138***	-0.151***	-0.150***	-0.050***	-0.026**	423

prod	-0.218***	-0.350***	-0.358***	-0.319***	-0.028***	-0.373***	-0.354***	-0.888***	-0.594**	
Nfa	0.569***	0.456***	0.460***	0.408***	0.300***	0.258**	0.410***	-0.312**	0.140	
Coint	0.028				-0.102***	-0.102***	-0.104***	0.043***	0.027	427
Rel	-0.809***	-0.478***	-0.656***	-0.662***	-0.007	-0.056	-0.218			
Nfa	0.493***	0.438***	0.375***	0.377***	0.092***	0.180***	0.387***			
CEEC8										
coint	0.013				-0.133***	-0.148***	-0.146***	-0.096***	-0.039**	308
prod	-0.115*	-0.262***	-0.274***	-0.257***	-0.306***	-0.188***	-0.140***	-0.452***	-0.380**	
Nfa	0.682***	0.288***	0.294***	0.323***	0.204	0.138	0.117	0.065	0.210	
Coint	0.018				-0.102***	-0.101***	-0.104***	0.097*	-0.056	308
rel	-1.279***	-1.042***	-1.008***	-1.034***	-0.460***	-0.527**	-0.497**			
Nfa	0.405***	0.274***	0.266***	0.267***	0.069	0.053	0.061			
CEEC5										
Coint	0.009				-0.175***	-0.198***	-0.193***	-0.038***	-0.053***	197
prod	-0.397***	-0.641***	-0.599***	-0.566***	-0.555***	-0.621***	-0.591***	-0.921***	-0.487***	
Nfa	0.176***	0.140***	0.093***	0.043***	0.036	-0.075	-0.057	-0.021	0.126	
Coint	0.011				-0.104***	-0.096***	-0.101***	0.010	-0.014	197
Rel	-1.186***	-0.052***	-0.007***	-0.035***	-0.201	-0.206	-0.159*			
Nfa	0.195***	0.424***	0.398***	0.399***	0.088**	0.074*	0.087*			
ALL (including Cyprus)										
coint	0.018				-0.084***	-0.087***	-0.087***	0.026		2626
prod	-0.066***	-0.392***	-0.381***	-0.364***	-0.271*	-0.409***	-0.395**			
Nfa	0.099***	0.035***	0.039***	0.030***	-0.257	-0.169	-0.223			
Coint	0.021				-0.068***	-0.067***	-0.068***	0.011*		2826
rel	-0.546***	-0.090**	-0.152***	-0.156***	0.050*	0.299*	0.024*			
Nfa	0.114***	0.102***	0.081***	0.085***	0.134	0.340	0.037			

Notes: DOLS, DOLS_AIC, and DOLS_SIC are the DOLS estimates obtained on the basis of fixed lags and leads, and the ones chosen using the Akaike and Schwarz information criterion. The same applies to the mean group estimators (MGE, MGE_AIC, MGE_SIC). *,*** and *** denote respectively statistical significance at the 10%, 5% and 1% levels. In the row "coint" under the column OLS are reported p-values for the Pedroni group ADF panel cointegration test. In the same line under MGE, MGE_AIC, MGE_SIC, PMGE and PMGE_unr are shown the error correction terms.

4.4 The extended specification: productivity, relative prices and net foreign assets

As a next step, the baseline specification including the real exchange rate and two explanatory variables is extended in accordance with equation (10): the real exchange rate is regressed at labour productivity, the CPI-to-PPI ratio and net foreign assets. Results are presented in Table 7 for the CPI-deflated real exchange rate. Results from the baseline specifications have suggested that the CPI-to-PPI ratio may be a reasonable proxy for labour productivity, as they were found significant and had the correct negative sign. However, the size of the coefficients varies considerably. In most of the extended specifications, both productivity and the CPI-to-PPI ratio enter the regression significantly. This suggests the absence of multi-collinearity between productivity and the CPI-to-PPI ratio. In the transition countries panel they enter with the same sign, whereas they have opposite signs in the OECD panel. Thus, the two variables seem to vehicle a different set of information. Productivity can stand for higher non-price competitiveness (mainly for the transition countries), but it can also reflect the need for real depreciation with higher growth to maintain external balance (as in the OECD panel, where the sign of labour productivity in industry becomes positive conditioned on the CPI-to-PPI ratio). The CPI-to-PPI ratio may stand for the B-S effect, but it may also represent the factors enumerated earlier, such as indirect taxes or regulated prices. It should be noted that net foreign assets are robust, especially for the transition economies, to the simultaneous inclusion of productivity and relative prices.

Table 7. Extended specification, RERCPI, 1975-2002

	OLS	DOLS	DOLS_AIC	DOLS_SIC	MGE	MGE_AIC	MGE_SIC	PMGE	PMGE_un	TOT Obs
OECD										
Coint	0.010				-0.073***	-0.070***	-0.070***	0.016***	0.023*	1534
prod	0.077***	0.016***	0.011***	0.016***	0.105	0.103	0.064			
Rel	-0.969***	-0.811***	-0.811***	-0.803***	-0.501***	-0.584***	-0.610***			
Nfa	-0.006	-0.012	-0.019*	-0.020*	-0.184	-0.198**	-0.124*			
Emerging										
Coint	0.016				-0.074***	-0.074***	-0.074***	-0.040***	-0.033	564
prod	0.051	-1.264***	-1.197***	-1.168***	-2.864*	-1.737	-1.560	-0.541***		
Rel	-1.690***	-1.332***	-1.349***	-1.365***	-0.472***	-1.045***	-1.144***	-0.082		
Nfa	0.154***	-0.314	-0.295	-0.257	-1.298	-0.543	-0.574	-0.255***		
CEEC11										
Coint	0.034				-0.106***	-0.143***	-0.112***	-0.051***	-0.023***	423
prod	-0.110*	-0.514***	-0.488***	-0.486***	-0.124	-0.077***	-0.007*	-1.099***	-0.924***	
Rel	-1.843***	-1.502***	-1.657***	-1.652***	-1.241	-0.795**	-0.904	0.887*	1.117	
Nfa	0.422***	0.276***	0.179***	0.190***	0.192***	0.184***	0.046***	-0.186	0.173	
CEEC8										
coint	0.023				-0.105***	-0.149***	-0.114***	-0.102***	-0.039***	308
prod	-0.017	-0.494***	-0.487***	-0.484***	-0.396	-0.108***	-0.235	-0.654***	-0.614***	
Rel	-2.273***	-2.033***	-2.059***	-2.052***	-1.865	-0.972***	-1.400	-0.057	-0.601	
nfa	0.397***	0.041***	0.031***	0.016***	0.088	0.087	0.289	0.054	0.021	
CEEC5										
coint	0.051				-0.187***	-0.197***	-0.173***	-0.027***	-0.037***	197
prod	-0.256***	-0.475***	-0.459***	-0.454***	-0.248***	-0.389***	-0.306***	-1.341***	-0.579***	
rel	-1.732***	-0.485***	-0.491***	-0.479***	-1.100***	-0.863***	-0.983***	0.181	-1.042	
Nfa	0.117***	0.181***	0.202***	0.226***	0.138*	0.085*	0.030	-0.022	0.096	
ALL (including Cyprus)										
Coint	0.014				-0.082***	-0.093***	-0.083***	0.031	2626.000	
Prod	-0.016	-0.474***	-0.445***	-0.439***	-0.627	-0.437	-0.348			
rel	-1.466***	-1.103***	-1.154***	-1.153***	-0.686***	-0.703***	-0.780***			
Nfa	0.119***	0.010***	0.019***	0.007***	-0.322	0.156	-0.177			

Notes: DOLS, DOLS_AIC, and DOLS_SIC are the DOLS estimates obtained on the basis of fixed lags and leads, and the ones chosen using the Akaike and Schwarz information criterion. The same applies to the mean group estimators (MGE, MGE_AIC, MGE_SIC). *,*** and *** denote respectively statistical significance at the 10%, 5% and 1% levels. In the row "coint" under the column OLS are reported p-values for the Pedroni group ADF panel cointegration test. In the same line under MGE, MGE_AIC, MGE_SIC, PMGE and PMGE_unr are shown the error correction terms.

4.5 In-sample versus out-of-sample panel estimates: The role of the constant term

In a recent paper, Maezo-Fernandez et al. (2004) argue that in-sample panel estimates are biased if the real exchange rate is undervalued at the beginning of the sample period.[15] Therefore, they propose to use out-of-sample panels, which do not include countries the real exchange rate of which is suspected to be undervalued at the beginning of the period. However, this approach has significant drawbacks, too. First, it does not provide country-specific constant terms for the countries. This can seriously affect the assessment of the size of deviation of the observed rate from the equilibrium rate.

Maezo-Fernandez et al. (2004) suggest the constant term to be set in the following ways: (1) average of constants of the sample (2) average of constants of the converging euro area countries, like Greece, Portugal and Spain, (3) the lowest constant term of the euro area countries. Appendix 2 contains the constant terms for the euro area countries from the OECD panel for a selected equation[16]. The average constant of the core (Austria, Belgium, Netherlands and Finland), the average of the Southern countries completed with Ireland and

[15] Maezo-Fernandez et al. (2004) regress the real exchange rate on productivity, openness and government expenditures.

[16] RERCPI=f(PROD,NFA), 1975- 2002.

the average of the eight countries put together are all very close to –0.05. Taking the lowest, namely that for Finland, is, however, higher in absolute terms: -0.19. Because these constant terms are obtained based on country specific estimations, they can be directly compared to the ones obtained for the acceding countries.[17] Table 8 below shows that constants of the CEE5 are well within the range of –0.5 to –0.19. However, the constant terms of the Baltic countries are much lower than the aforementioned range, so that the determination of the equilibrium rate could be seriously affected by the choice of constant.

Second, different test results for out-of-sample and in-sample estimates regarding the size and the sign of the included variables overshadow the advantages of the out-of-sample approach. Whereas in-sample estimates may reflect medium-term developments and therefore trace the equilibrium development more appropriately for policy purposes, out-of-sample estimates may mirror long-term behaviour which is more difficult to interpret in policy terms.

5 Conclusion

In this study, we used the stock-flow approach to the equilibrium exchange rate proposed by Faruqee (1995), Aglietta et al. (1997) and Alberola et al. (1999, 2002) to determine long-term factors driving the real exchange rate and compare results from in-sample and out-of-sample estimates. The stock-flow approach links the real exchange rate to productivity and net foreign assets. Recently, a growing number of papers showed that a decrease in net foreign assets yields an appreciation of the real exchange rate in transition economies. This finding contrasts with theory, which predicts an opposite relation between the two variables in the long run. Using panel cointegration techniques, we showed that for a group of small and open OECD countries, an increase in net foreign assets was linked with an appreciation of the real exchange rate. By contrast, a decrease in net foreign assets was found to be linked systematically to a real appreciation of the exchange rate for different groups of transition economies. Therefore, we find that the systematically different sign of net foreign assets may be related to the time period studied, i.e. the distinction between the medium run and the long run. The 30-year period for the OECD countries may be viewed as the long term, whereas the slightly more than 10-year period for the transition economies can be considered as the medium run, i.e. convergence towards a long-term level.

According to the model, in the long run, net foreign assets are assumed to have reached their desired level. Therefore, an increase in net foreign assets implies an appreciation of the real exchange rate because higher net foreign assets mean higher flows of income. However, the medium run is characterised by the adjustment of net foreign assets to their desired level. If countries desire a negative stock of net foreign assets (which seems to be the case in the transition economies), they run current account deficits and record a real appreciation of the exchange rate.

Secondly, we have demonstrated that productivity gains feed into the CPI-based real exchange rate mainly via the B-S effect in the OECD countries, whilst they cause the real exchange rate to appreciate also via the appreciation of the tradable price-deflated real exchange rate for the transition countries.

Thirdly, estimation results indicate that the CPI-to-PPI ratio is an imperfect proxy for productivity as an indicator of the B-S effect because this ratio not only reflects the relative price of market-based non-tradable goods but also a number of other factors. Moreover, it is not appropriate to use the CPI-to-PPI ratio as a proxy for productivity because it cannot fully convey the effect of productivity gains to the real exchange rate, i.e. the appreciation of the real exchange rate of the open sector.

All in all, in-sample (transition economies and all countries put together) and out-of-sample (OECD countries) estimations differ considerably, as regards the signs and the size of the

[17] The question to be addressed here is to what extent the constant term may be biased because of a possible undervaluation of the real exchange rate at the outset of the transition process.

determined coefficients. Although out-of-sample estimates may be more robust in econometric terms because of the higher number of observations, they do not appear to be superior in economic terms when compared to in-sample estimates derived for a set of transition countries for the following reasons: (1) the net foreign assets reflect a long-run perspective for the OECD countries and the medium run for the transition economies. This implies that the equilibrium rates derived from the panel of OECD countries represent the long run for the transition economies, and may be less easily interpreted for policy purposes. (2) the productivity series seems to reflect different factors in the two country groups: whereas it stands primarily for the Balassa-Samuelson effect in the more developed countries, it can be viewed as a reasonable proxy for increasing non-price competitiveness and higher quality of the goods produced in the countries catching-up. Therefore, we cannot support the idea that out-of-sample estimates may be better suited for assessing equilibrium rates of the (former) transition countries.

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APPENDIX 1.

Data sources and definition

Real exchange rate

The real exchange rate compares domestic price indices to foreign ones, in the same currency. The bilateral real exchange rate is computed as follows: $Q = EP^*/P$, where E is the nominal exchange rate (source: IMF, *International Financial Statistics*, line 00rf), P and P* are respectively the domestic and foreign price index (source: IMF, International Financial Statistics, line 64). The series are normalised to 1993 (1993=100)

The real exchange rate is computed in effective terms: $REER = \alpha_{i/US} Q_{i/\$} + \alpha_{i/UE} Q_{i/DM}$,

where $\alpha_{i/US} = \frac{X_{i/US} + M_{i/US}}{(X_{i/US} + M_{i/US}) + (X_{i/UE} + M_{i/UE})}$ and $\alpha_{i/UE} = \frac{X_{i/UE} + M_{i/UE}}{(X_{i/US} + M_{i/US}) + (X_{i/UE} + M_{i/UE})}$.

X and *M* are average bilateral exports and imports, taken from IMF *Direction of Trade Statistics*, and computed over 1990-2000.

Productivity

Industrial productivity is computed using the IFS, OECD MEI and UNIDO database, reformatted by Cepii using INDSTAT2002 ISIC REV3, a UNO database of industrial production. We use

- Industrial production
- Industry employment

Industrial productivity is computed for each country *i* of the sample as well as for the US and Germany. Relative industrial productivity is therefore the ratio of country *i*'s industrial productivity to the trade-weighted average of the US and Germany's industrial productivity

Net foreign assets

Net foreign assets data were computed by cumulating current account balances to NFA data (using IMF, *Balance of Payment Statistics*, line 78ald). Data are in dollars, and were normalised by national GDPs in the same currency (IMF, *International Financial Statistics*, line 99 and line 00rf).

APPENDIX 2.

Table 1. Constants from the specification RERCPI=f(PROD,NFA), 1975-2002

RERCPI2	prod,nfa														
	_at	_be	_nl	_fi	_gr	_ie	_pt	_es	_dk	_se	_ca	_au	_nz	_sa	_co
DOLS	-0.032	-0.018	-0.073	-0.191	0.023	0.012	-0.010	-0.009	-0.040	-0.088	-0.102	-0.303	-0.226	0.125	-0.014
DOLS_AIC	-0.032	-0.018	-0.071	-0.187	0.023	0.012	-0.010	-0.003	-0.040	-0.090	-0.101	-0.309	-0.230	0.121	-0.014
DOLS_SIC	-0.031	-0.018	-0.070	-0.186	0.023	0.011	-0.004	-0.003	-0.043	-0.090	-0.101	-0.309	-0.237	0.121	-0.010
MGE	-0.029	-0.013	-0.066	-0.158	-0.024	-0.084	0.010	-0.090	-0.035	-0.059	-0.249	-0.319	-0.125	0.213	0.039
MGE_AIC	-0.029	-0.015	-0.066	-0.158	-0.023	-0.064	-0.003	-0.109	-0.042	-0.059	-0.249	-0.319	-0.125	0.213	0.039
MGE_SIC	-0.029	-0.015	-0.066	-0.158	-0.023	-0.064	-0.003	-0.109	-0.042	-0.059	-0.249	-0.319	-0.125	0.224	0.039
	_cz	_hu	_pl	_si	_sk	_ee	_lv	_lt	_cy						
DOLS	-0.070	-0.047	-0.080	-0.089	-0.053	-0.209	-0.522	-0.736	-0.030						
DOLS_AIC	-0.070	-0.006	-0.079	-0.089	-0.050	-0.289	-0.522	-0.736	-0.038						
DOLS_SIC	-0.070	-0.013	-0.079	-0.089	-0.050	-0.289	-0.522	-0.736	-0.039						
MGE	-0.101	-0.048	-0.072	-0.098	-0.081	-0.992	-0.927	-3.529	-0.127						
MGE_AIC	-0.101	-0.048	-0.090	-0.098	-0.069	-0.992	-0.927	-2.794	-0.127						
MGE_SIC	-0.101	-0.074	-0.090	-0.098	-0.069	-1.118	-0.927	-2.794	-0.127						