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Estimates of Fundamental Real Exchange Rates for the Five EU Pre-Accession Countries

Kateřina Šmídková, Ray Barrell, Dawn Holland*

Abstract

Are there indications of real exchange rate misalignment in the case of the five pre-accession countries? Will stable real exchange rates, required by two of the Maastricht criteria, be in line with economic fundamentals in the pre-EMU period in these countries? In order to address these questions, we employ the concept of the fundamental real exchange rate (FRER), taking into account the specific features of countries in the advanced stage of transition. The FRER model approximates the integration gain with the impact of foreign direct investment on trade and allows for larger current account deficits if external debt is below a safety limit. The model coefficients are calibrated according to our previous econometric work. Sensitivity tests are used to deal with uncertainty about the baseline assumptions. According to the FRERs, there were signs of overvaluation for all the pre-accession economies, with the exception of Slovenia, at the end of 2001. The second main finding relates to the feasibility of stable real exchange rates in the pre-EMU period. Stability of real exchange rates will not automatically be in line with economic fundamentals in the forthcoming period and, moreover, the FRERs do not move in one direction in all the pre-accession countries. This finding suggests that some flexibility of exchange rates will be needed in the forthcoming period.

JEL Codes: F41, F47

Keywords: Fundamental Real Exchange Rates, EU Accession, EMU Entry, Modelling

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Nontechnical summary

The fundamental real exchange rate (FRER) is defined as the real exchange rate that is in line with economic fundamentals in the medium term. If we knew the values of the FRERs, we could learn very important information for the policy debate relating to EMU entry. First, significant deviations of the observed values of the real exchange rate from the ones computed according to the FRER methodology are indications of currency misalignment. Second, falling or rising FRER paths signal that economic fundamentals might require non-negligible changes in the real exchange rate. In the first case, the indication of the real exchange rate misalignment points to the potential costs of fixing the exchange rate at current levels. In the second case, the requirement for a flexible real exchange rate might make it difficult to fulfil the Maastricht criteria. Since we see both issues as essential to the policy debate, we have derived "FRER corridors" that allow us to analyse real exchange rates taking into account the uncertainty pertaining to the baseline computations.

The search for the FRERs has not been an easy task, although there are a lot of important benchmark studies; these we refer to in the paper. Two major modifications are worth summarising. First, we have extended the previously used models in order to reflect the specific features of the five pre-accession countries. This is reflected in the set of economic fundamentals we use to compute the FRERs. In addition to "traditional" variables such as the terms of trade and foreign and domestic economic activity, we use the stock of foreign direct investment to estimate the trade equations, and two variables—the initial level of external debt and a safety limit for external debt—to derive the sustainable current account deficits. The model coefficients are calibrated according to our previous econometric work. Second, owing to the uncertainty pertaining to the various assumptions of our baseline computation, we have designed FRER corridors, which are superior indicators to any individual path. The widths of these corridors reflect the outcomes of an extensive series of sensitivity tests. Specifically, we test how the FRER changes when the volatility of exogenous variables and the standard errors of econometric estimates are taken into account.

The FRER corridors computed for the five pre-accession countries provided several interesting findings. At the end of 2001, there were signs of overvaluation for all the pre-accession economies, with the exception of Slovenia. The scale of overvaluation was not dramatic, ranging between 5 and 10 per cent. However, the computations also show that in times of negative shocks, such as unfavourable changes in the terms of trade, foreign demand or foreign interest rates, it is quite easy for real exchange rates in the pre-accession countries to disconnect from economic fundamentals. For example, in 1999 a combination of several negative shocks caused problems for the pre-accession countries. The computations also indicate that the stability of real exchange rates will not be automatically in line with economic fundamentals in the forthcoming period and, moreover, the FRERs will not move in one direction in all pre-accession countries. Some countries might need real appreciation (e.g. Slovenia) and others real depreciation (e.g. Hungary and Poland) in order to have their real exchange rates in line with economic fundamentals. In the period 2000–2005, an average annual nominal appreciation of 3 per cent might be needed if inflation is to be gradually reduced to the eurozone levels.

1. Introduction

In the second half of the 1990s, the five EU pre-accession countries—the Czech Republic, Estonia, Hungary, Poland and Slovenia—entered the advanced stage of transition[1], and, at the same time, the EU negotiations with these countries picked up pace. These two challenges have had a significant impact as the countries have formed their views on exchange rate policies as well as on the development of their real exchange rates. During the advanced stage of transition, exchange-rate flexibility became much more important for countries with liberalised capital accounts. The Czech Republic, Poland and, subsequently, Hungary moved away from pegging their exchange rates and implemented inflation-targeting frameworks. Hence, it was only Estonia that, after a decade of transition, continued using the fixed exchange rate as a nominal anchor. Slovenia combined gradual approach to liberalisation with managed float. The variety of exchange-rate policies implemented by the five countries increased.

This variety has been in contrast with the ultimate target for economic policies across the five EU pre-accession countries. Their common target is given by the Maastricht criteria, which must be satisfied before EMU entry. Specifically, the two criteria[2] requiring low and stable inflation and a stable nominal exchange rate imply that real exchange rates in the pre-accession countries should be stabilised two years before entry, when the conversion rates are to be decided. At the same time, the whole pre-EMU period will also be a time of real convergence during which real appreciation or depreciation may be necessary in order to reflect important changes in the economy. It is then a natural question to ask when the stable real exchange rates will be in line with economic fundamentals in each of these five pre-accession economies. The second question to ask is which levels of the real exchange rate will ensure that there are no serious misalignments, and consequently, that the conversion rates will be sustainable after EMU entry.

This paper assesses real exchange rate developments for the group of five EU pre-accession countries from the perspective of these two questions. We search for real exchange rate paths that are in line with economic fundamentals in the medium term. The computations of fundamental real exchange rates (FRERs) can provide a very important quantitative background for the policy debate about the pre-EMU exchange-rate policies. If the slope of the FRER path is not horizontal, this may be an indication of a need for certain flexibility of the nominal exchange rate. A steep slope signals that economic fundamentals require changes in the real exchange rate that are not compatible with the above-mentioned two Maastricht criteria. A significant deviation of the actual real exchange rate from the FRER values may indicate a currency misalignment and a future need for corrections to bring the real exchange rate back into line with economic fundamentals. Such corrections may be too costly after EMU entry. In both cases, the FRER would signal that further convergence might be needed before EMU entry. In the analysis, we put the emphasis on the similarities and differences among the five EU pre-accession countries. Our intuition is that—although there is a common tendency towards catching-up—there are differences among the

[1] Stern (1998) characterises two stages of transition as follows. In the first stage, liberalisation, privatisation and stabilisation were priorities. In the advanced stage, the main focus was on implementing economic policies that enhance economic growth. The advanced stage may coincide with a period of real convergence towards the EU.

[2] See, for example, the ECB's Convergence Report (2000) for analysis of the convergence criteria

countries that could cause the FRER paths to differ. Hence, it is not possible to assume that one approach to exchange rate policy in the pre-EMU period will fit all five countries.

There are various approaches to evaluating the sustainability of a particular real exchange rate path. Owing to the nature of the above-mentioned two questions, we want to focus our analysis on the medium term[3]. One theory suggests that we could calculate various simple indicators of competitiveness based on purchasing power parity. However, this approach—although it is computationally the least costly—neglects many important factors relating to economic convergence and is not very well supported by the empirical findings[4]. Hence, we rather turn to the theoretical concept of the equilibrium exchange rate, even though its application is computationally more demanding. The equilibrium exchange rate is—according to the general definition—the rate that is consistent with both external and internal equilibrium of the economy.

This theoretical concept needs to be specified more precisely for the purposes of empirical work. The general definition is typically adjusted as follows. The external balance is defined in terms of the current account deficit. The targeted level of the deficit is decided before the actual computation. As a result, the computed equilibrium real exchange rate is a normative concept. The internal balance is defined in terms of full capacity output or in terms of the NAIRU; both are modelled independently from the real exchange rate[5]. Prior to the computation, the elasticities of the trade equations with respect to the real exchange rate and domestic and foreign activity must be estimated. The link between the current account and the stock of net external debt is used to close the model. Then the equilibrium real exchange rate consistent with the scenario of internal balance can be derived. This approach is considered a partial equilibrium approach, although the sequencing of steps also corresponds to assuming that domestic monetary and fiscal policies are successful in keeping the economy close to its internal balance while the real exchange rate equilibrates the external balance. This framework is used for all computations of the "fundamental" and "desirable" equilibrium exchange rates[6].

In order to compute the sustainable path of the real exchange rate during the advanced stage of transition and during the pre-EMU period, we suggest using a similar framework that—in addition to our benchmark studies[7]—takes into account several important factors. First, there has been a strong tendency towards integration. Liberalisation has increased the openness of the five EU pre-accession countries, and the world economy has had an increasing impact on domestic developments through trade and investment flows. Second, the level of external indebtedness

[3] There are various approaches to calculating sustainable real exchange rates, such as taking into account long-run factors (demographics and saving behaviour), short-run factors (short-term interest rates) and studies that estimate a single equation derived from a theoretical model for sustainable real exchange rates. Further descriptions can be found in Williamson (1994), Stein, Allen (1995) and Edwards (1989).

[4] A summary of the various methods of testing the purchasing power parity models, together with an overview of the empirical findings, can be found in Baucher-Breuer's chapter in Williamson (1994).

[5] This corresponds to assuming that the full-employment line is vertical. Artis, Taylor (1993) describe the general sequencing of steps in computations of equilibrium real exchange rates.

[6] Clark, Bartolini, Bayoumi, Symansky (1994) and Williamson (1994) introduce the concepts of DEERs and FEERs.

[7] Barrell, Wren-Lewis (1989) and Barrell, Sefton (1997) evaluated the performance of real exchange rates within the EMS. The application to the Czech data has been described in Smidkova (2001).

inherited from the first stage of transition may impose a serious financial constraint on the domestic economy. Only if a country was fortunate enough to start the pre-accession period with a low level of external indebtedness can trade deficits be financed easily and a stronger real exchange rate thus be feasible. Third, foreign direct investment (FDI) has been an important source of catching-up for the pre-accession countries. It has affected all domestic variables and also the trade balance because of the expected gains from integration, which should increase net exports.

When computing the FRERs, we follow our benchmark studies in using the structural trade equations of the five pre-accession economies as the buildings blocks of the model. In addition to standard trade determinants, we incorporate into the model the above-mentioned factors that are important specifically for pre-accession economies. The trade equations extended in this way have been estimated in an econometric panel in our previous work[8]. In order to ensure consistency, macro-econometric models of the five countries which have been integrated into the global econometric model NiGEM are used for projection of the domestic variables exogenous to the FRER model[9]. The NiGEM projections for the external variables provide further economic consistency in the international context. Within this framework, the FRER paths are computed.

The following two important modifications with respect to our benchmark studies are worth emphasising. First, we redefine the external balance in terms of stocks rather than flows. Instead of having a constant target for the current account deficit, as was the case in other studies, we target the stock of net external debt at the end of the simulation period. This modification implies that although the FRER is still a normative concept, the current account deficit can exceed the traditional safety limits in the short term if the external debt is low. By setting the target for external debt prior to computation of the FRERs, we reflect the fact that safety limits for external indebtedness are decided by financial markets internationally, and that solvency constraints are thus exogenous to domestic policies[10].

Analogous views on the external balance have been used by financial institutions to evaluate the sustainability of current accounts taking into consideration the stock of external debt accumulated in the past[11]. According to these views, the safety limit for the current account deficit is not decisive if the economy is solvent. A solvent economy does not face external constraints when financing its economic convergence and can achieve very high levels of productivity quite fast. Since the FRER model reflects this view, the fundamental real appreciation would in this case be

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[8] Barrell, Holland, Jakab, Kovacs, Smidkova, Sepp, Cufer (2002) describe the five country models as well as estimation details.

[9] See Barrell *et al.* (1993) for details on model properties, and Barrell *et al.* (2001) for recent applications. See National Institute Economic Review (2002) for a description of the recent NiGEM forecasts.

[10] Milesi-Ferretti, Razin (1996) put the emphasis on the links between the sustainability of current accounts, solvency and the willingness of foreign investors to lend.

[11] For example, Ades, Kaune (1997) have developed a methodology for computing sustainable current account deficits for developing countries. They emphasise that it is important to consider domestic potential for growth as well as the costs of servicing the external debt and the willingness of foreign investors to lend. They claim that the sustainable current account deficit in 1997 was around 2.3% for the Czech Republic, 0.8% for Hungary and 4.7% for Poland. They emphasise that the sustainable current account deficit will change over time.

faster than the appreciation suggested by simple calculations of the Balassa–Samuelson effect[12]. Nevertheless, one can relate the Balassa–Samuelson effect to the FRER framework because the availability of external finances co-determines the speed of convergence in productivity levels.

The opposite case is also important to notice. Countries with high external debt are more constrained under the debt target than under the constant target for the current account deficit. For these countries, problems with external balance constrain the domestic economy, since they cannot finance their economic convergence by borrowing abroad, and the difference in productivity levels can be removed only slowly. In the extreme case, the external constraint will outweigh the Balassa–Samuelson effect completely and real depreciation will be the only possible solution. To sum up, we add the initial stock of net external debt to the economic fundamentals that are important for assessing the real exchange rate. The pre-accession countries that inherited a large stock of external liabilities will have less room for appreciation of the FRER and their currencies are, *ceteris paribus*, more likely to be overvalued.

The second modification with respect to our benchmark studies relates to the expected gain from economic integration[13]. The FRER model adds the stock of FDI to a traditional set of economic fundamentals that otherwise consists of the terms of trade, world interest rates, and domestic and foreign economic activity. In the FRER model, the stock of FDI approximates the impact of economic integration on the trade balance[14]. Foreign affiliates have been shown to engage in relatively high levels of trade with their parent companies, which encourages both imports and exports. Hence, over time, exports and imports grow faster than the traditional set of fundamentals would suggest. In addition, technologies introduced by foreign firms may raise the variety and quality of goods produced, strengthening external demand. This implies that the stock of FDI improves net exports over time. Both potential gains from integration have, in the case of these five countries, been confirmed by econometric estimates. As a result, faster accumulation of FDI implies in the FRER model more room for fundamental real appreciation.

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[12] According to the Balassa–Samuelson effect, the real exchange rate can appreciate and stay in equilibrium if there is faster productivity growth in more open sectors, which pushes wages up across the economy as a whole. The faster is the convergence in productivity levels, the larger is the real equilibrium appreciation. De Broeck and Sløk (2001) find that a 1 per cent rise in relative productivity is associated with a 0.4 per cent real appreciation. This finding can be used for estimates of equilibrium appreciation, given that the difference in productivity levels and speed of convergence are known. Simple indicators based on the Balassa–Samuelson effect assume, for example, that convergence of the pre-accession countries to the EU average productivity level will take ten years.

[13] Gains from integration are often quoted as one of the sources of growth in the medium term, since international trade increases the variety of goods, competition, imitation of new technologies and import of technologies. For a summary, see, for example, Grossman, Helpman (1991) and Barry (1996).

[14] Barrell, Pain (1997) develop a general framework of interaction between FDI and the rest of the macro-econometric model. Holland, Pain (2000) introduce FDI into their trade equations when modelling developing and transitional economies. There are two channels through which the stock of FDI influences the economy according to these studies. First, there is an integration gain linking FDI with the trade balance directly. With an increasing stock of FDI, trade increases and net exports improve. This gain causes the fundamental exchange rate to appreciate. Second, there is a productivity gain linking FDI with the production function. In this case, an increase in FDI promotes growth and reduces prices. As a result, there is real exchange rate depreciation. The net effect on the real exchange rate depends on the econometric estimates of the individual coefficients. In the case of the five pre-accession countries, the integration gain outweighs the production gain, as shown in Barrell, Holland, Smidkova (2002).

When we compute the FRERs, the results depend on our baseline assumptions about exogenous variables and also on our previous estimates of the trade equations. Hence the baseline computations of the FRERs are subject to uncertainty and the indications of potential currency misalignment and the feasibility of stable real exchange rates may be subject to various biases. In order to obtain more robust indicators, we construct "FRER corridors" using results from a series of sensitivity tests. The tests are calibrated according the average volatility of past data series and according to the standard errors of the panel estimates. They are then combined into two groups considering external and domestic factors separately. Subsequently, the width of the FRER corridors allows us to see the significance of the indications of currency misalignment and the significance of the evaluation of the feasibility of fulfilling the two Maastricht criteria on price and exchange rate stability simultaneously.

The results of the FRER computations should be put into the context of the wide international debate. The interest in sustainable real exchange rates has been intensified by the introduction of the euro, since the external balances of the pre-accession countries can be now evaluated with respect to the eurozone. The recent debate has stressed that in the pre-accession countries, convergence towards the eurozone will naturally bring a certain degree of real exchange rate appreciation that will be in line with economic fundamentals, specifically with expected productivity gains. However, if real exchange rates appreciate too much, competitiveness might be lost. Hence, the deviations of real exchange rates from the fundamentals should be carefully analysed[15]. The assessments of real exchange rate developments in pre-accession countries available so far indicate that there is indeed a danger of overvaluation in some countries[16]. We also consider the "view from the other side" corresponding to these indications. Recent estimates of the misalignment of the euro have suggested that the euro was undervalued in 2000 with respect to other currencies[17].

The rest of the paper is organised as follows. In the next part, the equations of the FRER model and the way the coefficients have been calibrated are described. Two key features of the FRER model—the external financial constraint and the integration gain from FDI—are explained in more detail. In the third part, the baseline computations are shown. Two main observations relating to the slopes of the FRER paths are emphasised. First, during the advanced stage of transition, the real appreciation was in line with economic fundamentals in all five pre-accession countries. Second, in the pre-EMU period, the forecasts of economic fundamentals indicate different prospects for the individual countries. The FRER indicator of currency misalignment is derived. According to this indicator, there were signs of overvaluation in the pre-accession

[15] Frait, Komárek (2001) claim that although the speed of real exchange rate appreciation has been high among transitional economies, it might not be sustainable in the longer term owing to a potential loss of competitiveness.

[16] Begg, Halpern, Wyplosz (1999) and previously Halpern, Wyplosz (1996) estimated equilibrium exchange rates with their own methodology using a set of fundamental variables alternative to those suggested by Williamson (1994). According to their results, Hungary and Poland were close to overvaluation by 1996. In addition, there have been numerous studies assessing real exchange rates for single pre-accession countries. See, for example, Havlik (1996), Kovacs (2001), Stavrev (2000).

[17] Dieppe, Henry, Marin, Smets (2002) use several methodologies to assess this issue, such as the DEER approach and estimates of structural VARs. Their results indicate that the euro was undervalued in the range of 5–27% in 2000.

countries at the end of 2001. In the fourth part, extensive sensitivity tests are used in order to derive "FRER corridors". In comparison with the baseline computations, the FRER corridors provide more robust signals as far as currency misalignment is concerned. They also provide a more robust evaluation of whether the stable real exchange rates will be compatible with economic fundamentals in the pre-EMU period. The paper concludes with a summary of the major findings and suggests topics for further research.

2. The FRER Model

Let us start by explaining our definition of external balance. Instead of deriving a sustainable path for the real exchange rate from a limit that the current account deficit should not exceed in any period of time (a constant target for deficit), we use a less binding definition based on the targeted level of the (net) external debt to GDP ratio in the end period. This definition of external balance allows for the current account deficit to be relatively high in the pre-accession period when the catch-up process is at its fastest, but the size of the acceptable current account deficit depends, as was said, on the initial stock of external debt[18]. The FRER model ensures that, in the medium–term, the external debt will not exceed the safety limit set by the financial markets.

$$D^* = \delta\left[D_0, D_T\right] \qquad (1)$$

where D is the ratio of net external debt (in domestic currency in real terms) to GDP targeted by the authorities in the model. For the purposes of our computations, D* is represented by a function* δ *that extrapolates between the starting position* D_0*, given by the data, and the level that the authorities in the model want the debt-to-GDP ratio to settle at (after time T)* D_T*.*

In this paper, our baseline scenario works with a targeted debt-to-GDP ratio equal to 60 per cent in the end period, which corresponds to the safety limit quoted by private financial institutions. However, we are aware that the safety limit is very difficult to derive precisely. In order to test for the feasibility of this policy target, we run an extensive sensitivity test that tracks the consequences of setting the limit for the end period ten percentage points lower or higher. The test shows that the FRERs respond with a very small change, ranging from 0 to 0.4 per cent in ten years depending on country-specific factors. Consequently, our uncertainty about where exactly the safety limit is should not affect the FRER computations significantly.

The second important feature of the FRER model is the inclusion of the integration gains into the trade equations. The stock of FDI (relative to GDP) is the most likely driving force of economic convergence in the five pre-accession countries. The higher the stock of FDI, the higher is the economic integration, which in turn tends to promote trade and improve net exports. However, the impact of FDIs on net exports can differ from country to country and depends on whether the FDIs require large-scale imports of technology and whether this technology is used to produce

[18] A safety limit for the current account deficit was often used by foreign investors as a benchmark set by rule of thumb (typically equal to 4 per cent). If the limit was exceeded, investment positions in the country were re-evaluated. Since this was very restrictive for countries with a low level of external debt and too benevolent for large debtors, more recent studies of private financial institutions try to address the problem by suggesting that external debt should converge to a certain level (between 50 and 60 per cent of GDP). See Ades, Kaune (1997).

substitutes for imported goods. According to the theory, the overall impact of FDI on the trade balance should be an improving one, but it is important to test this hypothesis on data. According to our estimates, the stock of FDI improves net exports in all five pre-accession countries.

We modify the export and import equations along these lines. Exports depend on the relative price of exports, foreign demand, and the accumulated stock of FDI (in real terms and with respect to GDP). Imports depend on the relative price of imports, domestic output and the accumulated stock of FDI. It is worth noting that, for the sake of simplicity, the real exchange rate is defined in terms of import prices and domestic consumer prices. The relative price of exports is then expressed by the real exchange rate and terms of trade.

$$X = a_0 \left(\frac{E.Pm}{P} \right)^{a_1} \left(\frac{Px}{Pm} \right)^{\alpha_1} S^{\alpha_2} FDIS^{\alpha_3} \qquad (2)$$

where X is exports (index), E is the (dollar) nominal exchange rate, Px is the effective price of exports, P is the domestic price level, Pm is the effective price of imports, S is foreign demand, and FDIS is the stock of FDI in real terms with respect to GDP.

$$M = \beta_0 \left(\frac{E.Pm}{P} \right)^{\beta_1} Y^{\beta_2} FDIS^{\beta_3} \qquad (3)$$

where M is imports (index), and Y is domestic output.

The difference between imports, the interest rate payment on net external debt, and exports equals the increase in net external debt. We can thus solve the system of equations (1)–(3) in order to compute the FRER. Equation (4) defines the FRER as the real exchange rate consistent with the following important economic fundamentals: the terms of trade, world interest rates, domestic and foreign activity, the stock of FDI and the initial level of (net) external debt. The FRER also ensures that the constraint on external debt will be met, given the assumed interactions of domestic trade with the international environment and the scenarios for exogenous variables.

$$\left\{ \overline{M} \beta_0 (FRER)^{\beta_1} Y^{\beta_2} FDIS^{\beta_3} - \overline{X} a_0 (FRER)^{a_3} \left(\frac{Px}{Pm} \right)^{\alpha_1} S^{\alpha_2} FDIS^{\alpha_3} \right\} = \qquad (4)$$

$$(1-r) D^* Y - D_{-1}{}^* Y_{-1}$$

where FRER is the fundamental real exchange rate, $\overline{M}$ *is the volume of real imports in the base year,* $\overline{X}$ *is the volume of real exports in the base year, and r is the real interest rate abroad. A list of all the model variables is given in the Appendix.*

According to equation (4), the FRER depends on the international environment. If the terms of trade, the world interest rate, foreign demand or the inflow of FDI are changed dramatically by some international event, the path of the real exchange rate that is sustainable in the medium term changes as well. For example, falling world demand increases, *ceteris paribus*, the value of the FRER. In this paper, a higher value of the FRER means that economic fundamentals require real

depreciation. A fall in domestic output has the opposite effect on the value of the FRER, implying more room for fundamental appreciation.

The FRER also depends on the initial conditions. Specifically, the level of external indebtedness inherited from the first stage of transition causes the fundamental real exchange rate to differ across countries, all else being equal. This factor is not mentioned very often by empirical studies discussing sustainable real exchange rates, although a high initial level of external debt can impose a serious constraint on the sustainable values of the real exchange rate. The FRER depends also on the policy target for the debt-to-GDP ratio, which is, as was said, the end-period condition in the model. It is worth repeating that the necessity of defining a normative target for the external balance has not been removed by using a criterion other than the one for the current account deficit.

We need to specify baseline scenarios for all variables that are exogenous to our system of equations when calculating the FRER. In order to ensure consistency, macro-econometric models of the five countries which are a part of the global econometric model NiGEM are used for projection of domestic variables exogenous to the FRER model, and NiGEM projections for the external variables provide further economic consistency in the international context. In this framework, the paths for FRERs are computed. We are aware that the results are subject to uncertainty pertaining to the baseline scenarios for the exogenous variables. Therefore, we compute extensive sensitivity tests, presented in the following sections, in order to show that the FRERs do not change significantly when the scenarios are modified and when the scale of these modifications corresponds to the volatility of the historical data series.

An important part of every model specification is the calibration of its coefficients. Here, we can rely on previous work in which we estimated the econometric models of the five EU pre-accession countries using panel data[19]. We imposed common parameters across countries where justifiable, but allowed for country-specific parameters where there was evidence of significant differences in behaviour. This allowed the econometric models to reflect the different institutional structures in each economy. A fixed-effects model was adopted, allowing a separate intercept for each country to capture country differences in the levels of the variables. We imposed a dynamic error-correction structure on the estimated equations, which allowed the models to adjust gradually towards equilibrium in response to a shock. This is particularly important for models of transition economies, where markets may take extended periods to clear. The export and import equations were estimated as follows[20]:

[19] See Barrell, Holland, Jakab, Kovacs, Smidkova, Sepp, Cufer (2002).

[20] The relative price measure used in the estimation of the export equation relates domestic consumer prices to a weighted average of consumer prices in the destination countries. As such, the terms-of-trade correction applied to the export side of the FRER model is not an exact replication of the variable used in the estimation. However, the correlation coefficient between the two series since 1994 is between 91 and 97 per cent in all five countries, indicating that this introduces only a minimal, and statistically insignificant, bias.

$$\Delta \ln(X) = const - \underset{(4.3)}{0.13}.[\ln(X_{-1}) - \underset{(4.2)}{3.15}.\ln(RER_{-1}) - \underset{(*)}{1.00}.\ln(S_{-1}) - \underset{(6.1)}{0.7}.\ln(FDIS_{-1})] + dynamics + \varepsilon \quad (5)$$

SUR estimates
Sample 1995Q1–1999Q4
(*) parameter value imposed

$$\Delta \ln(M) = const - \underset{(4.4)}{0.13}.[\ln(M_{-1}) + \underset{(-4.3)}{0.62}.\ln(RER_{-1}) - \underset{(*)}{1.00}.\ln(S_{-1}) - \underset{(7.0)}{0.24}.\ln(FDIS_{-1})] + dynamics + \varepsilon \quad (6)$$

R^2 0.39 SE 2.7%
Sample 1994Q1–1999Q4
(*) parameter value imposed

Using these econometric results, we calibrate our five FRER country models with the values of the estimated long-run elasticities and the implied long-run constants. Table 1 summarises the coefficient values. Unit elasticity was imposed on demand in both the export and import equations, which implies that the country share of world exports and imports is independent of the level of world trade itself and of the level of total domestic demand. According to the estimates, a one per cent increase in the real stock of FDI relative to total final expenditure is associated with a 0.7 per cent increase in the volume of exports. This is somewhat higher than estimates for Ireland and estimates for the UK, Germany, France, Sweden and the Netherlands[21]. The same increase in FDI is associated with a 0.25 per cent increase in import volumes. The elasticity on imports is smaller than that on exports, which indicates that an increase in the FDI ratio, holding all else equal, will improve net trade in the FRER model. Hence, the integration gain will have an impact on the fundamental real appreciation[22].

After using the coefficients from Table 1 in equations (1)–(4), we obtain five different country models for calculating the FRERs. The same underlying structure gives us the opportunity to compare results across countries. Differences in results might emerge not only from dissimilar values of constants and initial conditions, but also because the same shock affects each country model differently. For example, the background econometric models define foreign demand as an effective index with weights reflecting the structure of trading partners. Hence, a shock to European demand for exports does not result in the same change in the FRERs, owing to the different trading-partner structures of each pre-accession country.

[21] See Barrell, te Velde (2000) and Pain, Wakelin (1998) for a comparison.

[22] It is important to keep in mind that in the model of the whole economy, exports feed into the domestic activity variable in the import equation, so that a rise in FDI has a secondary impact on imports through domestic demand. The gross impact on imports depends on the size of exports relative to domestic total final expenditure, which is in the range of 25–45 per cent in these economies. This makes the total import elasticity with respect to FDI 0.4–0.6, compared with an export elasticity of 0.7, pointing to a modest positive impact on the trade balance holding all else constant. See Barrell, Holland, Smidkova (2002) for more simulation of the consequences of an FDI shock.

Table 1: Summary of Coefficient Values

	CR	HU	PO	ES	SL
$\alpha 0$	2.92	0.12	2.35	1.78	3.24
$\alpha 1$			3.15		
$\alpha 2$			1.00*		
$\alpha 3$			0.7		
λ			0.13		
$\beta 0$	0.67	0.21	3.44	16.23	0.39
$\beta 1$			-0.62		
$\beta 2$			1.00*		
$\beta 3$			0.24		
λ			0.13		

Note: *Coefficient values labelled with (*) were imposed during the estimations. The five countries are the Czech Republic (CR), Hungary (HU), Poland (PO), Estonia (ES) and Slovenia (SL).*
Source: *Barrell, Holland, Jakab, Kovacs, Smidkova, Sepp, Cufer (2002).*

In addition to the coefficients, the econometric models estimated for the five countries, as part of the above-mentioned work, allow us to define consistent scenarios for all the variables that are exogenous to our equations (1)–(4). Feedbacks with the rest of the world are taken into account during the projections, since the models of the five countries have been incorporated into an existing global econometric model NiGEM. All important interactions between domestic variables are considered during the projections. Domestic demand, aggregate supply and the external sector are linked together in the underlying models through the wage-price system, wealth and competitiveness. The emphasis is put on the role of inflow of FDI, which is endogenous to the models[23]. To conclude, the advantage of the FRER computations lies in their background of consistent baseline scenarios for exogenous variables.

3. The Baseline Computation of FRERs

The model framework specified in the previous section allows us to compute the baseline values of the FRERs for the five EU pre-accession countries. We solve equation (4) for each country separately for the period 1994Q1:2022Q4 in Winsolve using the coefficients of the five country models described by Table 1. Exogenous variables representing the international environment are defined in line with the NIGEM forecast from July 2002. They are set equal to the observed values for the in-sample computations (1994–2001) and to the forecasted values for the out-of-sample computations (2002–2022). This is the case with foreign demand (the effective weighted

[23] In the FDI equation, a long-run unit elasticity on total final expenditure is imposed, so that the ratio of the stock of FDI to total final expenditure is constant. The FDI ratio is related to a measure of risk and unit labour costs relative to the rest of the world, so that a permanent improvement in competitiveness permanently increases the stock of FDI in the host economy. Risk is captured by the degree of transition as estimated by the EBRD: $\Delta \ln(FDIS) = \alpha_i - \lambda[\ln FDIS_{-1} - \ln TFE_{-1} - \beta_1 \ln RULT_{-1} - \beta_2 EBRD_{-5}] + dynamics + \varepsilon$.

index according to the trading matrix), the terms of trade (country specific according to the trading matrix) and foreign real interest rates.

Similarly, scenarios for domestic variables that are exogenous to the FRER model are derived from the NIGEM forecast for the five pre-accession economies. This is the case with output growth and the ratio of the FDI stock to output. The initial level of net external debt as well as export and import volumes in the base year are set in line with the 1994 data[24]. The targeted level of the debt at the end of 2022, our policy variable, is 60 per cent of GDP for all five countries in the baseline scenario. As has been explained already, the value of the target has been set in line with the views of the financial markets. The sensitivity of the FRERs with respect to the target is not very high because of the long horizon used for the simulations. We extrapolate with a log-function between the initial and targeted levels in order to get function D* defined by equation (1).

What can the baseline computation tell us? In Figure 1, we plot the trends in the FRERs for the period 1996Q1:2005Q4. This time span covers a significant part of the advanced stage of transition and part of the pre-EMU period. Our first observation is that the real appreciation that took place during the advanced stage of transition was probably in line with economic fundamentals. The FRER paths descend during this period in all five pre-accession countries. On average, the speed of fundamental appreciation slows over time. This observed tendency towards fundamental real appreciation in the advanced stage of transition is intuitive. In the FRER model, the stock of FDI is being gradually accumulated by the five pre-accession countries. *Ceteris paribus*, the FDI-related integration gain improves net exports. The increase in the FDI stock diminishes gradually over time owing to a closing technology gap, and this slows down the fundamental appreciation implied by the integration gain. In addition to the integration gain, there is an impact from the external financial constraint. Until the level of external debt—which increases owing to the trade deficits—reaches the safety limit, this constraint is soft, and the room obtained for higher trade deficits implies that there is room for fundamental real appreciation.

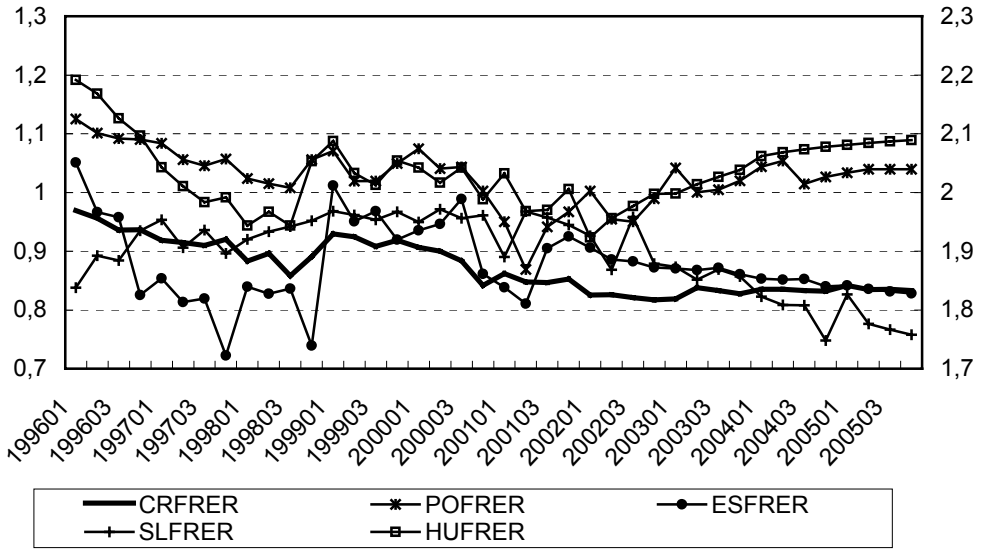
The second observation is related to the pre-EMU period. In this case, the picture is different across the individual countries. Our out-of-sample computations indicate that fundamental real appreciation is still feasible for three countries and tends towards zero over the longer term for two of them. However, the FRERs indicate that economic fundamentals might call for real depreciation in two countries. As was discussed already, this is the case where the size of the external debt starts constraining the economic convergence in the FRER model.

The second observation should be taken with caution, because it is conditioned on the economic outlook from July 2002 which was used to produce the scenarios for the exogenous variables. There are various factors that may soften the external financial constraint in the future. For example, the limits set by the financial markets for external debt are likely to change after the pre-accession countries join the EU. Also, the stronger-than-expected FDI inflow could alter the FRER paths from requiring real depreciation towards requiring real appreciation. Similarly, if economic growth picks up in the EU, the higher foreign demand for domestic goods will improve the prospects for sustainable real exchange rates. It is also likely that several pre-accession

[24] The data source is the IMF *BOP Statistics Yearbook (2001)*.

countries will still be able to use privatisation revenues in the near future in order to lower their level of external debt.

Figure 1: Trends in FRERs for the Five EU Pre-accession Countries



Note: *The FRERs of the individual countries are labelled as follows (in alphabetical order): CZ = Czech Republic, ES = Estonia, HU = Hungary, PO = Poland, SL = Slovenia.*

Table 2: Implied Sustainable Annual Changes in Nominal Exchange Rates

%	CR	HU	PO	ES	SL	AVERAGE
2000	-7.22	-5.95	-3.44	-6.46	-3.79	-5
2001	-6.09	-5.83	-13.83	-9.30	-4.96	-8
2002	-5.47	-5.57	1.71	-0.81	-5.70	-3
2003	-1.31	3.57	2.26	-3.90	-6.52	-1
2004	-1.05	3.62	0.29	-3.35	-8.11	-2
2005	-0.77	0.50	-0.65	-2.50	-2.48	-1
AVERAGE	-3	-1	-2	-4	-6	-3

Note: *The annual changes in nominal exchange rates are implied by the calculated values of the FRERs and by the assumed paths for inflation targets (relative to the average growth of import prices).*

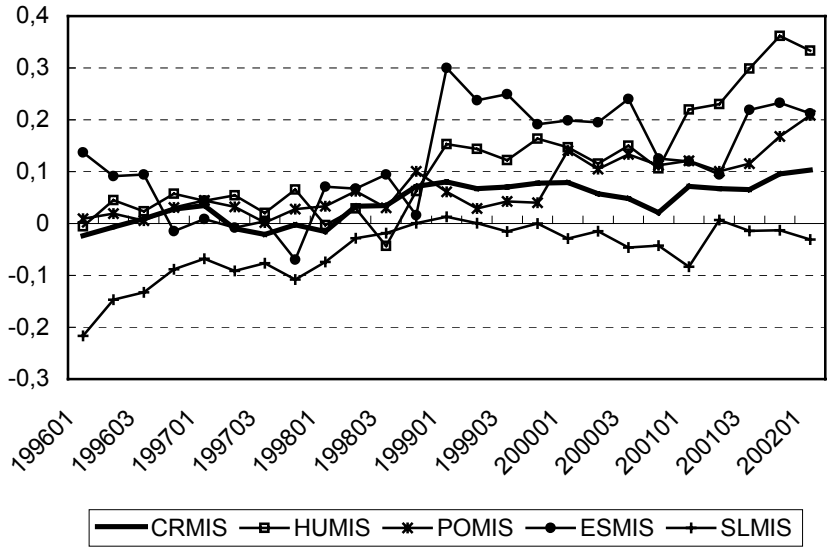
Finally, we can use the FRERs to illustrate the scope of the medium-term sustainable changes in nominal exchange rates which would be in line with economic fundamentals. Let us assume that inflation should converge to 3% at the end of 2005 in the five accession countries[25]. If import prices in dollars grow on average by 2% per annum, we can derive the sustainable paths for nominal exchange rates which are implied by the baseline FRERs and the above-stated two assumptions. This is similar to assuming what the differential is between the inflation targets at

[25] The illustrative calculation does not suggest that all five pre-accession economies are inflation targeters. See World Economic Outlook (2000) for a description of their monetary policy strategies.

home and in the eurozone under the condition that import prices and consumer prices move together in the medium term. Table 2 shows the results of our illustrative calculation. The average sustainable nominal appreciation implied by our assumptions is 3% per annum during a six-year period.

The first observation, suggesting that a certain degree of real appreciation was in line with economic fundamentals during the advanced stage of transition, provides a useful background for deriving the FRER indicator of currency misalignment[26]. Specifically, if the in-sample computations of the FRER values are lower than the actual values of the real exchange rates, the currency might be undervalued. If—on the other hand—the FRER exceeds the observed value of the real exchange rate, this is a signal that the currency might be overvalued. The FRER indicator is a positive number in this case. Figure 2 presents the FRER indicators for the period 1996–2001. However, these are the results corresponding to our baseline computations. We present more robust computations that take into account the outcomes of the sensitivity tests in the following section. It is still interesting to note that according to the baseline computations the indicators of misalignment differ across the individual pre-accession countries. With the exception of Slovenia, there were signals of overvaluation at the end of 2001.

Figure 2: The FRER Indicators of Real Exchange Rate Misalignment



***Note**: The difference between the FRER and the real exchange rate indicates the real exchange rate misalignment (in %). If positive, this indicator signals that the currency might be overvalued.*

[26] There are various indicators of currency misalignment. All are constructed with the aim of sending out a warning signal if the real exchange rate starts deviating from economic fundamentals. The signals differ according to the fundamentals that are taken into account by each particular indicator. The comparative advantage of the FRER indicator with respect to other indicators is that the set of fundamentals is quite extensive. Nevertheless, for the purposes of policy analysis it is always useful to rely on more than one indicator.

4. Sensitivity Tests and the FRER Corridors

We have already emphasised that the results of the baseline computations are subject to uncertainty. Specifically, they can be sensitive to the scenarios for exogenous variables and to the estimations of the trade equations. In order to evaluate the robustness of our baseline results, we conduct an extensive sensitivity analysis. We test for the sensitivity of the FRERs with respect to the uncertainty pertaining to the following exogenous variables: foreign demand, the terms of trade, interest rates abroad, domestic output and FDI flows. We calibrate the uncertainty pertaining to the baseline scenarios for these exogenous variables according to the average volatility of past data series.

We also run a sensitivity test on our baseline results with respect to the estimates of the trade equations. We use the country-specific standard errors of these equations in order to calibrate the uncertainty about the impact of the trade balance on the values of the FRERs. The last two individual tests are related to our definition of external balance. First, we check for the sensitivity of the FRERs with respect to the initial level of net external debt. Second, we test for the sensitivity of the FRERs with respect to the targeted level of net external debt. In both cases, we set the size of the test for all five countries equal to 10 percentage points. This is our expert approximation of the uncertainty pertaining to possible noise in the data and to the potential mistake we have made when estimating the safety limit set by foreign investors for external debt. Both tests also evaluate the robustness of the baseline results with respect to the shape of function D*.

In each case, the individual test is run twice, since we impose both positive and negative shocks to the baseline computations. For example, if a negative shock is applied to foreign demand, the FRER values computed according to equation (4) are higher than in the baseline case because the fundamentals have worsened. Hence, the real exchange rate should depreciate to stay in line with economic fundamentals. Analogously, a positive shock to foreign demand produces lower FRER values. These two alternative computations generate lower and upper bands for what we call the "FRER corridor", which in our opinion is a better indicator of the real exchange rate misalignment than the path obtained from the baseline computations. The width of the corridor allows us to see the impact of each particular uncertainty on the FRER.

Table 3 summarises the results of the nine individual sensitivity tests. Several observations are worth noting. A common shock to the world interest rate implies wider FRER corridors for countries that are larger external debtors. Given that the shock to the debt-to-GDP ratio is relatively large, and given the relatively small reaction of the FRERs to this shock, one can observe that the baseline results are robust as far as the specification of our function D* is concerned (including the targeted level of external debt in the end period). In contrast, there is a relatively high sensitivity of the results with respect to the terms-of-trade shock, Hungary being most sensitive to the common shock. As far as the standard errors in the trade equations are concerned, one can observe that the panel estimates did better for some countries than for others. Specifically, the errors in the trade equation for Hungary produce an FRER corridor several times wider than those for the rest of the panel.

Table 3: Summary of Individual Sensitivity Tests

		Width of the FRER Corridors in 2010 (%)				
Test	Scenario	**CR**	**HU**	**PO**	**ES**	**SL**
A	World Interest Rate (AV=1 pp)	0.33	1.77	0.82	0.21	0.70
B	Output (AV=1%)	0.43	1.08	0.53	0.43	0.38
C	Import Equation (SE)	2.70	10.18	2.76	3.06	0.94
D	End Debt Ratio (T=±10 pp)	0.11	0.38	0.10	0.04	0.22
E	Initial Debt Ratio (T=±10 pp)	0.07	0.36	0.20	0.05	0.17
F	Terms of Trade (AV=5%)	6.28	18.03	8.84	4.78	3.79
G	Export Equation (SE)	4.34	20.55	7.03	7.28	2.45
H	Foreign Demand (AV=5%)	2.14	5.41	2.72	2.04	1.74
I	FDI Ratio (AV=10 pp)	1.96	5.13	2.50	1.90	1.57
		Standard Errors in Trade Equations by Countries				
Test	Standard errors (volume)	**CR**	**HU**	**PO**	**ES**	**SL**
C	Import equation	16.76	39.86	16.06	18.18	6.57
G	Export equation	31.58	68.90	41.95	71.38	22.18

Note: *The individual countries are labelled as follows (in alphabetical order): CZ = Czech Republic, ES = Estonia, HU = Hungary, PO = Poland, SL = Slovenia. The specification of each individual test is given in brackets in the column "Scenario": AV = average volatility of data series, SE = standard errors of estimated trade equations (specified above), T = normative test..*

Although we have said that the individual FRER corridors provide better guidance as far as potential misalignment is concerned, we would still like to derive more robust indicators. It is difficult to draw general conclusions about misalignment or future sustainable paths for real exchange rates from the nine individual FRER corridors. Hence, we run two additional "combined" sensitivity tests. Then we construct the final version of the FRER corridors based on these—more robust—results. The corridors of the first type relate the FRERs to uncertainty about the world interest rate, foreign demand, the terms of trade and FDI flows. These are all external factors, described by tests A, F, H and I from Table 3. The corridors of the second type relate the FRERs to uncertainty about domestic output, the trade equations and the initial level of external debt. These are all domestic factors, described by tests B, C, E and G from the same Table. The targeted level of debt is not included in the combined tests because it is a policy variable.

Table 4 gives a numerical summary of our results. The width of the FRER corridors of both types is relatively modest if one considers all the uncertainty included in the combined sensitivity tests. We can consider the FRER indicator of real exchange rate misalignment to be robust also because all the corridors are significantly narrower than ±15%, which is the corridor measuring exchange-rate stability prior to EMU entry. The width of the Hungarian FRER corridor is closest to this benchmark. This is mainly due to higher country-specific standard errors from the panel estimates and to the largest external debt, which makes the FRER computations more sensitive to other

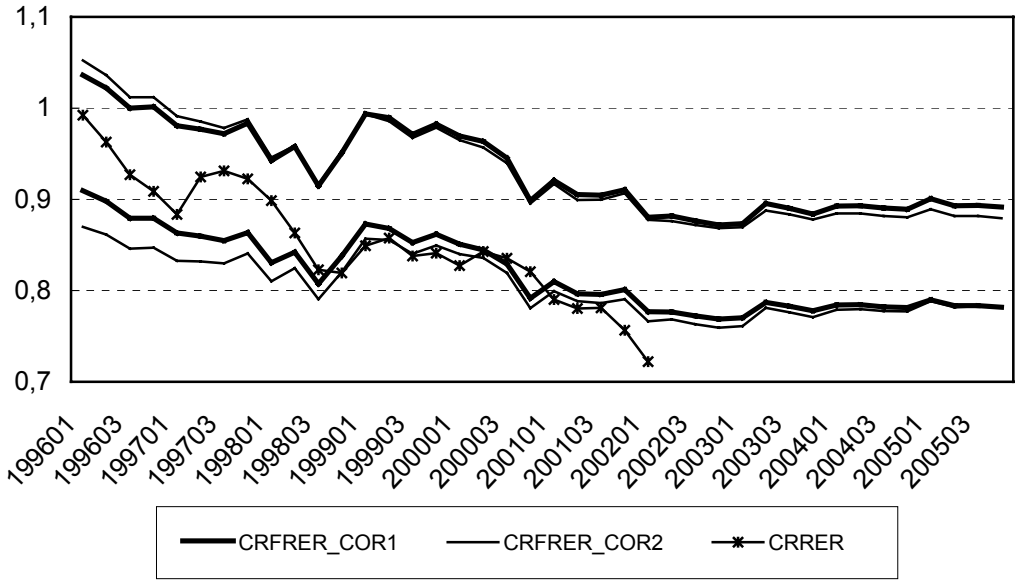
shocks. However, all our corridors are in the range of 10 to 30 per cent quoted by other studies for estimated uncertainty[27].

Table 4: Summary of Combined Sensitivity Tests

Corridors (%)	CR	HU	PO	ES	SL
Width of the FRER Corridors – Type 1					
2010	10.71	30.27	14.93	8.98	7.03
2022	9.65	27.34	13.04	8.14	5.95
Width of the FRER Corridors – Type 2					
2010	7.56	32.41	10.56	10.84	3.93
2022	4.23	18.80	6.17	6.38	2.05

***Note**: The individual countries are labelled as follows (in alphabetical order): CZ = Czech Republic, ES = Estonia, HU = Hungary, PO = Poland, SL = Slovenia. Type 1 corridors reflect uncertainty about external factors. Type 2 corridors reflect uncertainty about domestic factors.*

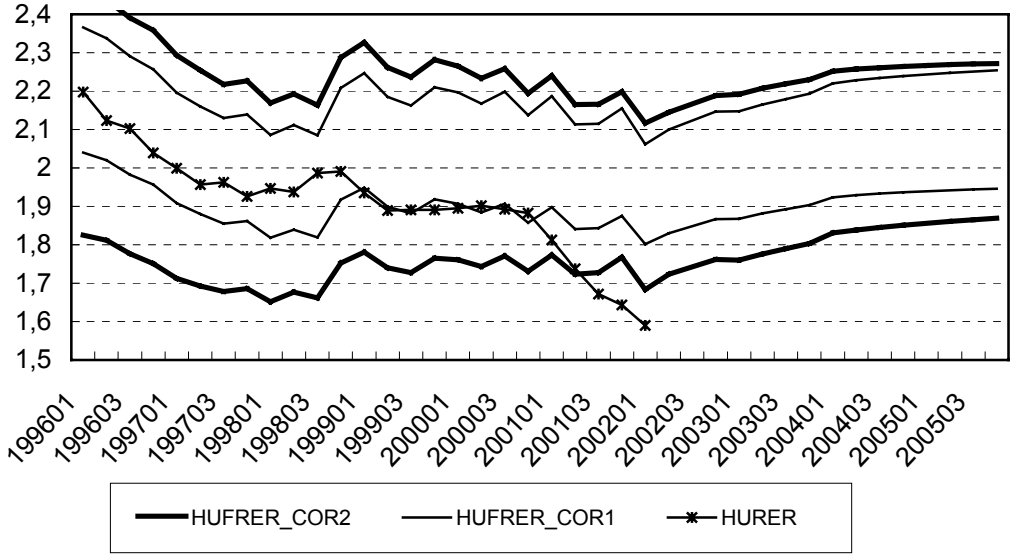
Figure 3: Two FRER Corridors for the Czech Republic



***Note**: The variables are defined as follows: CRRER is the real effective exchange rate calculated according to the NIGEM methodology. CRFRER_COR1 and CRFRER_COR2 are the bands of the FRER corridors of Type 1 and Type 2 respectively.*

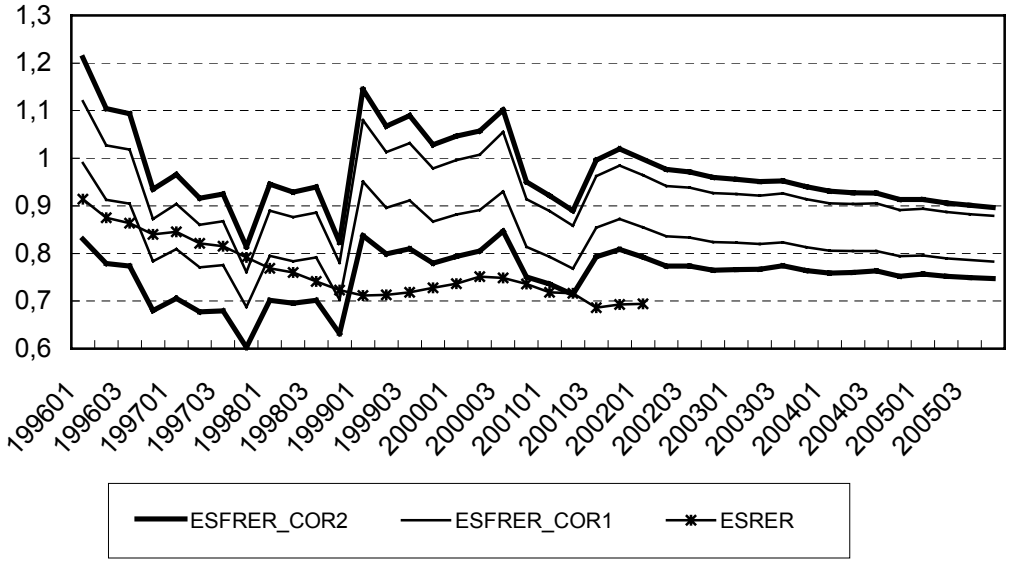
[27] Williamson (1994) and Bayoumi, Clark, Symansky, Taylor (1994) report alternative estimates of the uncertainties pertaining to computations of equilibrium real exchange rates. Detken, Dieppe, Henry, Marin, Smets (2002) estimate the uncertainty specifically for the equilibrium real exchange rates of the euro at around 20%.

Figure 4: Two FRER Corridors for Hungary



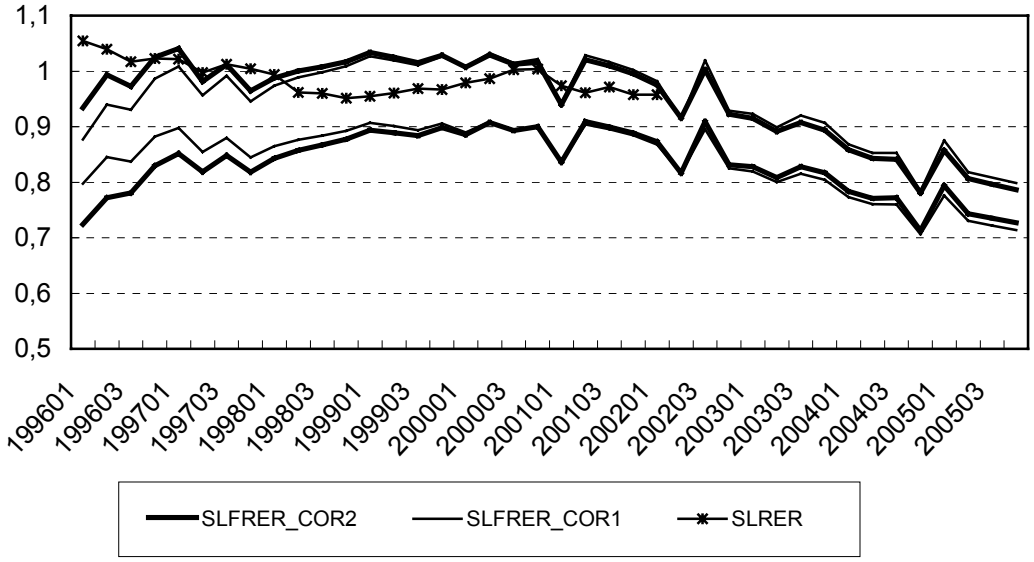
Note: *The variables are defined as follows: HURER is the real effective exchange rate calculated according to the NIGEM methodology. HUFRER_COR1 and HUFRER_COR2 are the bands of the FRER corridors of Type 1 and Type 2 respectively.*

Figure 5: Two FRER Corridors for Estonia



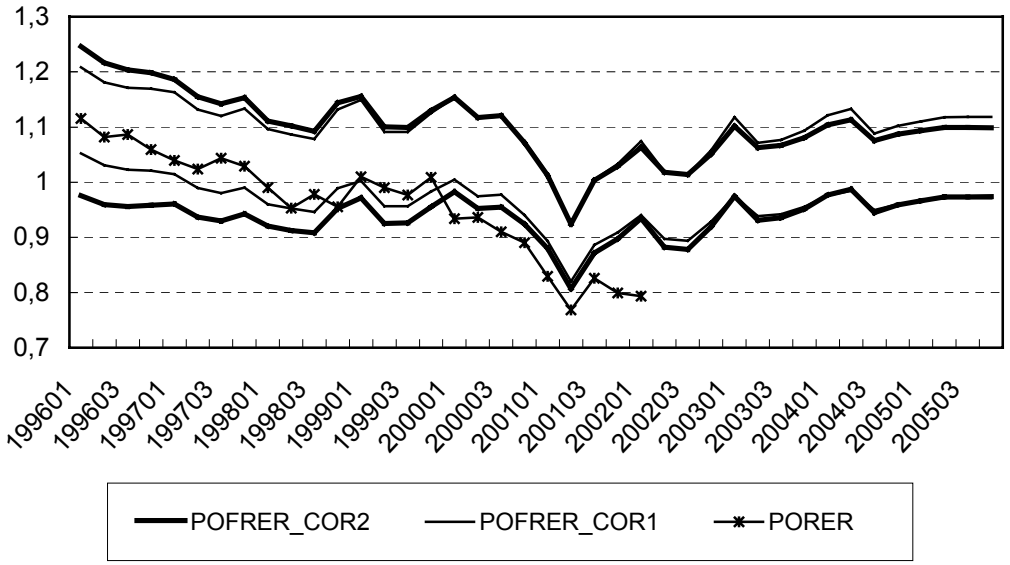
Note: *The variables are defined as follows: ESRER is the real effective exchange rate calculated according to the NIGEM methodology. ESFRER_COR1 and ESFRER_COR2 are the bands of the FRER corridors of Type 1 and Type 2 respectively.*

Figure 6: Two FRER Corridors for Slovenia



Note: *The variables are defined as follows: SLRER is the real effective exchange rate calculated according to the NIGEM methodology SLFRER_COR1 and SLFRER_COR2 are the bands of the FRER corridors of Type 1 and Type 2 respectively.*

Figure 7: Two FRER Corridors for Poland



Note: *The variables are defined as follows: PORER is the real effective exchange rate calculated according to the NIGEM methodology. POFRER_COR1 and POFRER_COR2 are the bands of the FRER corridors of Type 1 and Type 2 respectively.*

Figures 3 to 7 show the FRER corridors of both types for each country for the period 1996–2005. We compare them with the observed values of the real exchange rates available until 2002. The two main conclusions are as follows. First, although there is a general tendency towards fundamental real appreciation among the five pre-accession countries, the countries differ as far as the significance of this tendency is concerned. In same cases, one can observe a reversal in the appreciation trend in the medium run after external debt is accumulated to a certain limit. Second, at the end of 2001 there were signs of overvaluation in all the sample countries with the exception of Slovenia, which started the pre-accession period with a very favourable external debt position and, in addition, has faced large terms of trade changes.

All the data suggest a clear trend towards real appreciation. Over the 1996–2001 period, the real appreciation ranged from 10 per cent in the case of Slovenia up to 40 per cent in the case of Hungary. With the exception of Slovenia, whose real exchange rate is in line with its FRER corridors, the FRER models suggest that the speed of observed real appreciation was higher than the one suggested by economic fundamentals. Consequently, in 2001 the real exchange rate misalignment was approximately 5–10 per cent. Real exchange rates started to deviate from the FRER corridors in 1999 in Estonia, in 2000 in Poland, and in 2001 in the Czech Republic and Hungary. The 1997–1998 period—a time of turbulence on international financial markets—had the most significant impact in the Czech case. One can observe that the real exchange rate first hit the lower band of the FRER corridors before the currency turbulence and then it returned to the middle of the FRER corridor after the koruna had been allowed to float[28].

The cross-country differences among the FRER corridors are more considerable in the longer run, when the corridors indicate whether the stable real exchange rates will be compatible with economic fundamentals in the pre-EMU period. On the one hand, the appreciation of the real exchange rate will be in line with economic fundamentals after 2001 in the Czech Republic, Estonia and Slovenia. For these three countries, the speed of the suggested fundamental appreciation slows gradually over time. In 2005, the appreciation speed remains highest for Slovenia. It converges toward zero in the Czech and Estonian case. On the other hand, depreciation of the real exchange rate might be required by economic fundamentals in the longer run in the case of Hungary and Poland. However, owing to the width of the FRER corridors in both cases, the stability of the real exchange rate may still be sustainable. Moreover, the findings are, as was said already, based on the economic outlook from July 2002. The conditions may change after EU entry, so the conclusions should be taken rather as a warning signal that more FDI may be needed in order to ensure fast economic convergence in all five pre-accession economies.

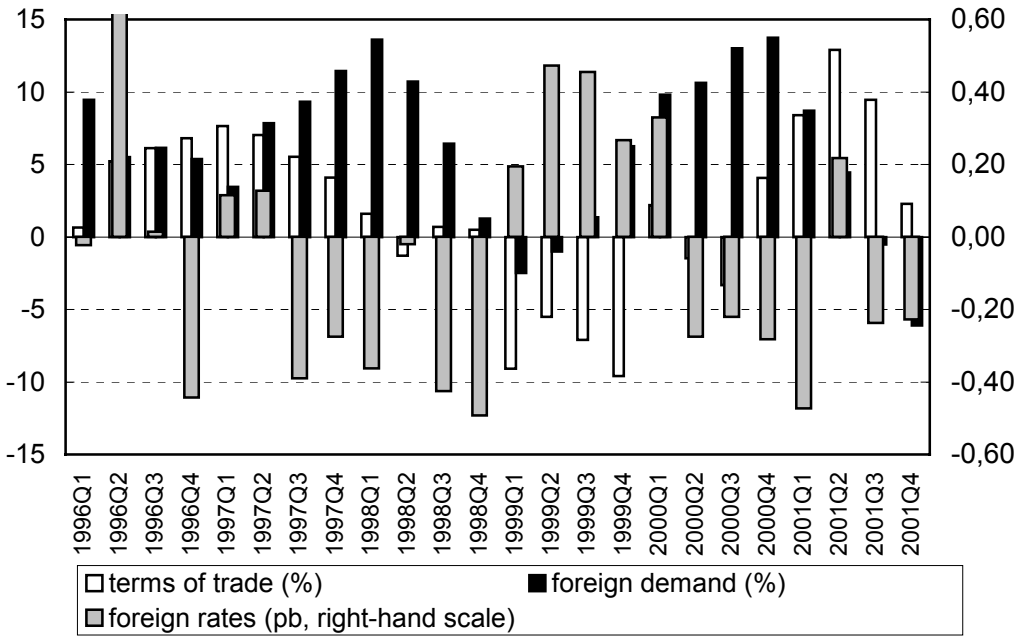
There are similarities in how the FRER corridors developed in the past. These are caused by common external shocks to the terms of trade, foreign demand and world interest rates. Owing to the nature of their causes, the similarities have a cyclical nature. Specifically, there were no negative external shocks in the 1996–1997 period that would have caused the FRERs to depreciate. In fact, just the opposite is true. Figure 8 illustrates that fast growth in foreign demand,

[28] One of the reasons why the Czech currency was influenced more than the other four pre-accession currencies is that the Czech financial markets were more open towards the international financial markets. See Smidkova et al. (1998) for more explanation.

favourable changes in the terms of trade and falling world interest rates allowed for faster fundamental appreciation that would—under less favourable international circumstances—have been out of line with economic fundamentals. In the two following years, there was a reversal in external developments which caused the FRERs either to slowly appreciate (in the Czech case), to stagnate (in the case of Hungary, Poland and Slovenia) or even to depreciate (in the case of Estonia). In 2002–2001, the negative external shocks again diminished, and so did the tendency of the FRERs towards deterioration. The predictions of the above-listed external shocks are useful to watch as warning signals of potential deviations of the currencies out of the FRER corridors.

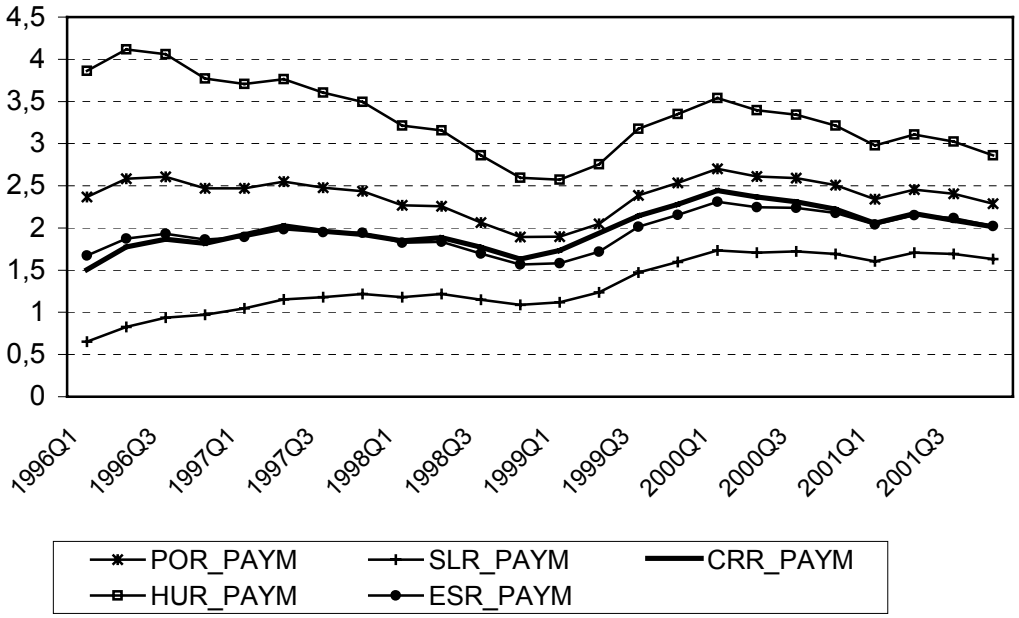
The differences in the FRERs among the five pre-accession economies should be also attributed to the stock variables in the FRER model, which can in some cases act in line with the external shocks and in other cases reduce their impact. It is worth stressing that stock variables also function as a memory of past external shocks. The impact of negative external shocks that are temporary can drive the economy in a certain period towards the safe limit set for external indebtedness. Then a loop can start in which high debt payments themselves generate depreciation of the FRER. Initially, the debt service corresponds to the transition inheritance of the individual countries. Specifically, Slovenia started with zero debt and had the advantage of very low initial debt payments, as shown in Figure 9. Hungary—on the other hand—is burdened from the beginning of our simulation period with very high debt payments. Over time, as the countries accumulate FDI and external liabilities, this difference is gradually reduced until the safe limit is reached at the end of the simulation period.

Figure 8: External Factors Influencing FRERs



Note: *The average changes in the terms of trade and foreign demand are calculated in per cent (left-hand scale) and the change in foreign interest rates is calculated in percentage points (right-hand scale).*

Figure 9: Debt Service According to the FRER Models



***Note**: The variables R_PAYM show the debt service (in % of GDP) in each of the five countries during the baseline computations. The individual countries are labelled as follows (in alphabetical order): CZ = Czech Republic, ES = Estonia, HU = Hungary, PO = Poland, SL = Slovenia.*

5. Concluding Remarks

This paper presents a model framework for computing the real exchange rates that are in line with economic fundamentals for the five pre-accession countries. The FRER model has three important features. First, external balance is defined in terms of a target for external debt at the end of the simulation period. The FRER model therefore reflects the fact that during the catch-up process any rule of thumb for the size of the current account deficit may be too restrictive as a criterion of external balance. Second, the impact of the stock of FDI on the trade balance is considered. An increase in the stock of FDI tends to increase the trade volume and reduce the trade deficit in the FRER model, owing to the estimates of the integration gain. Third, the FRER model has a strong empirical background. The parameters are calibrated in line with our previous estimates of the trade equations of the five pre-accession countries. The NIGEM forecast is used to specify paths for all the variables that are exogenous to the FRER model. As a result, the baseline scenario is consistent in the international context.

Using the FRER model, we derive FRER corridors by combining an extensive set of individual sensitivity tests into two groups reflecting the uncertainty pertaining to domestic and external factors respectively. The shocks describing the uncertainty are calibrated according to the volatility of the historical data series or according to the standard errors of our panel econometric estimates of the trade equations. The FRER corridors can be then used to address the two questions stated in the introduction. Specifically, if a real exchange rate is inside the FRER

corridor, this is an indication that there is not a problem with currency misalignment. If the FRER corridor is horizontal in the medium term, this is an indication that stability of the real exchange rate will be in line with economic fundamentals in the pre-EMU period. Our main findings relating to these two questions can be summarised as follows.

First, at the end of 2001 there were signs of overvaluation in all the pre-accession countries, with the exception of Slovenia. The deviation from the FRER corridor was around 10 per cent in the case of Estonia, Hungary and Poland and around 5 per cent in the case of the Czech Republic. In all four cases, the real exchange rate deviated from the FRER corridor owing to a combination of several negative external shocks. The shocks had more impact on Estonia owing to its extremely large openness. In the case of Hungary and Poland, the negative shocks had a large indirect impact owing to their already high levels of external debt. As was said, countries with larger external debts are more likely to reach the safety limit during a period of a temporarily worsened trade deficit. Then, appreciation of the real exchange rate is more likely to be out of line with economic fundamentals.

Second, during the advanced stage of transition there was a general trend towards fundamental appreciation of the real exchange rates among the pre-accession countries. The appreciation of the FRERs slowed over time. It is worth noting that—during this period—the real exchange rates appreciated irrespective of what exchange-rate regime was applied in each particular country. From the end of the 1990s onwards, the FRER corridors have specific slopes for each pre-accession country. On the one hand, real appreciation will be in line with economic fundamentals in Slovenia in the pre-EMU period. On the other hand, there are signs that real depreciation may be needed in the case of Hungary and Poland. Estonia and the Czech Republic are somewhere in between. The FRER corridors have a rather flat slope, suggesting that a stable real exchange rate will be in line with economic fundamentals. Given all the uncertainty pertaining to the baseline scenarios for exogenous variables, we interpret the results carefully. The FRER corridors signal that in the pre-EMU period, stability of the real exchange rates will not be automatically in line with economic fundamentals and that it is not possible to expect the real exchange rates to move in one direction in all pre-accession countries.

Hence, in the forthcoming period some flexibility of real exchange rates will be necessary, be it achieved through nominal exchange rates or through domestic prices. This may complicate attempts to satisfy the two Maastricht criteria on stable prices and stable nominal exchange rates at the same time. Moreover, the current deviations of the real exchange rates from the FRER corridors indicate that the time is not yet right for fixing the conversion rates within the ERMII. There are factors that are likely to make the fundamental real depreciation less probable than in our baseline computations. The limits set by the financial markets for external debt will probably change after the pre-accession countries join the EU. The subsequent increase in FDI could improve net exports. Also, if economic growth picks up in the EU in the pre-EMU period, higher foreign demand for domestic goods will improve the prospects for the FRERs. Alternatively, some pre-accession countries will still be able to use privatisation revenues to lower their level of external debt in the near future.

We trust that the results presented in this paper show that it is possible to start building a quantitative background for discussions about exchange-rate policies during the pre-EMU period.

However, there are still important areas for further research. For example, one important challenge would be to incorporate the equation determining FDI inflow into the current framework. It should be possible to extend the framework with an equation linking FDI inflow to the real exchange rate, which approximates relative competitiveness, and to the expected relative returns[29]. By doing so, one can expect the strength of the adjustment mechanism to be enhanced and fundamental rates to be more stable in the longer run. Another possible extension would be to test the FRER model on a larger group of countries in order to see whether it gives consistent results for less advanced pre-accession economies and for more developed economies.

[29] There are several benchmark studies for this future work: Lansbury, Pain, Smidkova (1996), Barrell, Pain (1997) and Holland, Pain (2000).

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Appendix

List of Variables

List of Model Variables		
Variable	**Name**	**Notes**
Foreign demand	S	Effective demand for imports
Real interest rate abroad	r	Effective real rate on debt
Import prices	Pm	Effective price index
Export prices	Px	Effective price index
Exchange rate	E	Dollar exchange rate
Net external debt ratio	D*	Ratio with respect to output
Domestic output	Y	Real output, constant prices
Exports	X	Real exports, index with respect to base year
Imports	M	Real imports, index with respect to base year
Stock of FDI ratio	FDIS	Ratio with respect to output
Domestic prices	P	Domestic CPI
Export volume	$\overline{X}$	Export volume in base year (1994)
Import volume	$\overline{M}$	Import volume in base year (1994)

Data Sources		
Variable	**Name**	**Data Source**
Foreign demand	S	NIGEM, April 2002
Real interest rate abroad	r	NIGEM, April 2002
Import prices	Pm	NIGEM, April 2002
Export prices	Px	NIGEM, April 2002
Exchange rate	E	NIGEM, April 2002
Net external debt ratio	D*	Authors' definition of policy target
Domestic output	Y	NIGEM, April 2002
Exports	X	NIGEM, April 2002
Imports	M	NIGEM, April 2002
Stock of FDI ratio	FDIS	NIGEM, April 2002
Domestic prices	P	NIGEM, April 2002
Export volume	$\overline{X}$	IMF, BOP Statistics Yearbook, 2001
Import volume	$\overline{M}$	IMF, BOP Statistics Yearbook, 2001

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