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

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Abstract

This paper investigates the determinants of equilibrium real exchange rates for the new EU member states and candidate countries, relying on an asset model inspired by Aglietta et al. (1998) and Alberola et al. (1999, 2002). The impact of productivity gains on both the Balassa-Samuelson effect and the behaviour of the tradable real exchange rate is especially assessed. Subdividing the panel into sub-panels, we show that the B-S effect is a common feature to all economies, but that the tradable price-based real appreciation is a distinct feature of transition and emerging economies. We also show that in transition countries, a decrease in net foreign assets leads to an appreciation of the real exchange rate, instead of the depreciation predicted by theory. Comparing in-sample and out-of-sample estimates (in terms of the country coverage) of equilibrium exchange rates shows that these measures can yield different results, and could therefore be considered as complementary tools in judging misalignments.

JEL: C15, E31, F31, O11, P17

Keywords: real equilibrium exchange rate, EU enlargement, , Balassa-Samuelson effect, productivity, net foreign assets, out-of sample panel

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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. This sizeable real appreciation is often 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, 2004; Égert 2002, Égert et al. 2003, Mihajlek and Klau 2004). Macro-economic models and reduced-form equations have also been used for assessing determinants of the real exchange rate. In addition to productivity, they consider a wide range of other determinants, 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 2004).

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 and 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.[1] 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, while such an approach attempts to correct the constant term, it cannot, by nature, account for possible parameter differences between transition countries and the more developed countries, e.g. in the OECD, regarding net foreign assets and productivity. Such differences are yet likely: 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; rapid changes in supply capacities and technology may imply that productivity impacts on the real exchange rate through different channels than in industrialised countries operating at the technological frontier.

In this paper, we make a further step in comparing panel estimates from out-of sample and in-sample estimates. As a background, we use the stock-flow approach as set out in e.g. Faruqee (1995), Aglietta et al. (1998) and Alberola et al. (1999, 2002). In this approach, the equilibrium real exchange rate is 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

[1] In-sample and out-of-sample estimates are defined here in terms of country coverage. Namely, out-of-sample measures of the equilibrium exchange rate for a given country are based on exchange-rate equations estimated on a sample where from this country is excluded. Conversely, in-sample measures are derived from equations estimated on a geographical sample including the country of interest.

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[2] 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. An 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.

Besides 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 also view productivity as channelling changes in the tradable price-based real exchange. This is the case in transition economies because industrial productivity gains do not only reflect the cost-competitiveness of the countries, but also quality improvements – i.e. non-price competitiveness – . Therefore, productivity improvements are expected 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, we show that transition and emerging market economies do experience a tradable price-based appreciation, which is not the case in the more developed OECD 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 relative productivity vehicles other type of information as well, and is an imperfect substitute for the Balassa-Samuelson effect.

The paper is organised as follows: Section 2 presents the theoretical framework. Section 3 describes the data and the estimation methods. Estimation results are then presented in Section 4. Finally, Section 5 concludes.

2 Theoretical Framework

2.1 Real Exchange Rate Decomposition

Decomposing the real exchange rate allows separating competitiveness from relative price issues, as all prices need not affect the ability of a country to sell goods or services abroad.

Considering the consumer price index (CPI) composed of tradable and non-tradable goods with α and (1-α) being the respective share of tradable and

[2] The term "transition economy" is used throughout the paper instead of "new EU member state" (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia) or "candidate country" (Bulgaria, Croatia and Romania) because for most of the period used for the estimations, the countries from Central and Eastern Europe can be viewed as transition economies.

non-tradable goods in the CPI, the real exchange rate (q)[3] can be split into two components: (1) the real exchange rate of the open sector, pT being the price index of tradable goods, and (2) the ratio of domestic to foreign relative price of non-tradable goods, pNT (which came to be known as the internal real exchange rate) as shown below (all variables are transformed into logs):

$$q = e + p^{T*} - p^{T} - \left[(1-\alpha)\left(p^{NT} - p^{T}\right) - (1-\alpha^{*})\left(p^{NT*} - p^{T*}\right)\right] \qquad (1)$$

This decomposition allows to separate the factors that influence the real exchange rate of the open sector (and hence the current account via the trade balance), from the ones that are related to the price developments in the non-tradable sector.

According to asset models of the real exchange rate[4] , the current account is driven, in the long run, 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 purchasing power parity (PPP). On the opposite, the relative price of non-tradable goods need not affect international competitiveness, and hence the current account position and changes in net foreign assets .[5]

2.2 The Real Exchange Rate of the Open Sector

The theoretical motivation of our empirical analysis draws on the model developed by Alberola et al. (1999, 2002). The equilibrium real exchange rate is defined as the real exchange rate that leads simultaneously to internal and external balances.

Internal balance is reached when the domestic goods market clears (non-inflationary level of employment, i.e. output near to its potential level). Hence, it conveys both a Balassa-Samuelson (B-S) effect (the relative price of non-tradable goods increases when productivity rises faster in the tradable sector than in the non-tradable sector) and a demand effect.

External balance refers to current account sustainability, which implies 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 characterised by the convergence of net foreign assets towards their desired

[3] q=e+p*-p where e and p are the nominal exchange rate and the overall price index. The asterisk denotes the foreign country. Note also that the exchange rate is defined as units of domestic currency per one unit of foreign currency. Thus, an increase (decrease) in the exchange rate denote a depreciation (appreciation).

[4] Frenkel and Mussa (1985), Faruqee (1995), Aglietta et al. (1997), Alberola et al. (1999) and Lane and Milesi-Ferretti (2002).

[5] It need not, but it can, if non-tradables are inputs for the production of tradables, and their increase implies cost pressure on the tradable goods prices.

level, i.e. current account deficits or surpluses are connected with desired 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.

This model leads to the following testable equation, where the real effective exchange rate (qt) is determined jointly by the dual productivity differential (prod)[6] and net foreign asset (nfa)

$$q = f(prod, nfa) \tag{2}$$

In such a framework, external equilibrium only relies on price-competitiveness, as net foreign asset developments feed back into the real exchange rate to achieve the desired current account position. However, current account developments do not only depend on price-competitiveness. This is especially the case in emerging markets, which experience an upgrading in the quality of specialisation, but also in developed economies, where product differentiation leads the price-elasticity of demand for tradable goods to decrease. This issue is explicitly taken into account in the theoretical model developed by Aglietta et al. (1998), drawing on Faruqee (1995).

In Aglietta et al (1998), the external equilibrium depends both on the net foreign asset position and non-price competitiveness (npc), the underlying assumption being that an improvement in non-price competitiveness allows for an appreciation of the real exchange rate for a given current account position. Consistently with other theoretical models, the internal equilibrium is determined by a Balassa-Samuelson effect. The resulting reduced real exchange rate equation is the following:

$$q = f(\overset{-}{prod}, \overset{-}{npc}, \overset{+/-}{nfa}) \tag{2'}$$

This model of stock-flow adjustment suggests a long-term relationship between the real exchange rate and net foreign assets on the one hand, and determinants of the trade account on the other. An increase in non-price competitiveness and in relative productivity leads to an appreciation of the equilibrium real exchange rate. The sign on net foreign assets 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 (hence, a positive relationship between nfa and q). Therefore, the effect of income payments for the foreign debt (requiring a real depreciation when nfa falls) may dominate the exchange rate determination only at a later point when the desired level of foreign debt or negative foreign assets is achieved (negative relationship between nfa and q).

[6] The dual productivity differential is defined as: $(prod^T - prod^{NT}) - (prod^{T*} - prod^{NT*})$

3 Estimation Issues

3.1 Measuring Non-Price-Competitiveness

Aglietta and others (1998) measure non-price competitiveness by means of the R&D expenditure. This proxy does not seem to fit well non-price competitiveness developments in transition economies, where technology is mostly imported from abroad via massive foreign direct investment (FDI)[7], which is in turn reflected in huge productivity advances in the industrial sector. This last feature gives support to the use of average industrial labour poductivity as a proxy for non-price competitiveness in. The catch-up process entails a shift towards the supply of goods of higher quality and value-added and better reputation. If labour productivity is associated with quality improvements, or a better product differentiation, the relative price of tradable goods can increase, because demand becomes less price-elastic.[8] While quality improvement 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 (2004).

Approximation of quality and technology changes by average productivity may however apply only to transition countries. The fact that an increase in productivity in the open sector may be linked to a real appreciation of the open sector's real exchange rate in transition economies is in sharp contrast with predictions of models within the New Open Economy Macroeconomics (NOEM) framework. In these models, an increase in productivity leads to a depreciation of the real exchange rate of the open sector because of a decrease in the prices of tradables relative to those in the foreign economy (Beningo and Thoenisssen, 2003, MacDonald and Ricci, 2002 and Világi, 2004).

When assessing the behaviour of the real exchange rate based on a broad measure of prices such as the CPI, productivity can also account for the B-S effect: an increase in the dual productivity differential leads to an appreciation of the internal real exchange rate and consequently the CPI-based real exchange rate. In our test, average labour productivity in industry in the home country relative to the foreign benchmark will capture both the non-price-competitiveness and the B-S effects [9] To distinguish between the two channels through which productivity affects the real exchange rate, not only the CPI-based real exchange rate, but also the producer price index (PPI)-deflated (as a proxy for tradable goods) real exchange rate is also regressed on productivity

[7] R&D is chiefly produced in the origin countries of the multinational firms which have been investing in the transition countries.

[8] The new theory of international trade also accounts for such a possibility. According to Krugman (1989), growth may be associated with 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.

[9] 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 tradable goods sector to higher prices of non-tradables is stable. This is fair compromise to capture two effects with one variable.

and net foreign assets.

3.2 Reduced Form Equations

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 (3):

$$q^{CPI} = f(\overset{-}{prod}, \overset{+/-}{nfa}) \tag{3}$$

The effect of productivity improvements on the real exchange rate of the open sector is also assessed in equation (4), where the producer price index (PPI)-deflated (as a proxy for tradable goods) real exchange rate is also regressed on productivity and net foreign assets:

$$q^{PPI} = f(\overset{-}{prod}, \overset{+/-}{nfa}) \tag{4}$$

Because of comparison reasons, we also perform the estimations using the relative price of non-tradables to that of tradables given by the domestic CPI-to-PPI ratio relative to the foreign CPI-to-PPI ratio:

$$q^{CPI} = f(\overset{-}{rel}, \overset{+/-}{nfa}) \tag{3'}$$

$$q^{PPI} = f(\overset{-}{rel}, \overset{+/-}{nfa}) \tag{4'}$$

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, however, two problems with this identification. 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, the latter referring to producer prices before adding indirect taxes);

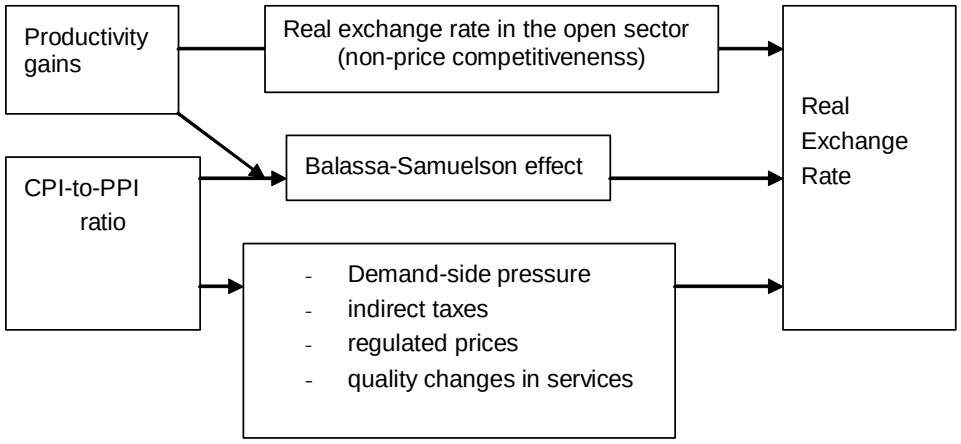
(c) The adjustment of regulated prices (which concerns most often non-tradables); and

(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 during the adjustment process if the desired stock of net foreign assets is negative. The relationship becomes negative once the desired NFA position is reached.

Finally, in a further extension, net foreign assets, relative prices and productivity are all considered in one single specification to see whether the productivity variable and the relative price variable vehicle a different set of information. As long as they both enter the equation significantly and with the correct sign, the productivity variable would describe the effect of non-price-competitiveness on tradable prices, whereas the CPI-to-PPI ratio would stand both for the above-mentioned four factors and for the Balassa-Samuelson effect:

$$q^{CPI} = f(\overset{-}{prod}, \overset{-}{rel}, \overset{+/-}{nfa}) \tag{5}$$



The transmission from productivity and the CPI-to-PPI ratio to the real exchange rate

3.3 Data Sources and Definitions

The dataset 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

[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.

is also included in the dataset. On the basis of the 35 countries, the following panels were considered: (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 real exchange rates for the transition economies, 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 appreciation 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] All data are quarterly ; the definition of variables and data sources are given in the Appendix.

Table 1. Overview of panels

Panel1	15 OECD countries
Panel2	8 emerging countries
Panel3	11 CEE transition countries
Panel4	8 transition countries (CEEC5+B3)
Panel5	CEEC5
Panel6	Panel 1 + Panel 2 + Panel 3
Panel7	Panel 6 + 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[14], 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

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

[14] In doing so, we do not consider the rest of the world, which implicitly suggests that real exchange rate adjustments, if any, are to be made against the euro (mostly) and the dollar (marginally). This hypothesis, although apparently restricting, matches both the increasing orientation of transition countries economies towards the euro area, and the future of EMU participation, which will leave asymmetric shocks to be adjusted through the relative prices against other EMU countries. See Bénassy-Quéré et al. (2004) for developments about the inclusion/exclusion of the rest of the world in real effective equilibrium exchange rates estimations.

	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.

(c) 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:$\ln(1 + (NFA/GDP)/100)$

3.4 Econometric Issues

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:

$$\Delta y_{i,t} = \pi_t \cdot y_{i,t-1} + \sum_{t=1}^{n-1} b_i \cdot \Delta y_{i,t-1} + \mu_i + \gamma_i \cdot t + \varepsilon_{i.t}, i = 1, 2, ..., N; t = 1, 2, ..., T \tag{6}$$

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).

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:

$$Y_{i.t} = \beta_0 + \sum_{i=1}^{n} \beta_n \cdot X_{i,t} + \sum_{i=1}^{n} \sum_{j=-k_1}^{k_2} \gamma_{i,j} \cdot \Delta X_{i,t-j} + \varepsilon_t \tag{7}$$

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 (8) where the dependent variable in first differences is regressed on the lagged values of the dependent and independent variables in levels and first differences:

$$\Delta Y_{i,t} = \beta_0 + \rho(Y_{i,t-1} + \sum_{i=1}^{n} \beta_n X_{i,t-1}) + \sum_{j=1}^{l_1} \eta_j \Delta Y_{i,t-j} + \sum_{i=1}^{n} \sum_{j=0}^{l_2} \gamma_{i,j} \cdot \Delta X_{i,t-j} + \varepsilon_t \tag{8}$$

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.

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

4 Estimation Results

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 become stationary after differentiation. Thus, the panel cointegration techniques can be applied to the data. Equations (3) and (3') are estimated for the 7 panels described earlier.[15] 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 yield 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

[15] 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. As results are very similar, only the estimates based on the Schwarz information criterion are reported. Moreover, only results for the CEE11 and CEE5 are shown, as they are similar to what is obtained using different sub-partitions of the CEE data set. Complete results are displayed in Appendix 3.

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 3.

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 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.[16] 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

[16] The CPI to PPI ratio should be connected to relative productivity by a multiplicative factor, which accounts for the weight of the non-tradable sector in the economy : (1-α), where α is the weight of the tradable sector. According to our estimates, the implicit weight of the tradable sector would range between 50% and 0%. The usually accepted figure is around 30%, which matches neither estimate. This is an indication that both variables convey different information. Moreover, in the emerging countries and CEE panels, the estimated parameters do not allow to infer implicit weights for the tradable sector, which is a further indication of both variables relying to different phenomena.

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 to a depreciation, if the movements towards a higher net foreign assets position dominates the effect of subsequent 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, Hinnosar et al. (2003) find a negative sign for Estonia, and Rahn (2003) for Czech Republic, Estonia, Hungary, Poland and Slovenia, 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) 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 indicate 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.

	DOLS	DOLS_AIC	DOLS_SIC	MGE	MGE_AIC	MGE_SIC	No. OBS
OECD							
COINT				-0.043***	-0.041***	-0.042***	1554
PROD	-0.165***	-0.166***	-0.160***	0.083	-0.140	0.124	
NFA	-0.076***	-0.075***	-0.074***	-0.224***	-0.236***	-0.235***	
COINT				-0.054***	-0.051***	-0.052***	1590
REL	-0.745***	-0.760***	-0.763***	-1.132***	-1.214***	-0.744***	
NFA	0.037	0.035	0.035	-0.495	-0.513*	-0.088	
EMERGING MARKET ECONOMIES							
COINT				-0.034***	-0.036***	-0.033***	564
PROD	-1.481***	-1.486***	-1.217***	-1.841***	-1.769***	-1.858*	
NFA	-0.359	-0.361	-0.340	-0.078	0.049	0.063	
COINT				-0.054***	-0.054***	-0.054***	704
REL	-1.443***	-1.450***	-1.449***	-1.479***	-1.479***	-1.479***	
NFA	-0.205	-0.209	-0.192	-0.276	-0.276	-0.276	
CEEC11							
COINT				-0.138***	-0.148***	-0.148***	423
PROD	-0.455***	-0.471***	-0.437***	-0.045*	-0.017***	-0.024***	
NFA	0.627***	0.631***	0.569***	0.343***	0.379***	0.540***	
COINT				-0.103***	-0.086***	-0.088***	427
REL	-1.479***	-1.656***	-1.663***	-1.161***	-0.476***	-0.510***	
NFA	0.437***	0.374***	0.376***	0.202***	0.294***	0.243***	
CEEC5							
COINT				-0.174***	-0.199***	-0.197***	197
PROD	-0.780***	-0.736***	-0.736***	-0.760***	-0.824***	-0.790***	
NFA	0.121***	0.172***	0.176***	0.150**	0.115	0.156	
COINT				-0.100***	-0.086***	-0.089***	197
REL	-0.949***	-0.994***	-1.036***	-1.046**	-1.128***	-1.216***	
NFA	0.423***	0.397***	0.398***	0.124***	0.246*	0.125	

The CPI-based real effective exchange rate

Notes DOLS_SIC are the DOLS estimates obtained on the basis of the Schwarz information criterion. The same applies to the mean group estimators (MGE_SIC). *,*** and *** denote respectively statistical significance at the 10%, 5% and 1% levels. In the row "coint" under MGE_SIC and PMGE are shown the error correction terms.

4.3 The PPI-based Real Effective Exchange Rate

In a second step, equations (4) and (4') are used which connect the real effective exchange rate deflated by the PPI – which proxies tradable goods prices – to productivity / the CPI-to-PPI ratio and net foreign assets. The aim of this series of exercises is to investigate the impact of productivity 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 in the CPI-to-PPI ratio leads to a depreciation of the tradable price-deflated real exchange rate. This is in line with prediction of NOEM models.

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 to a depreciation in the transition countries.

	DOLS	DOLS_AIC	DOLS_SIC	MGE	MGE_AIC	MGE_SIC	No. OBS
OECD							
COINT				-0.063***	-0.061***	-0.061***	1534
PROD	0.015***	0.021***	0.013***	0.013***	0.043***	0.023***	
NFA	-0.124***	-0.125***	-0.120***	-0.203***	-0.207***	-0.194***	
COINT				-0.054***	-0.052***	-0.053***	1590
REL	0.253***	0.239***	0.234***	0.057***	0.541***	0.012***	
NFA	-0.030	-0.028	-0.028	-0.226	-0.771**	-0.217*	
EMERGING MARKET ECONOMIES							
COINT				-0.056***	-0.057***	-0.056***	564
PROD	-1.159***	-1.121***	-1.087***	-1.182***	-1.267***	-1.271***	
NFA	0.257**	0.239**	0.219*	0.950	0.783	0.784	
COINT				-0.054***	-0.054***	-0.054***	704
REL	-0.446***	-0.453***	-0.452***	-0.472***	-0.472***	-0.472***	
NFA	-0.206	-0.210	-0.193*	-0.278	-0.278	-0.278	
CEEC11							
COINT				-0.138***	-0.151***	-0.150***	423
PROD	-0.350***	-0.358***	-0.319***	-0.028***	-0.373***	-0.354***	
NFA	0.456***	0.460***	0.408***	0.300***	0.258**	0.410***	
COINT				-0.102***	-0.102***	-0.104***	427
REL	-0.478***	-0.656***	-0.662***	-0.007	-0.056	-0.218	
NFA	0.438***	0.375***	0.377***	0.092***	0.180***	0.387***	
CEEC5							
COINT				-0.175***	-0.198***	-0.193***	197
PROD	-0.641***	-0.599***	-0.566***	-0.555***	-0.621***	-0.591***	
NFA	0.140***	0.093***	0.043***	0.036	-0.075	-0.057	
COINT				-0.104***	-0.096***	-0.101***	197
REL	-0.052***	-0.007***	-0.035***	-0.201	-0.206	-0.159*	
NFA	0.424***	0.398***	0.399***	0.088**	0.074*	0.087*	

The PPI-based real exchange rate
Notes as for Table 3

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

As a next step, the baseline specification including the (CPI-based) real exchange rate and two explanatory variables is extended in accordance with equation (5): the real exchange rate is regressed on labour productivity, the CPI-to-PPI ratio and net foreign assets. The results are presented in Table 5. Estimates of 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). This is what we would expect on the basis of NOEM models and is in line with the findings in MacDonald and Ricci (2002) and Lee and Tang (2003). The B-S effect, captured through the CPI-to-PPI ratio causes the real exchange rate to appreciate through the internal real exchange rate, whereas an increase in productivity in the open sector leads to a real depreciation of the open sector's real exchange rate. 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.

	DOLS	DOLS_AIC	DOLS_SIC	MGE	MGE_AIC	MGE_SIC	No. OBS
OECD							
COINT				-0.073***	-0.070***	-0.070***	1534
PROD	0.016***	0.011***	0.016***	0.105	0.103	0.064	
REL	-0.811***	-0.811***	-0.803***	-0.501***	-0.584***	-0.610***	
NFA	-0.012	-0.019*	-0.020*	-0.184	-0.198**	-0.124*	
EMERGING MARKET ECONOMIES							
COINT				-0.074***	-0.074***	-0.074***	564
PROD	-1.264***	-1.197***	-1.168***	-2.864*	-1.737	-1.560	
REL	-1.332***	-1.349***	-1.365***	-0.472***	-1.045***	-1.144***	
NFA	-0.314	-0.295	-0.257	-1.298	-0.543	-0.574	
CEEC11							
COINT				-0.106***	-0.143***	-0.112***	423
PROD	-0.514***	-0.488***	-0.486***	-0.124	-0.077***	-0.007*	
REL	-1.502***	-1.657***	-1.652***	-1.241	-0.795**	-0.904	
NFA	0.276***	0.179***	0.190***	0.192***	0.184***	0.046***	
CEEC5							
COINT				-0.187***	-0.197***	-0.173***	197
PROD	-0.475***	-0.459***	-0.454***	-0.248***	-0.389***	-0.306***	
REL	-0.485***	-0.491***	-0.479***	-1.100***	-0.863***	-0.983***	
NFA	0.181***	0.202***	0.226***	0.138*	0.085*	0.030	

Extended specification

Notes as for Table 3

4.5 In-Sample vs. Out-of-Sample Panel Estimates: Constant Terms or Parameter Values?

In a recent paper, Maeso-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.[17] Therefore, they propose to compute out-of-sample measures of the equilibrium real exchange rate for accession countries. Estimates are run on a benchmark panel, which does not include the countries which are suspected to have undervalued real exchange rates at the beginning of the period. Parameter estimates are then applied to these countries (hence, it is an out-of-sample measure of the real exchange rate).

One obvious difficulty with such an approach relates to the computation of constant terms for the "in-sample" countries, as country specific constant firms cannot be derived from the out-of-sample.[18] There is another difficulty

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

[18] Maeso-Fernandez et al. propose to estimate the constant terms by using either (1) the average of constant terms of the sample, (2) the average constant of the converging euro

however, which is evidenced by the sensitiveness of parameter values to the composition of the geographical sample. Depending on the countries included in the sample, our results show that estimated coefficients can change dramatically. At least on the basis of the stock-flow approach, this result strongly questions the economic meaning of equilibrium exchange rate measures, which rest only on out-of-sample estimates.

Indeed, while out-of-sample estimates mirror long-term behaviour – and can be difficult to interpret in policy terms –, in-sample estimates may reflect medium-term developments and therefore trace the equilibrium development more appropriately for policy purposes.

Therefore, out-of-sample estimates alone do not allow to assess the degree of misalignment of a currency because of the strong heterogeneity between the panel for which the estimations are performed and the countries for which those estimations are applied. When this is not the case, in-sample estimates are useful to assess whether the observed long-run misalignment is compensated by a medium-run equilibrium, or whether it is both a long-run and medium-term misalignment.

5 Conclusion

In this study, we used the stock-flow approach to the equilibrium exchange rate proposed by 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. We also follow Aglietta et al. (1998) by taking into account the impact of non-price competitiveness on equilibrium real exchange rate developments. A number of conclusions arise from our empirical analysis.

Firstly, we show that the normally positive relationship between net foreign asset accumulation and real exchange rate appreciation is not a general feature of small open economies. A number of papers had already shown that a decrease in net foreign assets yields an appreciation of the real exchange rate in transition economies. Using panel cointegration techniques, and splitting our sample into smaller and more homogeneous sub-samples, we show that an improving net foreign asset position does correspond to a real exchange rate appreciation for a group of small and open OECD countries. By contrast, a decrease in net foreign assets is found to be systematically linked to a real appreciation of the exchange rate for different groups of transition economies.

We suggest 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

area countries, such as Greece, Portugal and Spain, or (3) the lowest constant term of the euro area countries. Note, however that these strategies do not allow for the case when the country-specific constant terms are outside the range given by the out-of-sample panel.

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 inflows 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, the sources of CPI-based real exchange rate appreciation differ between groups of countries. Real exchange rate in OECD countries are found to behave in line with predictions of NOEM models implying that the B-S effect causes the real exchange rate to appreciate whilst productivity gains in the open sector result in a depreciation of the open sector's real exchange rate. In contrast to this stand our findings for transition economies, where the real exchange rate appreciates not only because of B-S type of factors but also because of the appreciation of the open sector driven by improving non-price-competitiveness.

Thirdly, our results indicate that the CPI-to-PPI ratio is an imperfect proxy for relative prices when measuring 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 (and relative prices in general) as a proxy for relative productivity in transition economies 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.

Finally, we show that sizeable differences exist between in-sample (transition economies and all countries put together) and out-of-sample (OECD countries), as regards the sign and the size of the estimated coefficients. This suggests that both measures offer complementary information on equilibrium exchange rates. Equilibrium rates derived from the panel of OECD countries give an insight on the long run for the transition economies, but may be less easily interpreted for policy purposes.

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