DISCUSSION PAPER SERIES

No. 4809

EQUILIBRIUM EXCHANGE RATES IN TRANSITION ECONOMIES: TAKING STOCK OF THE ISSUES

Balázs Égert, László Halpern
and Ronald MacDonald

INSTITUTIONS AND ECONOMIC PERFORMANCE

Centre for Economic Policy Research

www.cepr.org

Available online at: www.cepr.org/pubs/dps/DP4809.asp

ISSN 0265-8003

EQUILIBRIUM EXCHANGE RATES IN TRANSITION ECONOMIES: TAKING STOCK OF THE ISSUES

Balázs Égert, Oesterreichische Nationalbank
László Halpern, Institute of Economics, Hungarian Academy of Sciences; CEU, WDI and CEPR
Ronald MacDonald, University of Strathclyde

Discussion Paper No. 4809
December 2004

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 4809

December 2004

ABSTRACT

Equilibrium Exchange Rates in Transition Economies: Taking Stock of the Issues*

In this Paper we present an overview of a number of issues relating to the equilibrium exchange rates of the new EU member states from Central and Eastern Europe. In particular, we present a critical overview of the various methods available for calculating equilibrium exchange rates and discuss how useful they are likely to be for the new member states. We then consider some methodological issues, relating to the implementation of an equilibrium exchange rate model for new member states, such as the speed with which equilibrium exchange rates change and issues of implementation. Finally, we present an overview of the various extant measures of equilibrium that have been calculated for the new member states.

JEL Classification: C15, E31, F31, O11 and P17
Keywords: Balassa-Samuelson effect, equilibrium exchange rate, Purchasing Power Parity, tradable prices and transition economies

Balázs Égert
Foreign Research Division
Oesterreichische Nationalbank
Otto-Wagner-Platz-3
1090-Vienna
AUSTRIA
Tel: (43 140) 420 5246
Fax: (43 140) 420 5299
Email: balazs.egert@oenb.at

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=158713

László Halpern
Institute of Economics
Hungarian Academy of Sciences,
Budaörsi 45
H-1112 Budapest
HUNGARY
Tel: (36 1) 397 6180
Fax: (36 1) 319 3136
Email: halpern@econ.core.hu

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=105353

Ronald MacDonald
Department of Economics
University of Strathclyde
Sir William Duncan Building
130 Rotttenrow
Glasgow G4 0GE
Tel: (44 141) 548 3861
Fax: (44 141) 552 5589
Email: r.r.macdonald@strath.ac.uk

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=105427

*Earlier versions of this Paper benefited from comments and suggestions from Enrique Alberola, Mark DeBroeck, Péter Karádi, Kirsten Lommatzsch, Dubravko Mihaljek, Renzo Orsi, Thomas Reininger and Cezary Wójcik. The opinions expressed in this Paper do not necessarily represent the views of the Oesterreichische Nationalbank or the European System of Central Banks (ESCB).

Submitted 29 November 2004

1. Introduction

In the last decade, the topics of equilibrium exchange rates and exchange rate misalignment have been the focus of much academic and policy related research.[2] This is especially the case for the economies of Central and Eastern Europe (CEE), which started their transformation process from planned to market-based economies in the late 1980s and early 1990s and are now on the verge of joining the euro. At the start of the transition process, there was considerable interest in the choice of an appropriate exchange rate regime for transition economies and also on the issue of whether their currencies were fairly valued at a given point in time. In particular, the observed trend appreciation of the real exchange rate in these countries has raised the issue of whether this reflects adjustment towards equilibrium, due to an initial undervaluation, or whether it corresponds to an equilibrium appreciation.[3] Potentially, overvaluation should be of great concern for these economies because of their high openness, in terms of exports and imports as a proportion of GDP, and because of their export-led economic catching-up process.

The prospect of ERM-II entry, and of the subsequent adoption of the euro, for the recently acceded entrants to the EU has given added importance to the issue of what is the correct equilibrium exchange rate for these countries. Getting the rate wrong could have very serious implications for these countries given the degree of catch up that they still have to undergo. Although it is often thought that an overvalued exchange rate would have the greatest deleterious implications, due to its effect on competitiveness, undervaluation may also have a negative economic impact. For example, an undervalued currency may ignite inflation through the prices of imported goods, coupled with an overheating economy fuelled by booming exports, which, in turn, would prohibit the fulfilment of the Maastricht criterion on price stability. So getting the exchange rate right is crucially important for CEE countries.

Other key aspects of transition economics, such as enterprise restructuring and economic growth have already been extensively surveyed (see, for example, Coricelli and Campos, 2002; Djankov and Murrell, 2002; and Kornai, Maskin and Roland, 2003). However, to our knowledge there is no comprehensive survey of equilibrium exchange rate issues for the Central and Eastern European countries and we attempt to redress that imbalance in this paper by presenting an overview of a number of issues relating to the choice of an appropriate entry rate into ERMII and the euro area for the new EU member states in Central and Eastern Europe.[4] In particular, we present a critical overview of the various methods available for calculating equilibrium exchange rates, such as Purchasing Power Parity, the internal-external approach and its variants (the Fundamental Equilibrium Exchange Rate, the Macroeconomic Balance Approach and the NATREX), the Behavioural Equilibrium Exchange Rate, the Permanent Equilibrium Exchange Rate, the capital enhanced equilibrium exchange rate and the New Open Economy Macroeconomic Approach to the determination of the equilibrium exchange rate. We then discuss how useful these measures are likely to be for new member states. Some methodological issues are then considered and these relate to the implementation of an equilibrium exchange rate model for the new member states and the speed with which equilibrium exchange rates change over time. Finally, we overview the various extant measures of equilibrium that have been calculated for the new member states.

The outline of the remainder of this paper is as follows. Section 2 presents basic concepts and definitions of the exchange rate. Section 3 discusses the theoretical underpinnings of the leading approaches to calculating and measuring equilibrium exchange rates (where relevant we include empirical evidence from industrialized countries in this overview). Section 4 attempts to link the different approaches. Section 5 gives an overview of the empirical literature as it relates to CEE countries. Section 6 summarizes the findings. Finally, Section 7 provides concluding remarks.

---

[2] See e.g. Williamson (1994), MacDonald (1995, 2004), Sarno and Taylor (2002), Stein (1995, 2002) and Driver and Westaway (2004).

[3] If there is initial undervaluation and the real exchange rate did not appreciate, or the equilibrium appreciation exceeded the observed real appreciation, the exchange rate remained undervalued.

[4] Our study focuses on the CEEC5 (Czech Republic, Hungary, Poland, Slovakia and Slovenia) and the Baltic countries (Estonia, Latvia and Lithuania). Hence, we do not deal with countries in South-Eastern Europe and in the Former Soviet Union (FSU).

2. Basic Concepts and Definitions

The real exchange rate can be defined in a number of ways, two of which are relevant for our discussion in this paper. The first definition, termed the "internal real exchange rate", is the ratio of non-tradable to tradable prices:

$$Q^I = P^{NT} / P^T \qquad (1),$$

where Q^I is the internal real exchange rate and P^{NT} and P^T stand, respectively, for the price level of the non-tradable and tradable sectors.

This definition of the real exchange rate is usually thought to be appropriate for small, open developing countries whose trade consists chiefly of commodities. The internal real exchange rate does not include the nominal exchange rate, as the latter is assumed to be either fixed or to be driven by commodity prices in world markets. This is why estimating the equilibrium "internal real exchange rate" provides little guidance on the equilibrium nominal exchange rate.

By contrast, and of more relevance for our purposes in this paper, is the macroeconomic definition of the real exchange rate, which can also be referred to as the "external real exchange rate," (hereafter, this is simply referred to as the real exchange rate), this is defined as the nominal exchange rate multiplied by the foreign price level, divided by the domestic price level:

$$Q = (E \cdot P^*) \cdot P^{-1}, \qquad (2)$$

or in logarithms:

$$q = e + p^* - p \ , \qquad (2a)$$

In this case, the nominal exchange rate (E) is expressed in home currency per unit of foreign currency.[5] In words, the real exchange rate (Q) is the ratio of the foreign (EP^*) and domestic price (P) levels converted into the same unit of measurement, i.e. domestic currency units. P and P^* denote the domestic and foreign price levels. If the variables are expressed in indices, the real exchange rate shows the relative shift which has occurred between the foreign and domestic price levels over a given period of time.

In our discussions of the influence of productivity effects on the real exchange rate it shall prove useful to unravel the real exchange rate given in (2a) into an internal and external component. For example, an analogous representation of the definition of the real exchange rate given in (2a) can also be written for tradable goods as:

$$q^T = e + p^{T*} - p^T . \qquad (2b)$$

If it is further assumed that the overall price level can be split into tradable and non-tradable prices, which, after transforming variables into logarithms, can be written in the following way:[6]

$$p = \alpha \cdot p^T + (1-\alpha) \cdot p^{NT} , \qquad (3)$$

where α stands for the share of tradable goods in the consumer price basket and $(1-\alpha)$ represents the share of non-tradable goods, and an analogous expression is assumed to hold in the foreign country. Using equations (2a), (2b) and (3), the real exchange rate can then be decomposed into three components:

- (A) the nominal exchange rate (e)
- (B) the ratio of foreign to domestic tradable prices ($p^{T*} - p^T$)
- (C) the ratio of the domestic to the foreign relative price of non-tradable goods: $(1-\alpha)(p^{NT} - p^T) - (1-\alpha^*)(p^{NT*} - p^{T*})$

[5] Throughout the paper, the exchange rate will be defined in this way. Therefore, a rise in the exchange rate implies a depreciation, while a fall indicates an appreciation.

[6] Small letters refer to logarithms hereafter.

$$q = \underbrace{e}_{A} + \underbrace{p^T * - p^T}_{B} - \underbrace{((1-\alpha)\underbrace{(p^{NT} - p^T)}_{D} - (1-\alpha^*)(p^{NT} * - p^T *))}_{C} \qquad (4)$$

The first two components, A and B build the real exchange rate for tradable goods, while the third component, C, is the relative price of non-tradables to tradables across countries (sometimes also refereed to as internal relative prices). The so-called internal real exchange rate, D, is part of C. Expression (4) is a useful reference point for the discussion in the next section.

3. Theoretical Foundations of the Equilibrium Exchange Rate

A number of alternative methods have been used to calculate an equilibrium exchange rate for CEE countries and we consider the main approaches in this section.

3.1 Purchasing Power Parity

There exist several approaches to defining an equilibrium exchange rate. Perhaps the best known of these is *purchasing power parity* (henceforth PPP), which was formalized and synthesized in a string of papers by Cassel (1916a, b and 1918). PPP indicates that the nominal exchange rate is the domestic price level divided by the foreign price level:

$$E^{PPP} = P / P^* . \qquad (5)$$

PPP is usually taken as a measure of the long-run nominal exchange rate, rather than a concept that holds continuously. Cassel recognised that in the short run, the nominal exchange rate prevailing in the foreign exchange market may deviate from that suggested by PPP due to, for example, non-zero interest differentials and foreign exchange market intervention. In the short-run, therefore, the extent of deviation from PPP might be thought of as an over- or undervaluation of the home currency. This can be illustrated by introducing the following equation:[7]

$$Q = E / E^{PPP} . \qquad (6)$$

Therefore, if the actual nominal exchange rate is higher than that determined by PPP ($E > E^{PPP}$ and $Q > 1$), the real and nominal exchange rates are undervalued, whereas in the opposite case they will be overvalued ($E < E^{PPP}, Q < 1$). If $E = E^{PPP}$, then the real exchange rate is equal to 1 and, of course, PPP holds (the real exchange rate is fairly valued in PPP terms).

The conjecture underlying PPP is that the *Law of One Price* (LOOP) holds for every good in the price basket and therefore the second component on the right hand side of (4) is zero. In accordance with the LOOP, a given good should cost the same in the home and foreign country when the price is expressed in the same currency ($P_i = E \cdot P_i *$). This is secured by an international goods arbitrage mechanism, which involves shipping the good from the location where it is cheaper to that where it is more expensive. For this arbitrage process to work perfectly, perfect competition has to prevail in both the home and foreign markets, there must be no trade barriers and capital movements must not be restricted.

There are a number of reasons why PPP might be misleading as a yardstick for assessing equilibrium real exchange rates of which only the most important ones are enumerated here.[8]

Even though the LOOP holds, if the composition and the weights of the price basket differ across countries, PPP is a flawed measurement, as it is akin, say, to comparing apples with oranges and pears. Differences in the composition of the price basket can come from different consumer and production patterns: consumers may want to consume different goods or varying quantities of the same good and producers can manufacture

[7] Note that this formula is sometimes also referred to as the Exchange Rate Deviation Index (ERDI). Q is defined as units of local currency over one unit of foreign currency. 1/Q is the real exchange rate given as units of foreign currency to one unit of domestic currency, and is also labeled as the comparative or relative price level or the exchange rate gap.
[8] The failure of PPP in the tradable sector is addressed after we consider the Balassa-Samuelson effect.

different goods in different countries. This is likely to be an important issue when using PPP to calculate the equilibrium values of the new member states with their old EU-15 counterparts.

But perhaps most importantly, the presence of non-tradable goods in the price basket will, as suggested by (4), bring about a systematic deviation of the observed exchange rate from the exchange rate implied by PPP. This deviation is expected to be substantial, especially when comparing countries at different stages of economic development. The reason for this is that non-tradable prices in developing countries are far lower than in developed countries.

So it would seem that PPP on its own does not appear to be a very useful construct in explaining the equilibrium exchange rates of transition economies. One popular way of extending PPP is to allow for factors that impart systematic movements in the relative price of non-tradable goods, and perhaps the best known explanation for such systematic deviation is the so-called Balassa-Samuelson effect (B-S effect henceforth), which we now consider.

3.2 Trend Adjusted Purchasing Power Parity

In this section we present a discussion of what we refer to as trend adjusted PPP. This variant of PPP essentially allows for deviations of the real exchange rate from unity due to productivity differentials. We first give an overview of the basic Balassa-Samuelson[9] proposition and then go on to consider extensions and problems with the approach. Since this approach is often thought to have special relevance for transition economies, we devote some time to it here.

3.2.1 Accounting for Market Non-tradable Prices: The Balassa-Samuelson Effect

The standard Balassa-Samuelson explanation (see Balassa, 1964; Samuelson, 1964) for the relationship between productivity in the tradable sector relative to that in the non-tradable sector (henceforth referred to as dual productivity) and the price of non-tradable goods relative to that of tradable goods (henceforth referred to as the relative price of non-tradable goods), depends on the following crucial assumptions. The explanation is based on a two sector economy in which both tradable and non-tradable goods are produced. It is assumed that market forces are at work in both sectors. The LOOP is assumed to hold continuously for tradable goods and so prices in this sector are given exogenously. Wages are linked to the level of productivity in the open sector and are equalized across sectors so that the wage level in the closed sector is comparable to that in the open sector. Finally, prices in the sheltered sector depend on wages, i.e. on unit labour costs rather than on the productivity level in this sector. Given these assumptions and in the context of a two-sector neoclassical framework with perfect capital mobility and with the interest rate assumed exogenous, we can obtain the following relationship:

$$\hat{p}^{NT} - \hat{p}^{T} = \frac{\delta}{\gamma}\hat{a}^{T} - \hat{a}^{NT}, \qquad (7),$$

where circumflexes (^) stand for growth rates, δ and γ denote the share of labour in the sheltered and open sectors, respectively, $\hat{p}^{NT} - \hat{p}^{T}$ represents the growth rate of the relative price of non-tradable goods and $\hat{a}^{T} - \hat{a}^{NT}$ is the growth rate of dual total factor productivity.[10] Equation (7) could be referred to as the

[9] The Balassa-Samuelson effect is sometimes also termed the Harold-Balassa-Samuelson or the Ricardo-Harold-Balassa-Samuelson effect. In this paper, the term Balassa-Samuelson will be used.

[10] The supply side of the two sectors is modeled by means of two different, constant-returns-to-scale Cobb-Douglas production functions: $Y^T = A^T(L^T)^{\gamma}(K^T)^{(1-\gamma)}$ and $Y^{NT} = A^{NT}(L^{NT})^{\delta}(K^{NT})^{(1-\delta)}$ where $A^T, A^{NT}, L^T, L^{NT}, K^T$ and K^{NT} represent the level of total factor productivity, labor and capital in the open and closed sectors, respectively. Because of profit maximization, interest rates (i) and nominal wages (w) in both sectors equal the marginal products dY^T/dK^T , dY^{NT}/dK^{NT} dY^T/dL^T and dY^{NT}/dL^{NT} ,respectively:

$$i^T = \log(1-\gamma) + a^T - \gamma(k^T - l^T) \qquad (3')$$

$$i^{NT} = (p^{NT} - p^T) + \log(1-\delta) + a^{NT} - \delta(k^{NT} - l^{NT}) \qquad (4')$$

internal transmission mechanism of the B-S effect. Note that a decrease in the share of labour in the open sector relative to that in the sheltered sector would lead to a rise in the relative price of non-tradables even without any change in productivities. The transformation of equation (4) into growth rates, combined with equation (7), yields equation (8) as long as the share of tradables in the consumer price basket is the same in the home and foreign economies ($\alpha = \alpha *$):

$$\hat{q} = \hat{e} + \hat{p}^{T*} - \hat{p}^{T} - (1-\alpha)((\frac{\delta}{\gamma}\hat{a}^{T} - \hat{a}^{NT}) - (\frac{\delta *}{\gamma *}\hat{a}^{T} * - \hat{a}^{NT} *)), \quad (8),$$

where the growth rate of the CPI-based real exchange rate equals the rate of growth of the real exchange rate for the open sector, and, most importantly, the difference between the growth rates of dual total factor productivity at home and abroad. So, an increase in the dual productivity differential should lead to a real appreciation of the currency. Rearranging equation (8), as in equation (8'), shows that an increase in the difference between productivity in the home and foreign countries' open sectors causes a real appreciation, whilst an increase in the difference between productivity in the home and foreign countries' closed sectors has the opposite effect. Note that equations (8) and (8') are sometimes labelled as the external transmission mechanism of the B-S effect.

$$\hat{q} = \hat{e} + \hat{p}^{T*} - \hat{p}^{T} - (1-\alpha)(\frac{\delta}{\gamma}(\hat{a}^{T} - \hat{a}^{T} *) - (\hat{a}^{NT} * - \hat{a}^{NT} *)), \quad (8'),$$

It is also worth noting an analogous relationship to (8), defined in levels (as opposed to growth rates) and on the basis of average labour productivity (instead total factor productivity):[11]

$$\frac{P^{NT}}{P^{T}} = \frac{\gamma}{\delta} \cdot \frac{Y^{T}/L^{T}}{Y^{NT}/L^{NT}}, \quad (9),$$

where Y and L denote output and labour and Y/L is the average labour productivity. Transforming equation (9) into logarithms leads to:

$$p^{NT} - p^{T} = const + (a^{T} - a^{NT}), \quad (10),$$

where $const$ is a constant term containing $\log(\gamma)$ and $\log(\delta)$. Applying equation (10) to equation (4) gives equation (11), provided $\alpha = \alpha *$:

$$q = const + (e + p^{T} * - p^{T}) - (1-\alpha)((a^{T} - a^{NT}) - (a^{T} * - a^{NT} *)), \quad (11),$$

where the real exchange rate is linked to the difference between dual average labour productivity at home and abroad (henceforth referred to as the dual productivity differential). Note that the constant term now contains $\log(\gamma)$, $\log(\delta)$, $\log(\gamma *)$ and $\log(\delta *)$, multiplied by $(1-\alpha)$.

$$w^{T} = \log(\gamma) + a^{T} + (1-\gamma)(k^{T} - l^{T}) \quad (5')$$

$$w^{NT} = (p^{NT} - p^{T}) + \log(\delta) + a^{NT} + (1-\delta)(k^{NT} - l^{NT}) \quad (6')$$

Equations (3') to (6') are expressed in logarithmic terms. Tradable prices are exogenous because of perfect competition in the open sector. Given that capital is assumed to be fixed in the short run, the first order conditions (FOC) in the open sector determine the capital-labor ratio and the nominal wage. Wage equalization across sectors implies that this wage level is exogenous in the sheltered sector. In turn, the FOC in the sheltered sector give the capital-labor ratio in the sheltered sector and the price of non-tradables relative to that of tradables. To obtain equation (7), equations (3') to (6') are totally differentiated and rearranged (for a step-by-step derivation, see Égert, 2003).

[11] Given that the marginal productivity of labor is equal between the open and closed sectors, equations(3') and (4') can be equated based on which the relative price of non-tradables can be expressed as follows: $\frac{P^{NT}}{P^{T}} = \frac{\partial Y^{T}/\partial L^{T}}{\partial Y^{NT}/\partial L^{NT}}$. A well-known feature of Cobb-Douglas production functions is that marginal productivity equals average productivity: $\frac{\partial Y^{T}}{\partial L^{T}} = A^{T}\gamma(\frac{K^{T}}{L^{T}})^{(1-\gamma)} = \gamma\frac{Y^{T}}{L^{T}}$ and $\frac{\partial Y^{NT}}{\partial L^{NT}} = A^{NT}\delta(\frac{K^{NT}}{L^{NT}})^{(1-\delta)} = \delta\frac{Y^{NT}}{L^{NT}}$, which yields equation (9).

Such a derivation has two advantages. First, sectoral average labour productivity can be used in its own right and not as a proxy for sectoral total factor productivity.[12] In addition, the terms γ and δ are incorporated into the constant term. Second, the level relationship makes it possible to use cointegration methods to estimate the long-run relationship between the real exchange rate and the dual productivity differential.[13]

From the model set out above, we can summarize the key propositions of the BS model:

1) Different productivity levels imply, via differences in market-based non-tradable prices, different price levels expressed in the same currency;
2) The real and nominal exchange rates of low-productivity (typically developing) countries seem undervalued in PPP terms;
3) If productivity growth is higher in the open sector compared to the sheltered sector, non-tradable prices, and thus the overall price level, will rise (also referred to as structural inflation);
4) Higher growth of the productivity differential in the home country relative to the foreign country is reflected in faster increases in the price level, leading to a real appreciation of the home currency.

Since PPP is assumed to hold for the open sector, competitiveness is not affected by the real appreciation that results from the productivity imbalance. The last assumption has important implications, particularly we believe for transition economies. In particular, it implies that all of the appreciation of the real exchange rate, deflated by the consumer price index (as a proxy for overall inflation), comes from increases in non-tradable prices, and that this can be fully ascribed to the B-S effect (the appreciation of the CPI-based real exchange rate). By contrast, in the event that PPP is not verified for the open sector and, say, the real exchange rate based on producer prices (as a proxy for tradable prices) also appreciates, the B-S effect can explain only the difference between the CPI- and the PPI-deflated real exchange rate.

It is sometimes argued that there is an equivalence between a B-S induced exchange rate appreciation (with fixed nominal exchange rates) and a real appreciation caused by the nominal exchange rate. Clarifying the nature of this equivalence would seem to be important since often exchange rates are driven by non-price determinants, such as interest rate movements. For example, if some exogenous factor causes the nominal exchange rate to appreciate then, on the basis of the LOOP, there should be a proportionate decrease in the price of tradables, leaving competitiveness unaffected. By contrast, the real exchange rate of the closed sector will appreciate, generating an appreciation of the overall real exchange rate. However, two problems arise with this account: (1) the B-S model does not contain any straightforward mechanism explaining the initial nominal appreciation (i.e. it does not provide a general model of the exchange rate), and (2) if a nominal appreciation occurs for any other reason, because the exchange rate pass-through is usually below one, competitiveness in the open sector would deteriorate.

3.2.2. Extensions of the Standard Balassa-Samuelson Framework

The standard simple B-S framework can be extended in at least three directions, and these extensions may be of importance for transition economies. The first extension raises the issue of the failure of the PPP in the tradable sector. The second extension adds demand side factors to the determination of the relative price of non-tradables and, finally, non-market-based non-tradable (regulated and administered) prices can be distinguished from market-based non-tradables referred to in the standard B-S framework.

3.2.2.1. The Failure of PPP in the Tradable Sector

There are a number of potential reasons for the violation of the LOOP in the open sector, such as the absence of perfect competition and the existence of transportation costs. If the LOOP is in fact violated in the open sector it implies that the B-S effect cannot account for the entirety of long-term real exchange rate

[12] In equations (7) and (8), total factor productivity can be approximated by average labor productivity, which may, however, be a biased proxy. Labor productivity (LP) can be decomposed into (1) the capital-labor ratio, i.e. capital intensity (CI) and into (2) TFP (LP=CI+TFP). Therefore, the level of labor productivity might be systematically higher or lower than TFP, with capital intensity working as a "leverage." In the event that capital intensity changes over time, the evolution of labor productivity will differ from that of TFP. Needless to add that if capital intensity differs across countries, labor productivity as a proxy for TFP will induce an additional bias when productivity developments are compared across countries. Therefore, it would be preferable to use equations (10) and (11) where average labor productivity can be used directly.

[13] A specification in growth rates such as in equations (7) and (8) would imply that the cointegration technique (extensively used in the literature: see table 5a), which is meant to link variables that are non-stationary in levels but stationary in first differences, could not be applied because the growth rates may already render the series stationary.

movements. For instance, Mussa (1986) observed a strong correlation between nominal and real exchange rates for industrialized countries during the post-1973 floating period, implying that overall real exchange rate movements are dominated by changes in the real exchange rate of the open sector. This finding is also documented in Engel (1993, 1999) for the US and, more recently, in Monacelli (2004) for a set of industrialised economies. Canzoneri, Cumby and Diba (1999) provide econometric evidence that PPP cannot be verified for the open sector for a number of OECD countries, especially when the US dollar is used as the numeraire currency.

New Open Economy Macroeconomics (NOEM) models deal with two important aspects of why the real exchange rate in the open sector may drive the overall real exchange rate: (a) home bias and (b) market segmentation which gives a role to pricing-to-market (international price discrimination). These effects can be demonstrated in a simple accounting framework employed, for instance, in Beningo and Thoenissen (2003) and Lee and Tang (2003). Let us decompose tradable prices into a home-produced (p^H) and a foreign-produced component (p^F)with β and $1-\beta$ representing the respective shares in the price index: $p^T = \beta \cdot p^H + (1-\beta) \cdot p^T$. Applying this term to both the home (p^T) and foreign (p^{T*}) economies and using equation (2b) yields:

$$q^T = \underbrace{(\beta - \beta^*)(p^F - p^H)}_{home\ bias} + \underbrace{\beta^*(e + p^{H*} - p^H) + (1-\beta^*)(e + p^{F*} - p^F)}_{market\ segmentation} \quad (12)$$

In contrast to the standard B-S framework, which assumes homogenous tradable goods, home consumers may prefer home brands rather than foreign brands, i.e. goods are not perfectly substitutable across countries. This implies that β is higher than 0.5, and this can cause the real exchange rate to deviate from absolute PPP even if the LOOP is verified for individual goods.[14] Market segmentation introduces a degree of inertia into tradable prices across countries and, for example, allows firms to price to market.[15]

Based on a static general equilibrium model with imperfect substitutability and product variety, à la Dixit and Stiglitz (1977), MacDonald and Ricci (2002) show that productivity in the tradable sector not only impacts positively on the real exchange rate through the B-S effect (via the indirect wage channel) but, if there is a home bias, it also has a direct negative effect on the price of home-produced tradables relative to that abroad leading to a real depreciation. However, if the share of non-tradables in the overall price index is not too small, the B-S effect will dominate the decrease in the price of tradables. Hence, an increase in productivity in the open sector causes the real exchange rate to appreciate.[16]

Beningo and Thoenissen (2003) calibrate a dynamic general equilibrium model for the UK against the euro area, which produces similar results to the model of MacDonald and Ricci (2002). However, in the Beningo and Thoenissen model, an increase in productivity in the open sector yields an overall depreciation of the real exchange rate because its negative impact on the real exchange rate in the open sector (depreciation) outweighs its positive impact on the relative price of non-tradables (appreciation). Világi (2004) in fact argues that international price discrimination has to be included in a dynamic general equilibrium NOEM model, if one does not want the B-S effect-induced real appreciation to be offset by the real depreciation of tradables via the terms of trade channel.

The non-tradable component of tradable prices, which mostly incorporates the costs of distribution services (also called non-tradable processing component), which varies across countries, is a big reason for firms to charge different prices in different countries all things being equal (Corsetti and Dedola, 2004). MacDonald and Ricci (2001) develop a static model to demonstrate the effect of the distribution sector on the real

[14] For empirical evidence, see e.g. Haskel and Wolf (2001).

[15] Prices may be sticky in the foreign or in the local currency. If prices are set in the local currency of the target market (local currency pricing, LCP), prices do not adjust to changes in the nominal exchange rate. If prices are set in the firms own currency (producer currency pricing, PCP), there is full pass-through from exchange rate to prices. Indeed, pricing-to-market is needed to lower the exchange rate pass-through.

[16] For a panel composed of 10 OECD countries for the period 1970 to 1992, MacDonald and Ricci find empirical evidence, using panel dynamic OLS, in favor of the model. When wages for tradables are introduced (to control for the indirect B-S effect operating though wages, $q = f(a^T - a^{T*}; a^{NT} - a^{NT*}; w^T - w^{T*})$), the sign on the productivity variable in the open sector becomes negative, indicating that an increase in that variable leads to a real depreciation, as predicted by the model.

exchange rate. It can be shown that the real exchange rate depends not only on relative productivity in tradables and non-tradables but also on relative productivity in the distribution sector (D):

$$q = \phi_1(a^T - a^{T*}) - \phi_2(a^{NT} - a^{NT*}) + \phi_3(a^D - a^{D*}) \qquad (13)$$

The distribution sector may impact on the real exchange rate through two channels: an increase in the distribution sector's productivity decreases the price of tradables, via their lower non-tradable component and thus leads to a real depreciation, while at the same time, it causes a real appreciation via the wage channel (as in the case of the B-S effect).[17]

3.2.2.2. Demand-Side Factors

Bergstrand (1991) uses a simple general equilibrium model to demonstrate the importance of other factors, in addition to relative productivity, as determinants of the relative price of non-tradables. In such a framework, the demand for and supply of non-tradable goods (relative to tradable goods) can be solved for the relative price of non-tradables, which yields the following formula:

$$\hat{p}^{NT} - \hat{p}^T = \phi_1 \cdot (\hat{a}^T - \hat{a}^{NT}) + \phi_2 \cdot \hat{k} + \phi \cdot_3 \hat{y} \qquad (14)$$

where $\hat{k}$ and $\hat{y}$ are changes in the capital-labour ratio and in per capita income, respectively. The implications of the model are that the relative price determination can be augmented with the capital-labour ratio, as proposed by Bhagwati (1984)[18], and, perhaps most importantly, demand-side variables, such as government and private consumption. Because of a high income elasticity of demand for non-tradable goods, an increase in dual productivity, accompanied by increasing disposable income per capita, may result, in the long run, in rising consumption, which falls increasingly on non-tradable goods. Thus, demand-side pressure in the sheltered sector yields higher non-tradable prices.

The standard B-S effect rests on a two-sector, two-input, small open economy model. According to Fischer (2004), a three-sector four-input model makes it possible to show that investment demand can also lead to a rise in the price of non-tradable goods.

3.2.2.3 Baumol-Bowen and the Role of Regulated Prices in Transition Economies

As noted in Froot and Rogoff (1994), the Baumol-Bowen effect produces, in general, the historical observation that service prices are likely to rise more than the overall price level because productivity gains in the manufacturing industry put upward pressure on wages in services (as opposed to non-tradables in the B-S framework) via the intersectoral wage spill-over effect. The mechanism behind this "cost disease" is very similar to the one presented in equation (7)[19]. The trend appreciation of the real exchange rate as described in the B-S model is based on sectors and prices which are governed by market forces. Baumol and Bowen (Baumol and Bowen, 1965, 1966, and Baumol, 1996) analyze the case of largely nonprofit sectors, such as health, education or the live performing arts. They argue that "nonprofit organizations (…) earn no pecuniary return on invested capital and they claim to fulfill some social purpose" (Baumol and Bowen, 1965, p. 497). Put differently, nonprofit organizations have structural financial difficulties because their operating revenues are lower than what would follow from profit maximizing price setting and their expenditures. Because the non-profit sector relies heavily on public (or private) subsidies, it can be viewed as

---

[17] MacDonald and Ricci (2001) use the same dataset used in MacDonald and Ricci (2002) to test the empirical validity of the model. The estimation results, based on a specification similar to equation (13), indicate that an increase in productivity of the distribution sector yields a real appreciation, while rising productivity in tradables (non-tradables) results in a standard appreciation (depreciation) of the real exchange rate. It is interesting to note that the inclusion of the relative wage variable as in MacDonald and Ricci (2002) changes the sign on tradables productivity from positive to negative underlying the robustness of the home bias channel.

[18] Bhagwati (1984) proposes an alternative explanation to the B-S effect to explain why service prices are lower in less developed countries than in industrialized economies. His argument is not explicitly based on differences between productivity in the open sectors but, rather, on different factor endowments in poor and rich countries. It can be observed from the data that the capital-labor ratio of the tradable sector is higher in rich countries, as compared to poor countries. Provided consumers want to consume the same basket of goods in both rich and the poor economies, Bhagwati demonstrates in a general equilibrium model, that the poor (rich) country will specialize in labor-intensive (capital-intensive) goods. This will result in a lower wage level in the poor country's open sector, which, in turn, determines wages and prices in the sheltered sector. This framework implies that a rise in the capital-labor ratio of the open sector leads to an increase in the relative price of tradables.

[19] For instance, Lojschova (2003), Mihaljek and Klau (2004) and Wagner and Hlouskova (2004) argue that equation (7) represents the Baumol-Bowen effect and that equation (8) shows the B-S effect. This is, to a large extent, a terminological issue (we call it the internal transmission mechanism of the B-S effect)

an administered rather than a market-based sector (as in the B-S framework)[20]. Baumol and Bowen (1966) document that, for instance, the average cost of a single performance at the Royal Shakespeare Theatre in 1963 was 13.6 times higher than the corresponding costs at the Drury and the Covent Garden theatres in London from 1740-75. At the same time, the overall price level in England rose by about 600%. Also, cost increases may be lower than what productivity gains in the open sector would require because the intersectoral wage equalization attenuates this effect.[21] Furthermore, Baumol and Bowen (1965) state that albeit also on the rise, ticket prices considerably lagged behind soaring costs. To summarize, there are reasons to think that prices in the non-profit sector do not behave in a manner which conforms with the B-S effect.

Administered and regulated prices,[22] which are composed mainly of services, represent a large component of consumer price indices for transition economies. However, for historical reasons, changes in these prices are usually the highest (in contrast to the Baumol-Bowen effect) and are not related to productivity increases (as opposed to the B-S effect).[23]

Because regulated items can be inputs for tradable and market non-tradable goods, an increase in regulated prices may affect tradable goods' competitiveness directly and indirectly through the market-based non-tradable component of tradable goods.

However, increases in regulated prices may not affect competitiveness and may also partly be viewed as an equilibrium phenomenon, for two reasons.

First, Prices of regulated services including public transport, communication, energy and water supply were left largely unchanged at the outset of transition. In setting the price of regulated items, only operational costs were considered initially because the capital stock of the sectors concerned was inherited from the communist era and because of political considerations. Eventually, capital maintenance costs were also considered to account for wear and tear. However, once general price liberalization was over, the progressive replacement of the capital stock at market prices, partly through privatization, led to huge increases in regulated prices because the cost of capital had to be taken into account as well (see Zavoico, 1995). This was all the more important as the regulated sectors tend to be very capital intensive. It appears that the adjustment of regulated prices is, however, not over yet. First, prices may still be below cost recovery in some cases. Second, governments still provide direct and indirect subsidies, which may be cut because of efforts to consolidate public finances and because of the need to comply with competition rules in the acquis communautaire. Finally, the need for additional capital investment to meet the quality of services required by EU standards may also imply further price increases (Égert, 2003a). To dampen price increases, efficiency can be improved via privatization and market liberalization. In the case of industries where true market competition is not possible, an appropriate price regulatory framework should be implemented, as was the case in England and Wales (Saal and Parker, 2001).

Second, regulated prices may impact on tradable goods that do not enter international competition.

3.3 The Internal-External Balance Approach: The Fundamental Equilibrium Exchange Rate (FEER) and its Variants

For a small open economy, a straightforward way of defining the equilibrium real exchange rate is in terms of the sustainability of its external balance, i.e. a sustainable current account and sustainable external debt. The Balassa-Samuelson framework implicitly recognizes the external sustainability issue by stressing that any appreciation of the real exchange rate should go in tandem with appropriate productivity gains, which, in turn, ensures that the competitiveness of exports is maintained. However, it is straightforward to demonstrate that there are factors other than productivity growth, such as the real interest rate, fiscal policy or the determinants of savings and investment, which can play a crucial role in current account and external debt sustainability.

---

20 The Baumol-Bowen effect assumes that services have close-to-nil productivity advances ("stagnant services", Baumol, 1996). Hence, it becomes a special case of equation (7) where $\hat{a}^{NT} = 0$.

21 This is because of "the willingness of those who work in these field to sacrifice money income for the less material pleasure of their participation in the arts. (Baumol and Bowen, 1965, p. 501.)

22 The terms administered and regulated prices will be used interchangeably in the remainder of the paper.

23

The notion of the external sustainability-based equilibrium real exchange rate was first advocated by Nurkse (1945), and then further elaborated by Artus (1978). In the context of empirical exchange rate issues the concept gained popularity with a series of publications by Williamson (1985, 1994). Williamson coined the expression Fundamental Equilibrium Exchange Rate (FEER) for the sustainable external account-based equilibrium real exchange rate. In accordance with Williamson's definition, the FEER is the real effective exchange rate that simultaneously secures internal and external balance for a country, or for a number of countries simultaneously. Internal balance is defined as the non-accelerating inflation rate of unemployment (NAIRU). Put differently, internal balance is reached when the economy functions at full capacity output accompanied by low inflation. External balance is achieved when the balance of payments is in a 'sustainable' position over a medium-term horizon, ensuring external debt sustainability.[24] The general flavour of the internal-external balance approach may be captured by the following equation:

$$S(W) - I(X) = CA(\hat{q}, Y) = -KA(Z) \tag{15}$$

where S denotes national savings, I denotes investment spending, CA and KA are the current account and the capital account and W,X,Y and Z are vectors of variables, to be discussed below, and $\hat{q}$ is the real exchange rate consistent with internal balance.

When it comes to operationalising the FEER, there are two key issues to be addressed. The first relates to the determinants of potential output growth associated with low inflation. Two main approaches have been adopted in the literature. On the one hand, historical GDP growth can be statistically decomposed into trend and cyclical components, using, for example, the Hodrick-Prescott (HP) filter or the Beveridge-Nelson decomposition. Alternatively, economic theory can be used to determine the magnitude of potential growth. The second issue to be addressed is that of the sustainability of the current account position. One way of defining current account sustainability is if a current account imbalance is covered, ex ante, by an equal and opposite capital account imbalance and if it stabilizes the external debt-to-GDP ratio at a given level. This is the approach taken by Williamson in his operationalisation of the internal-external balance approach. It remains, though, an open question as to what the optimal level of this ratio is and often a great deal of judgment has to be applied to obtain an appropriate value. A second approach involves viewing the current account in terms of saving and investment balances. According to this approach, labelled the ***Macroeconomic Balance (MB) approach***, econometric models are estimated by regressing saving and investment onto an array of explanatory variables, such as population growth, the fiscal position or openness etc. Fitted values for investment and saving are then used to derive medium-term values of the current account. This is, for example, the approach taken by the IMF in its implementation of the internal-external balance approach (see, for example, Isard et al., 2001).

Given some metric of internal and external balance there are essentially two mechanical ways of estimating a FEER. The first involves taking an estimated macro-econometric model, imposing internal and external balance, and solving for the real exchange rate, which is then classified as the FEER. However, by far the most popular method of generating a FEER involves focussing on an estimated current account equation and setting it equal to a sustainable capital account (see Wren-Lewis (1992)). There are essentially five steps involved in this process:

1) Determination of the targeted current account position;

2) Estimation of the elasticities of the trade account with respect to domestic and foreign output and to the real effective exchange rate ($TB = f(Y, Y^*, REER)$);

3) Calculation of the change in the real effective exchange rate (REER) that would place domestic and foreign output on their potential path and that would achieve the targeted current account. However, it is hard to achieve these three objectives simultaneously. Therefore, it is normally assumed that internal balance in both the home and foreign economies is achieved without the aid of the real effective exchange rate;

[24] Bayoumi et al. (1994) define a horizon from four up to six years.

4) Determining the change in the real effective exchange rate that makes the current account, adjusted for internal balances (i.e. the current account that would prevail at potential output), move to its target value. The change in the real effective exchange rate is effectively the total misalignment; and

5) If necessary, calculating the bilateral equilibrium nominal exchange rates from the equilibrium real effective exchange rate.

Šmídková and others (2003) propose introducing an external debt target into this framework, and this widens the horizon of the standard FEER model from the medium term to the long run. This variant of the FEER, also called the ***Fundamental Real Exchange Rate*** (FRER), imposes a long-term external debt target to which the actual external debt is required to converge in the long run. The equilibrium exchange rate is the exchange rate that secures the attainment of this target.

Barrell and Wren-Lewis (1989) demonstrate that in calculating the FEER it is very important to allow for revaluation effects through the net foreign asset term, especially if the Marshall-Lerner condition just holds. As Wren-Lewis (1992) emphasises, this implies that the real interest rate has settled at its long-run equilibrium value in the medium-run. Clearly this is a strong assumption, since it places a constraint on monetary policy in the medium-run. Furthermore, Wren-Lewis (1992) notes that the FEER is a 'method of calculation of a real exchange rate which is consistent with medium term macroeconomic equilibrium.' That is to say, the FEER approach does not embody a theory of exchange rate determination. Nonetheless, there is the implicit assumption that the actual real effective exchange rate will converge over time to the FEER. Hence embedded in this approach is a medium-run current account theory of exchange rate determination. That is, it is assumed that a divergence of the actual real rate from the FEER will set in motion forces that will eventually eliminate this divergence, but as the approach characterises only the equilibrium position, the nature of the adjustment forces is left unspecified.

In addition to the difficulty in measuring a sustainable capital account, the calculation of trade elasticities has often meant that an extra layer of judgement has to be imposed before the FEER can be calculated. This is because the estimated trade elasticity (or elasticities) often turns out to be effectively zero (see Goldstein and Khan (1985)). Furthermore, what has been described by Driver and Westaway (2004) as the 'Achilles heel' of the FEER approach, is the hysteresis introduced into the FEER due to interest payments on the net foreign asset term. Bayoumi et al (1994) consider this effect in some detail. To illustrate, assume that in the initial period the current exchange is at the FEER level and internal and external balance obtains. The actual real exchange rate then depreciates in the next period, thereby improving the current balance and improving the country's net foreign asset position. The latter, in turn, implies that in future periods the real exchange rate, consistent with medium-run capital accumulation, will no longer be the FEER; in particular, the FEER needs to appreciate to squeeze out the effects of the net asset accumulation. This hysteresis effect is a necessary consequence of viewing the exchange rate as a medium run concept. Taking a stock measure of equilibrium would of course rule out this kind of effect

Driver and Wren-Lewis (1999) assess the sensitivity of FEER calculations of the US dollar, Japanese yen and German mark to different formulations and assumptions. They find that two key factors impart a considerable amount of uncertainty into FEER type calculations. For example, changes in the assumed value of the sustainable capital account (as a proportion of GDP) of 1% can produce changes in the value of the FEER of around 5%. Since such changes in the capital account could easily be due to measurement error, this suggests caution needs to be exercised in interpreting point estimates of the FEER. For example, in using a FEER to define the equilibrium rate with which to lock two currencies together, some sort of confidence interval should be applied to the point estimate (this uncertainty is one of the reasons why Williamson argues that crawling peg arrangements should feature wide exchange rate bands). Driver and Wren-Lewis also show that it is often difficult to produce well-defined estimates of the trade equations, and therefore the underlying trade elasticities, which are so central to the FEER. Inevitably this means that the FEER estimate will be sensitive to the chosen elasticity.

3.4 The Natural Real Exchange Rate (NATREX)

The NATural Rate of EXchange (NATREX) was developed by Stein (1994, 1995 and 2002), and is also based on an internal-external balance framework. In contrast to the FEER approach, the NATREX approach distinguishes equilibrium real exchange rates at two horizons, in the medium run and long run. In the medium run, the real exchange rate can be viewed at equilibrium when internal and external balances are achieved simultaneously, very much as in the FEER approach. However, the definition of internal balance is slightly different to that used in the FEER approach, because it is defined in terms of full capacity utilization, rather than in terms of the NAIRU. As in the FEER approach, external balance is synonymous with current account sustainability:

$$CA-(S-I)=0\,. \tag{13}$$

That is, the current account corresponds to net exports (*NX*) minus net income payments/inflows related to foreign debt/assets, i.e. net factor income ($CA = NX - i^* \cdot FDEBT$) should be equal to long-term net capital inflows, determined by saving and investment decisions.

Consider now the investment and consumption functions and the determinants of the trade balance that are connected via the national account identity as in equation (17):

$$\frac{I}{Y}=f(\overset{+}{a},\overset{-}{\frac{K}{Y}},\overset{-}{r},\overset{+}{Q})\,, \tag{14}$$

$$\frac{C}{Y}=f(\overset{+}{\frac{K}{Y}},\overset{-}{\frac{FDEBT}{Y}},\overline{Z}\ )\,, \tag{15}$$

$$\frac{NX}{Y}=f(\overset{+}{Q},\overset{-}{\frac{D}{Y}},\overset{+}{\frac{D^*}{Y}},\overset{+/-}{TOT})\,, \tag{16}$$

$$\frac{I}{Y}+\frac{C}{Y}+\frac{NX}{Y}=1\,, \tag{17}$$

where I denotes investment, C denotes consumption (an aggregate of both private and public consumption), K is the capital stock, $FDEBT$ is foreign debt, NX is the trade balance, D and D^* represent domestic and foreign demand, respectively, K is the capital stock, $\overline{Z}$ denotes a vector of exogenous variables, the most important of which is the social thrift parameter that stands for the social (private and public) propensity to save and Y represents GDP. The + and – signs above the explanatory variables indicate the hypothetical relationships with respect to the dependent variables. Substituting equation (14) – (16) into the identity (17) and solving it for the real exchange rate (Q) yields the medium-term equilibrium real exchange rate, or NATREX. In practice, equations (14) – (16) are estimated using econometric techniques and the estimated medium-term NATREX is given by applying the estimated parameters to the solution of the system.[25]

In the NATREX model, a change in foreign debt and in the capital stock (K) feeds back into the macroeconomic balance. For instance, an increase in foreign debt resulting from a deteriorating current account position decreases wealth ($K - FDEBT$), and this leads to a fall in consumption. As a consequence, import demand drops and the real exchange rate depreciates, which, in turn, ameliorates the current account position and decreases foreign debt. This feedback mechanism eventually stabilizes foreign debt.

The value added of the NATREX approach, relative to the FEER, is that it additionally considers the influence of the stock of capital and net foreign debt on the long run exchange rate and it also describes the path of the real exchange rate from the medium-term equilibrium to the long-term equilibrium. In contrast to the medium-term NATREX, which as we have seen, is based on current values of the capital stock and foreign debt, the long-term equilibrium is derived when the stock of capital and the stock of foreign debt are stabilized at their steady-state levels, given respectively in equations (18) and (19):

$$\frac{K}{Y}=\frac{1+g}{\delta+g}\cdot\frac{I}{Y}\,, \tag{18}$$

[25] Equations (14) to (16) are normalized using actual output, which implies that the medium-run NATREX is the exchange rate that brings investment, consumption and net exports such as estimated in equations (14) to (16) in line with observed output (equation (17)). However, if equations (14) to (16) were normalized using potential output, the medium-term NATREX would be given as the exchange rate that equalizes medium-term aggregate demand with potential output (Karádi, 2003).

$$\frac{FDEBT}{Y} = \frac{1+g}{g} \cdot \frac{CA}{Y}, \qquad (19),$$

where δ denotes the rate of depreciation of the capital stock and g stands for the growth rate of GDP.

To illustrate the difference between the medium- and long-run real exchange rates, Stein (1995) considers two cases: first a decrease in the propensity to save and, second, a rise in productivity. In both cases, the medium-term NATREX appreciates. In the first case, a decrease in savings implies an increase in consumption, and this leads to a worsening of the current account and foreign debt. The resulting capital inflows cause the real exchange rate to appreciate, which restores both internal and external balance. However, in the long-run the real exchange rate depreciates because increased foreign debt causes interest payments to rise. Indeed, the real exchange rate depreciates to improve the trade balance required to service the debt.

As in the savings example, a positive productivity shock also produces a medium run real exchange rate appreciation and this also implies a larger current account deficit and an increase in foreign debt. However in contrast to the propensity to save example, an increase in productivity may result in an appreciation of the long-run real exchange rate, since in addition to foreign debt, the capital stock also rises in the medium term. This, in turn, makes productivity increase further, and the resulting higher GDP growth produces higher savings. Given this development, foreign debt decreases and the real exchange rate appreciates in the long run to counterbalance the improving current account. At the same time, however, the higher capital stock implies higher imports, which may offset some of the appreciation of the real exchange rate.

Its emphasis on productivity and savings as key determinants of the real exchange rate would seem to make the NATREX an important tool for the analysis of transition countries exchange rates. Recent attempts to estimate the structural form of the NATREX model include Detken et al. (2002) for the euro area and Karádi (2003) for Hungary. In contrast to the FEER approach, however, the NATREX is often written as a reduced form relationship, such as in equation (20), and this has been the most popular way of estimating the NATREX:

$$Q = f(a, \frac{K}{Y}, r, \frac{NFA}{Y}) \,. \qquad (20)$$

The way in which the equilibrium measure is recovered in a reduced form NATREX, is similar to the Behavioural Equilibrium Exchange Rate, which we now discuss.

3.5 The Behavioural Equilibrium Exchange Rate (BEER)

The BEER approach of Clark and MacDonald (1999) is not based on any specific exchange rate model, and in that sense may be regarded as a very general approach to modelling equilibrium exchange rates. However, it takes as its starting point the proposition that real factors are a key explanation for the slow mean reversion to PPP observed in the data. In contrast to some of the FEER based approaches, discussed above, its specific modus operandi is to produce measures of exchange rate misalignment which are free of any normative elements and one in which the exchange rate relationship is subject to rigorous statistical testing. To illustrate their approach, Clark and MacDonald (1999) take the risk adjusted real interest parity relationship, which has been used by a number of researchers to model equilibrium exchange rates (see, for example, Faruqee (1995) and MacDonald (1998a,b)):

$$\Delta q^e_{t+k} = r^e_{t,t+k} - r^{*e}_{t,t+k} + \lambda_t \qquad (21)$$

where Δq^e_{t+k} is the difference between the real exchange rate expected in t for $t+k$ ($q^e_{t,t+k}$) and the observed real exchange rate in period t (the q_t), $r^e_{t,t+k} = i_t - \Delta p^e_{t+k}$, $r^{*e}_{t,t+k} = i^*_t - \Delta p^{*e}_{t+k}$ represent the domestic and foreign ex ante real interest rates. Expression (20) may be rearranged as an expression for the real exchange rate as:

$$q_t = q^e_{t,t+k} - (r^e_{t,t+k} - r^{*e}_{t,t+k}) - \lambda_t \qquad (22)$$

If $q^e_{t,t+k}$ is interpreted as the 'long-run', or systematic, component of the real exchange rate, it can be assumed to be the outcome of the expected values of the fundamentals and can be replaced by $\bar{x}^e_{t,t+k}$ as in (22)

$$q_t = \bar{x}^e_{t,t+k} - (r^e_{t,t+k} - r^{*e}_{t,t+k}) - \lambda_t . \quad (23)$$

With rational expectations imposed, (23) can be rewritten as:

$$q_t = \bar{x}_t - (r_t - r^*_t) \quad (24)$$

In practical terms, the real exchange rate can be written as a function of the long- and medium-term fundamentals (x) and the short-term variables (z):

$$q_t = q_t(\bar{x}_t, \bar{z}_t) \quad (25)$$

The estimation of the BEER essentially proceeds in five stages:

1) Estimating the statistical long-run relationship between the real exchange rate, the fundamentals and short-run variables, which is tantamount to estimating a reduced form real exchange rate model;

2) Calculating the actual or current misalignment. Short-term variables are set to zero and actual values of fundamentals identified in step 1) are substituted into the estimated relationship. The actual misalignment is taken as the difference between the fitted and the actual value of the real exchange rate;

3) Identifying long-run, or sustainable, values for the fundamentals. This can be achieved either by decomposing the series into permanent and transitory components (for example, using an HP filter or a Beveridge-Nelson decomposition), or using a subjective evaluation of the long-term values is also possible (see Baffes et al., 1999);

4) Calculating total misalignment. In this case long-term values of fundamentals are substituted into the estimated relationship, relating the real exchange rate to the fundamentals, and short-term variables are again set to zero. Total misalignment is the difference between the fitted and actual value of the real exchange rate when sustainable values of fundamentals are used. Total misalignment depends on the short-term effect and on the departure of fundamentals from their long-term value;

5) Given a value for the equilibrium real exchange rate the nominal equilibrium exchange rate can also be deduced.[26]

3.6 The Permanent Equilibrium Exchange Rate (PEER)

3.6.1. Decomposition of the Real Exchange Rate

The so-called permanent equilibrium exchange rate (PEER) model is based on decomposing a real exchange rate into its permanent (q_t^P) and transitory (q_t^T) components:

$$q_t = q^P_t + q^T_t . \quad (26)$$

The permanent component is then taken to be the measure of equilibrium. In the literature, a number of alternatives have been proposed for extracting the permanent component from an economic series. Perhaps the best known is the univariate and multivariate decompositions of Beveridge-Nelson. Huizinga (1987) was the first to plot the permanent component derived from a univariate BN decomposition against the actual real rate and then make inferences about the extent of over- or undervaluation of particular currencies. Cumby and Huizinga (1990) use multivariate B-N decomposition (MBN) for the same purpose. Clarida and Gali (1994) show that the univariate and multivariate decompositions give very different measures of misalignment, in the sense that the two measures can give conflicting signals.

[26] Note that this is a highly simplified approach to deducing the nominal equilibrium exchange rate because it does not account for the dynamic effects of a nominal adjustment. A sizeable change in the nominal exchange rate that would correct for real misalignments in period t may move the real exchange rate away from equilibrium because of the nominal adjustment's effects on domestic (and foreign) prices. Such an effect could be considered by examining nominal exchange rate pass-through (Darvas, 2001) or by using a structural model of the economy.

Clarida and Gali (1994) use an SVAR approach to extract demand and supply shocks (taken to be the permanent components of the real exchange rate) and nominal shocks (taken to be the transitory components) of real exchange rates. They then construct figures to show the importance of the three shocks on the real exchange rates of the US dollar bilateral rates of the Canadian dollar, German mark, Japanese yen and UK pound. MacDonald and Swagel (2000) apply the Clarida-Gali method to the real effective exchange rates of the German mark, Japanese yen, UK pound and US dollar (and also the bilateral US dollar exchange rates of the German mark, pound sterling and Japanese yen). They interpret the cyclical, or business cycle, component as the sum of the demand and nominal shocks and netting this out from the actual real exchange rate, produce an alternative measure of the permanent (i.e. supply side) component of the real exchange rate. Detken et al. (2002), augment the basic Clarida-Gali model to include a relative employment term, the difference in the ratio of government consumption over GDP and the long-term interest differential.

3.6.2. Decomposition of the Cointegrating Vector

Clark and MacDonald (2000) also propose using the permanent component calculated from a VAR system and interpret this as measure of equilibrium, which is referred to as the Permanent Equilibrium Exchange Rate (or PEER). In contrast to the studies that use SVARs, the PEER does not rely on Blanchard-Quah style restrictions but it does require the existence of cointegration amongst the variables entering the VAR and relies on the decomposition of Granger and Gonzalo (1995).

Clark and MacDonald (2000) interpret the PEER as one way of calibrating a BEER. For example as an alternative to steps three and four of the BEER approach, discussed in the last section, is a single step that consists in decomposing the fitted estimated long-term relationship into permanent and transitory components using the Gonzalo-Granger method. This version of the BEER is usually referred to as the Permanent Equilibrium Exchange Rate (PEER).

3.7 UIP and PPP: Capital Enhanced Measures of the Equilibrium Exchange Rate - CHEERS

In this section we consider the so-called capital enhanced equilibrium exchange rate, or CHEERs (see MacDonald (2004)), approach to defining an equilibrium exchange rate. The main advantage of this approach is that it is highly tractable and can be used to provide reasonable measures of equilibrium exchange rates for both developed and transition economies in the absence of the kind of data needed to implement some of the other approaches. In the academic literature the approach has been popularised by Juselius (1991, 1995), Johansen and Juselius (1992), MacDonald and Marsh (1997, 1999) and Juselius and MacDonald (2000). The approach captures the basic Casselian view of PPP that an exchange rate may be away from its PPP determined rate because of non-zero interest differentials. Unlike the pure form of Casselian PPP, in which non-zero interest differentials only have a transitory impact on the real exchange rate, here the interest rates can have a medium run, or business cycle, effect. The essential proposition of this approach is that the long-term persistence in the real exchange rate is mirrored in the interest differential. Since the approach requires only a limited menu of variables it has been argued to be potentially useful for transition economies where data limitations are often severe. We consider the CHEERs approach firstly from a statistical perspective and then from an economic perspective.

Since interest differentials are usually empirically found to be I(1) processes (see for example, Juselius and MacDonald (2000)) some combination of an appropriate interest differential and the real exchange rate may cointegrate down to a stationary process:

$$[e_t + \beta_1(p_t^* - p_t) + \beta_2(i_t - i_t^*)] \sim I(0) \tag{27}$$

The CHEERs approach, therefore, involves exploiting the following vector:

$$x_t' = [e_t, p_t, p_t^*, i_t, i_t^*]. \tag{28}$$

As a measure of the equilibrium exchange rate, CHEERs is clearly a 'medium-run' concept in the sense that it does not impose stock-flow consistency. This may be seen as a disadvantage of the approach for assessment purposes. However, it may, nevertheless, provide a useful measure of equilibrium in circumstances where data on net foreign asset positions and other fundamentals are not available.

3.8 The New Open Economy Macroeconomics Approach to Equilibrium Exchange Rates.

Obstfeld and Rogoff (2001) have shown how the New Open Economy Macroeconomic (NOEM) approach may be used to address misalignment issues. Although this approach has so far not been widely used for assessment purposes, the fact that only a very small amount of information is required to produce a measure of the equilibrium exchange rate would seem to make it ideally suited for the calculation of equilibrium exchange rates of the current group of new EU member states. In illustrating the approach we follow the example in Obstfeld and Rogoff (2001). The latter was set up to show how much the US exchange rate would have to move in 2001 in order to restore balance on the US current account.

The key element in the new open economy (NOEM) class of model is that the optimising behaviour of consumers has implications for the current account which, in turn, has implications for exchange rates. The approach has more in common with the FEER based approach than the other approaches considered in this paper, since it does not produce a measure of the equilibrium exchange rate. Rather it asks the question: how much would the exchange rate have to move to reduce a current account imbalance to zero?

The first assumption in the NOEM is that the authorities have an internal balance objective, as in the internal-external balance approach. Consumers are assumed to have a CES Utility function of the form:

$$\left[\gamma C^{T\frac{\theta-1}{\theta}} + (1-\gamma)C^{NT\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \qquad (29)$$

where θ is price elasticity. When θ=1, (29) simplifies to the simple log form:

$$\gamma \log C^T + (1-\gamma)\log C^{NT}. \qquad (30)$$

The domestic production of both tradables and non-tradables is assumed exogenous at Y^T and Y^{NT}, respectively, and so the consumption of non-tradable goods must match the production of non-tradable goods, that is $C^T = Y^{NT}$. However, the existence of international trade means that the consumer's consumption of the tradable good is not tied to production - $C^T \neq Y^{NT}$

If prices are assumed fully flexible then it follows that the relative price of non-tradable to tradable goods - $p = P^{NT} / P^T$ - is determined in the following way.

$$p = \frac{1-\gamma}{\gamma}^{1/\theta} C^T / Y^{NT^{1/\theta}} \qquad (31)$$

and it follows that the exact CPI, in terms of the tradable good, is:

$$P = \left[\gamma + (1-\gamma)p^{1-\theta}\right]^{\frac{1}{1-\theta}} \qquad (32)$$

Given the above set up, calculation of the required exchange rate change – real and nominal - to remove a current account imbalance hinges on having numerical values for θ and C^T / Y^N. For the parameter θ, Ostry and Reinhart (1992) have reported point estimates of around 1 for short to medium run horizons, although the figure is likely to be higher in the long-run. An estimate of C^T / Y^N may be obtained from the current account ratio:

$$\frac{CA}{Y} = \frac{Y_T - C_T - iD}{Y} \qquad (33)$$

where Y (GDP) and D (net external debt) are expressed in terms of tradable goods[27]. The impact of the rise in the relative price of tradable goods (p falls) on the CPI depends on the central bank's price stabilisation

[27] Taking the situation of the US in 1991, where a current account deficit as a proportion of GDP of 4.4 per cent existed, Obstfeld and Rogoff assume Y/Y is 25% and iD/Y is 1.2% (which implies an interest rate of 6% and a GDP to net debt ratio of 20%). If for external balance, the ratio of the current account to income, CA/Y, falls to zero the drop in net imports of tradables would be 16%

policy. If the Fed tries to stabilise the CPI then with Y^{NT}=75% and Y^{T}=25% a 12% rise in tradable prices would be required and a 4% fall in non-tradable prices. Since P_T is set in world markets this implies a 12% depreciation of the exchange rate.

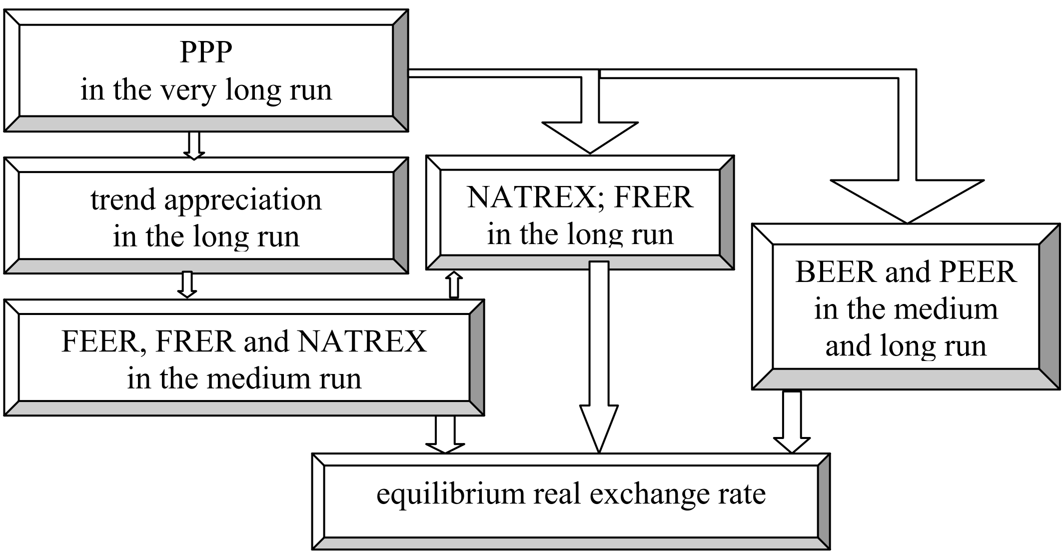
The effects of current account changes depend crucially on the underlying assumptions. For example, if the parameter θ equalled 0.5, instead of 1, this would imply a nominal exchange rate depreciation of 24%. Alternatively, a value of Y^T / Y of 15% would imply a 20% exchange rate depreciation. If the assumption of price flexibility is swapped for one of some price stickiness this will alter the current account implications for the exchange rate further. For example, if exporters only pass through one-half of any exchange rate change to importers, the Fed would have to let the dollar depreciate by 24% to stabilise the CPI and the level of employment in the non-tradable sector. With price stickiness of tradable and non-tradable goods, and if imports account for about ½ of all tradable consumed, then a US dollar depreciation of between 40 and 50 per cent would be required.

The upshot of the Obstfeld and Rogoff analysis is that there is an important short – long distinction in the effects of the current account on the exchange rate. In the long-run with price flexibility and a higher value of θ, the required exchange rate change would be much smaller than in the short-run where the combination of price stickiness and a relatively small value of θ would produce a large exchange rate change.

4 The Connection between Different Approaches

So far we have presented the major models which have been used to estimate equilibrium real exchange rates in CEE countries. They can be structured as follows: PPP is perhaps of most use in the very long run, i.e. in a secular context. The B-S effect, both in levels (PPP adjusted for differences in productivities) and dynamics (convergence towards the PPP level in the event of rapid growth) should provide good guidance in the long-run, although in addition to the non-tradable price channel, a trend appreciation of the tradable price-deflated real exchange rate can, as we have seen, also occur in the long-run and it is important that this is recognised. The FEER and medium-term NATREX, since they focus medium-term current account sustainability, should be useful for more immediate exchange rate assessment issues. The long-term NATREX, which considers adjustments of the capital and net foreign debt stocks toward their steady state level, gives further guidance on the evolution of the long run real exchange rate. The BEER is useful for both medium and longer run assessment issues. The time horizon profiles of the different approaches are summarized in Figure 1.

Figure 1 Time Hierarchy of the Different Approaches



(i.e. 4.4/28.2). With prices fully flexible and θ equal to unity, the relative price of non-tradable to tradable goods, *p*, has to fall by 16% otherwise there would be an excess supply of non-tradable goods which would conflict with the internal balance assumption.

In order to gain a better understanding of the interrelationships between the different equilibrium exchange rate approaches, consider Figure 2, where the grey corridor represents what may be called the PPP zone. For countries at comparable levels of development, the level of the real exchange rate should be equal to 1, i.e. the price levels in the home and foreign countries should be equal when expressed in the same currency unit ($EP^* = P$, that is, absolute PPP holds). Nonetheless, because of differences in, for example, the tax system and wage policies and because of trade barriers and other market imperfections, the equilibrium real exchange rate fluctuates in a band of, say, $\pm\mu$ around 1. Also, differentiated goods allow for pricing-to-market practices, which may shift the PPP ratio (with the band around it) away from 1, even in the long run.

When countries at different stages of development are considered, the less developed country's real exchange rate is usually undervalued when using the PPP concept and, consequently, it is higher than 1.[28] But this is an equilibrium undervaluation in PPP terms. At the same time, the real exchange rate is in equilibrium when taking into account the difference in the levels of dual productivity between countries. Point A represents this situation.

In these two cases, the absence of major changes in relative economic development, especially in relative dual productivity levels, would imply no major changes in the level of the equilibrium real exchange rate. However, for industrialized countries PPP has proven difficult to verify especially when standard time series methods are applied to relatively short time spans of 20 to 30 years. Although the use of secular time series and large panel data sets appears to show that real exchange rates are significantly mean reverting, the typical half-life (i.e. the time needed for the deviation vis-à-vis equilibrium to diminish by half), ranges from three to five years - Rogoff (1996) - and is too slow to be consistent with PPP. However, a more plausible explanation for the PPP puzzle has recently emerged. Using threshold autoregressive (TAR) models, it is possible to show that within a band around equilibrium, such as shown in Figure 2, the real exchange rate exhibits non-stationarity, i.e. it follows a stochastic trend because transaction costs are high enough to prohibit goods arbitrage. However, when the real exchange rate moves beyond a threshold, over which profits to be realized from goods arbitrage exceed transaction costs, the real exchange rate tends to return to the PPP corridor,[29] which may be different for individual countries. Typically, nonlinear adjustments towards the band are found to happen much faster when compared with the typical half-life of three to five years.[30]

If one country experiences higher economic growth, and especially rapid increases in dual productivity that cause the price level to rise, compared with those in the other countries, its equilibrium real exchange rate appreciates systematically. This reflects a successful catching-up with the other countries if this country starts from a less-developed stage. Alternatively, if it starts from a similar stage of development, it can also grow apart from the rest of the world. In Figure 2, the equilibrium real exchange rate appreciates until it reaches, through points B and C, the PPP corridor of $1\pm\mu$. The equilibrium appreciation itself is also a corridor because of transaction costs.

However, it may be that the real exchange rate is not in equilibrium when considering dual productivity levels. For instance, point A' shows the situation of the real exchange rate when it is undervalued, not only in PPP terms, but also when accounting for differences in dual productivity levels. This implies an initial undervaluation of the domestic currency that could call for a quick real appreciation towards levels given by productivity. In contrast, A" refers to the position in which the real exchange rate can be viewed as overvalued when differences in dual productivity levels are accounted for. As a consequence, the actual real appreciation should be lower than the equilibrium trend appreciation in line with productivity advances so as to compensate for this misalignment and to ensure that the real exchange rate returns to the "equilibrium corridor."

During periods of rapid change in relative economic development levels, the equilibrium real exchange rate may exhibit trending behaviour over a period of 15 to 30 years. For such a period, PPP cannot be used as a yardstick, although it may be indicative in periods over which relative economic performances equalize (Froot and Rogoff, 1994; Froot et al. 1995). But a period of 15 to 30 years is still far too long to interpret the equilibrium real exchange rate for policy purposes and so some other more appropriate measure is required. The FEER approach provides a medium-term definition of the equilibrium real exchange rate which is

[28] The exchange rate is expressed as home currency units over one unit of foreign currency.

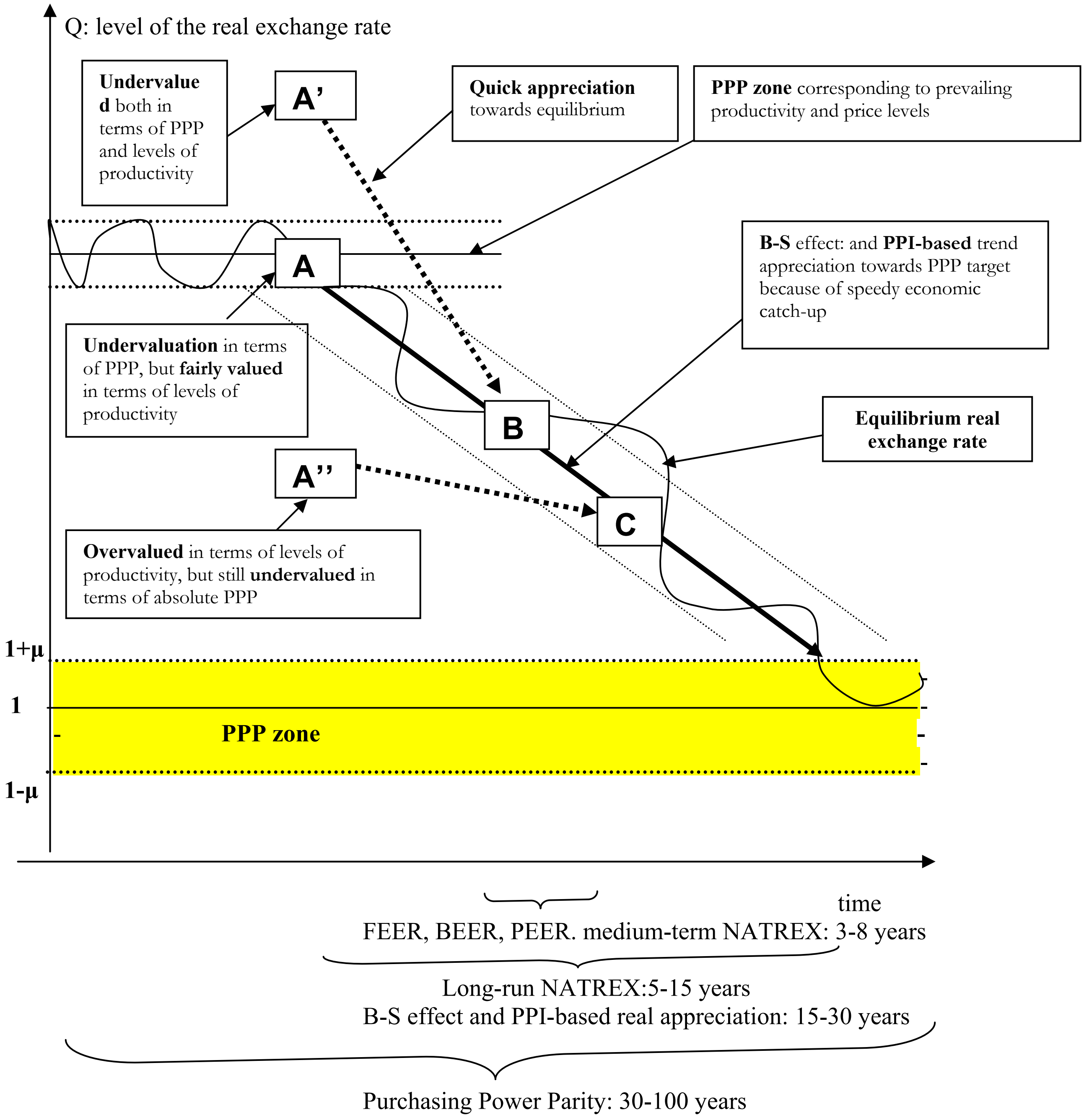
[29] The speed with which the real exchange rate returns to the band may be modeled in different ways. The TAR model assumes abrupt adjustment back to the band, whereas smooth transition autoregressive (STAR) and self-exciting threshold autoregressive (SETAR) models allow for smoother adjustment toward the band of inaction.

[30] For an overview, see Sarno and Taylor (2002).

compatible with current account sustainability. This implies that even during a period of trend appreciation, the equilibrium real exchange rate can depreciate or appreciate compared to the trend because of external imbalances.

Accordingly, not only the observed real exchange rate, but also the equilibrium real exchange rate can fluctuate within the band in the medium run. The reason for this is that productivity increases consider current account developments and net foreign indebtedness only implicitly by referring to competitiveness in the tradable sector. This is possibly not always sufficient to secure current account sustainability in the medium term, and that is why the BEER including these variables, and especially the FEER approaches, can explicitly tackle this issue in the medium run. It may be that, in spite of the fact that the equilibrium real exchange rate appreciates in the longer run, it has to depreciate in the medium run so as to bring back the current account to its long-term value, which ensures a viable path for the foreign debt.

Figure 2. Trend Appreciation of the Equilibrium Real Exchange Rate



5 Real Exchange Rate Behaviour in Transition Economies: Some Stylised Facts

In this section we consider some of the stylised facts relating to the exchange rate behaviour of transition economies. Table 1 and Figure 3 confirm that: (a) the real exchange rate of the transition economies is substantially undervalued in terms of PPP; and (b) the real exchange rates of the transition economies experienced a strong appreciation from the outset of the transition process, although the extent of the appreciation has been very different across individual countries. As is also shown in Table 1, the nominal German mark/euro exchange rate implied by PPP (given by the ratio of the domestic and foreign price levels) is far lower than the actual nominal exchange rate in eight transition economies from 1996 to 2002. This means that the real exchange rate in levels is higher than 1 and the undervaluation is sizeable. Furthermore, an ocular analysis of Figures 3a and 3b reveals that the CPI-based real exchange rate of the five CEE economies and the three Baltic countries appears to appreciate, to a different extent throughout the period 1990 to 2002. According to Table 2, not only the real exchange rate of services is undervalued in terms of PPP, as suggested by the B-S model, but also the real exchange rate of different types of goods turns out to be undervalued, albeit to a lesser extent.

Table 1 PPP and the Nominal and Real Exchange Rates in 1996, 1999 and 2002

	1996			**1999**			**2002**		
	PPP (1)	**NER (2)**	**RER (2)/(1)**	**PPP (1)**	**NER (2)**	**RER (2)/(1)**	**PPP (1)**	**NER (2)**	**RER (2)/(1)**
Czech Republic	5.76	18.04	3.13	13.85	34.6	2.5	14.88	32.7	2.2
Estonia	---	---		6.35	14.78	2.33	7.63	16.61	2.18
Hungary	35.76	101.4	2.84	100.66	237.2	2.36	118.3	257.9	2.18
Latvia	---	---		0.25	0.59	2.36	0.25	0.62	2.48
Lithuania	---	---		1.55	4	2.58	1.5	3.68	2.45
Poland	0.67	1.77	2.64	1.81	4	2.21	2.04	4.1	2.01
Slovakia	6.01	20.37	3.39	13.87	41.36	2.98	16.95	45.33	2.67
Slovenia	47.29	89.97	1.9	118.87	182	1.53	143.83	240	1.67

Source: Authors' own calculations based on data obtained from NewCronos/Eurostat.

Note: PPP is the domestic to German price level ratio. Data on absolute price levels were obtained from NewCronos/Eurostat.

NER stands for the nominal exchange rate against the Deutsche mark in 1996 and against the euro in 1999 and 2002.

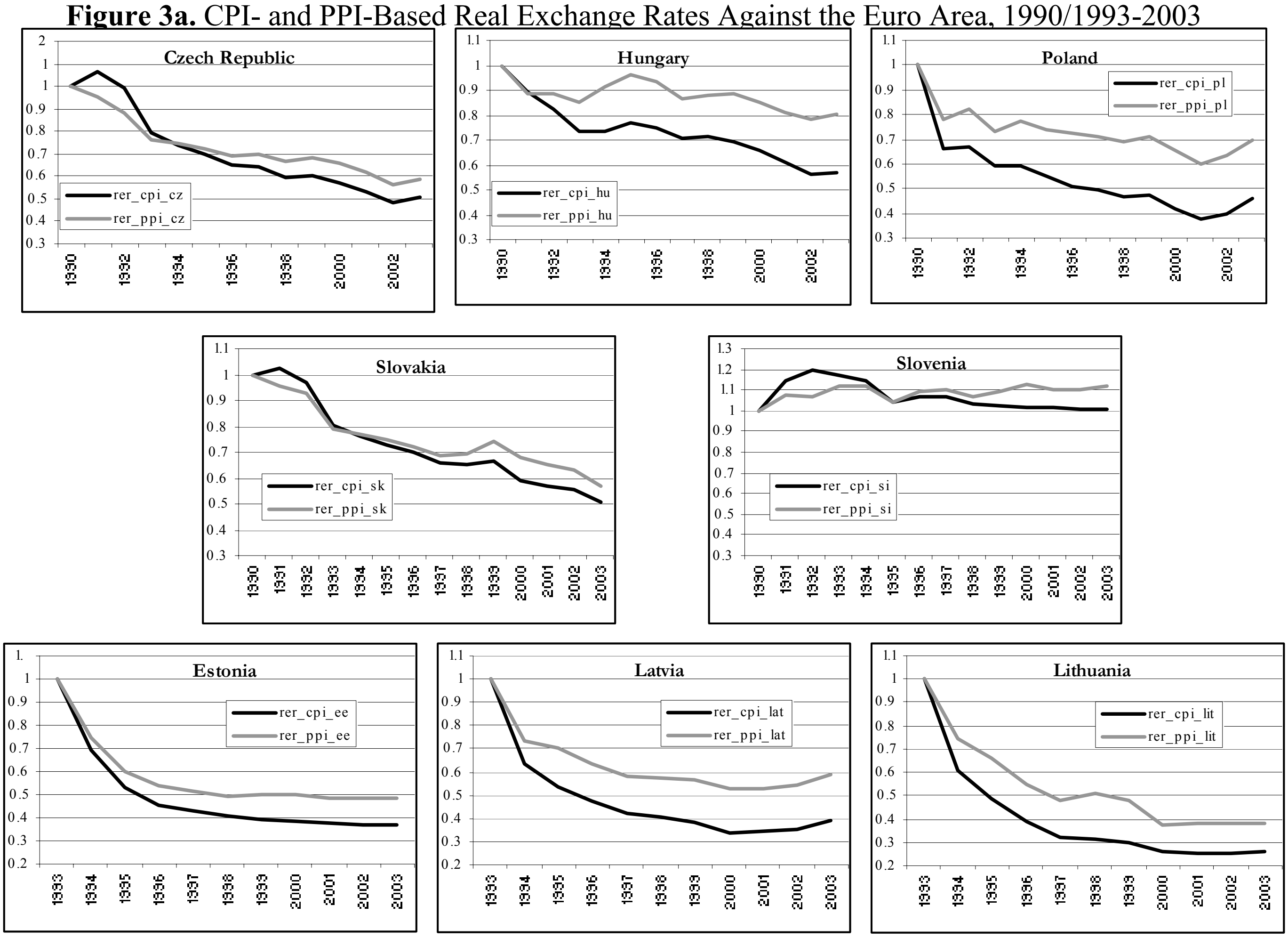
RER is the real exchange rate and is obtained as NER/PPP.

Table 2. Level real exchange rates of different groups of goods and services in new EU member states, 2002

	Durable	**Semi-durable**	**Food**	**Market services**	**Non-market services**	**Property prices**
				EU-15=100%		
CEEC-8	1.13	1.47	1.46	1.80	2.42	2.41

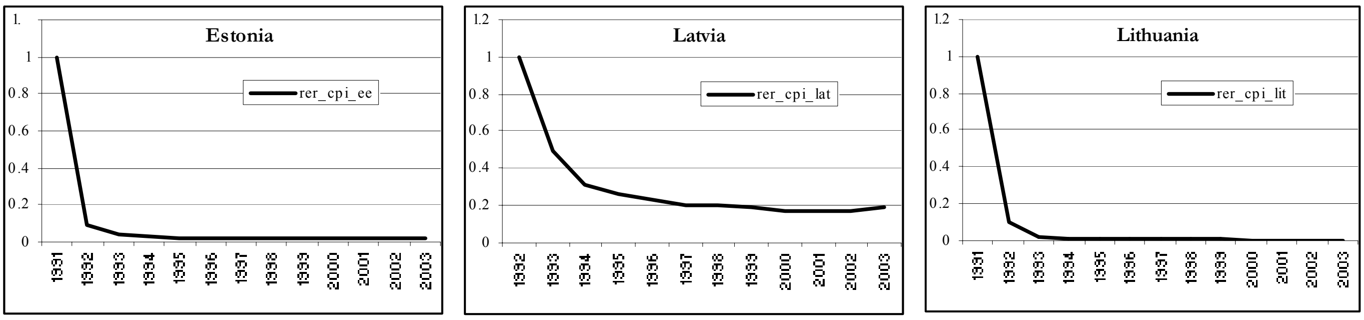
Source: Authors' calculation based on data obtained from NewCronos/Eurostat

Figure 3a. CPI- and PPI-Based Real Exchange Rates Against the Euro Area, 1990/1993-2003



Source: Authors' own calculations based on data obtained from the WIIW Annual Databased (CEEC5), Eurostat (euro area), IFS/IMF and national sources (Baltic States).

Figure 3b. CPI-Based Real Exchange Rate Against the Euro Area for the Baltic States, 1990- 2003



Source: As for Figure 3a.

6. Methodological Considerations in Transition Economies

We now turn to the issue of the statistical techniques used (displayed in Figure 1) to estimate the equilibrium real exchange rate. The first, and simplest, approach used for transition economies involves the calculation of descriptive statistics, for key relationships from the simple B-S model. This consists of computing yearly average growth rates for dual productivity (or the dual productivity differential) and the relative price of non-tradables (or the relative price differential). Alternatively, data can be analyzed graphically to determine if the real exchange rate and the relative price differential are in line with the dual productivity differential.

Table 3. Overview of Major Differences in the Estimation Methods

Approach	Estimated Specification	Econometric Methods	Misalignment
Simple B-S model	$(a^T - a^{NT}) \rightarrow (p^{NT} - p^T)$ $(a^T - a^{NT}) - (a^{T*} - a^{NT*}) \rightarrow (p^{NT} - p^T) - (p^{NT*} - p^{T*})$ $(p^{NT} - p^T) - (p^{NT*} - p^{T*}) \rightarrow RER$ $(a^T - a^{NT}) - (a^{T*} - a^{NT*}) \rightarrow RER$	Descriptive statistics Time series Panel Cross-section	None. Actual
BEER	$(a^T - a^{NT}) \rightarrow (p^{NT} - p^T)$ $(a^T - a^{NT}) - (a^{T*} - a^{NT*}) \rightarrow RER$ $(a^T - a^{T*}), (a^{NT} - a^{NT*}) \rightarrow RER$ $(a^T - a^{NT}) \rightarrow RER$ $(p^{NT} - p^T) - (p^{NT*} - p^{T*}) \rightarrow RER$	Time series Panel: in-sample, out-of-sample	None Actual Total
FEER	Multi-country model Single-country model Full-scale macromodel Model of foreign trade	Structural models – 4 steps	Total
NATREX		Single equation Structural model	Total

More rigorous tests of the simple and extended versions of the B-S model have involved using time series methods, such as the cointegration methods discussed in the BEER section. Another way of estimating the simple and extended B-S model consists of employing panel estimation methods. Since the philosophy underpinning the application of panel methods differs to some extent from the use of time series methods, we describe them in more detail below. The basic idea is that the countries included in the panel should behave relatively similarly in the long-run. This implies that the real exchange rate is assumed to react quite similarly to changes in the fundamentals in every country of the panel. The estimation of the relationship between the real exchange rate and its fundamentals yields average coefficients for the whole panel and if long-term homogeneity holds in the panel, the estimated average coefficients are expected to properly reflect the long-run behaviour of the real exchange rate of individual countries and can thus provide a better estimate than that which would be obtained by purely time series methods.

The equilibrium real exchange rate can be derived from panel estimates in much the same way as it is from a time series analysis: first, the actual misalignment is determined and then, in a second stage, the total misalignment is obtained based on the long-term values of the fundamentals.

A further point worth noting with respect to panel methods relates to in-sample and out-of-sample panel estimates. For the in-sample approach the equilibrium real exchange rate is assessed for the countries included in the sample and for the period used for the estimation. By contrast, out-of-sample estimates involve estimating the link between the real exchange rate and fundamentals for a given set of countries and then computing the equilibrium exchange rate for countries not included in the sample, and/or for a different period,[31] by substituting the corresponding fundamentals series into the estimated equation.

Regarding the calculation of misalignment, the following patterns emerge from the literature on the CEE countries:

1) Some papers simply do not compute misalignment. The sole aim of these papers is to show the empirical linkage through which the real exchange rate is connected to fundamentals (real exchange rate determination, as in step 1 of the BEER and panel estimations), i.e. to estimate a model of real exchange rate determination.

2) Others calculate only actual misalignment. This is particularly the case when purely time-series or panel estimators are used.

3) Finally, another part of the BEER and panel literatures also aims at identifying total misalignment. In this regard, it should be noted that the FEER approach always produces a measure of total misalignment.

[31] E.g. the panel includes countries A, B, C,…, M for 1960-90, and the equilibrium exchange rate is assessed for the case of countries N and L for the period 1995-2003.

7 What Have We Learned from the Literature?

7.1 The Trend Appreciation of the Real Exchange Rate

Perhaps the most widely studied relationship for the exchange rates of CEE countries is the role of productivity in explaining the trend appreciation of these currencies. There are a number of ways in which the influence of productivity on the trend appreciation of the two real exchange rates referred to earlier has been captured. The first approach, of relating productivity differentials to the internal price terms, is used most often when investigating the simple B-S, or trend appreciation model, while the remaining approaches, which feature the overall real exchange rate, can be employed, in principle, to test both the simple B-S framework and the BEER approach.

First, there is a test of the relationship linking dual productivity with the relative price of non-tradable goods for the home country ($(a^{T} - a^{NT}) \rightarrow (p^{NT} - p^{T})$), where "$a$" stands for productivity. This can be referred to as the internal transmission mechanism and is a test in the spirit of the Balassa-Samuleson hypothesis. A second and more appropriate test considers the link between the dual productivity differential and the difference in the home and foreign relative price of non-tradable goods (relative price differential henceforth) ($(a^{T} - a^{NT}) - (a^{T*} - a^{NT*}) \rightarrow (p^{NT} - p^{T}) - (p^{NT*} - p^{T*})$). In this context it is worth noting that usually no distinction is made between market and regulated non-tradable prices, which could produce substantially biased estimates. Two complementary sets of regressions then follow, one in which the real exchange rate is regressed on the home country's dual productivity ($(a^{T} - a^{NT}) \rightarrow \text{RER}$), a regression which links the dual productivity differential to the real exchange rate ($(a^{T} - a^{NT}) - (a^{T*} - a^{NT*}) \rightarrow \text{RER}$). Alternatively, the productivity differential for tradables and the one for non-tradables can be used separately $((a^{T} - a^{T*}),(a^{NT} - a^{NT*}) \rightarrow RER)$. In terms of the real exchange rate the regression $(p^{NT} - p^{T}) - (p^{NT*} - p^{T*}) \rightarrow \text{RER}$ is often considered as an alternative to $(a^{T} - a^{NT}) - (a^{T*} - a^{NT*}) \rightarrow \text{RER}$, where the relative price differential is taken as a proxy for the dual productivity differential. However, it is important to note that this is not an equivalent relationship because productivity may also impact directly on tradable prices. Furthermore, even if the relationship $(p^{NT} - p^{T}) - (p^{NT*} - p^{T*}) \rightarrow \text{RER}$ is found to be significant, it might well be a spurious proxy for the productivity relationship and could, for example, reflect the influence of regulated prices.

7.1.1 The Role of Market Non-Tradables: The Balassa-Samuelson Effect

The real exchange rate of the transition economies has experienced strong appreciation from the outset of the transition process, although the extent of the appreciation has been very different across individual countries. It is a widely held view that this appreciation is largely due to the B-S effect and thus has not resulted in an overvaluation of the currencies. A first strand of papers (e.g. Sinn and Reutter, 2000; Rother, 2002; Golinelli and Orsi, 2002; Jazbec, 2002) supports this view. However, another group of papers, listed in Table 4, has recently shown that, at best, half of this appreciation can be ascribed to the B-S effect (see Kovács, 2001, 2002; Flek et al., 2002; Égert, 2002; Égert et al., 2003, and Mihaljek and Klau, 2004)[32]. The main reason for this finding is that PPP does not hold for the open sector, since the PPI-based real exchange rate (used as a proxy for the real exchange rate in the open sector) has also appreciated, though to a lesser extent than the CPI-based real exchange rate. The B-S effect is expected to explain the difference between the overall inflation-deflated (CPI) and the tradable price-based (PPI) real exchange rates. [33]

[32] Curiously enough, even the first strand of papers finds a very low inflation differential for the Czech Republic that could be attributed to the B-S effect. This is because increases in overall and dual productivity in the Czech Republic were among the lowest in the transition countries. However, another explanation for this outcome may lie in statistical problems: The Czech Statistical Office may have considerably underestimated output in the Czech Republic (Filer and Hanousek, 2000). This is all the more possible as the Czech Republic was the biggest net FDI receiver among the transition economies not only in terms of FDI per capita but also regarding the absolute stock of FDI cumulated from 1991 to 2003, which amounts to nearly USD 42 billion (EBRD, 2003).

[33] When using the CPI and the PPI, this only holds if overall inflation is composed of tradable goods and market-based services, and if the tradable component of the PPI corresponds to that of the CPI.

The equilibrium appreciation of the real exchange rate, and thus the underlying inflation differential vis-à-vis Germany and the euro area that can be imputed to the B-S effect, is found to amount to up to 2.0% in Hungary and Poland and is much lower in the other countries.[34] In the Czech Republic and Latvia, it is close to zero.[35] This finding has important implications: for example, the B-S effect, i.e. productivity-driven market service inflation, is likely to be no barrier to meeting the Maastricht criterion on price stability, defined as the average inflation rate (measured in terms of the harmonized CPI) of the three best-performing EU countries in terms of price stability plus 1.5%.[36] However, this does not mean that the fulfilment of the criterion would pose no problem for tradable price inflation, and especially regulated price inflation may be of importance in this respect. For instance, in addition to the standard B-S framework, Wagner and Hlouskova (2004) use GDP per capita as a demand-side variable, along with tradable prices, to generate inflation rates for 8 CEECs. They find that using these additional variables gives a medium-term inflation rate in the range from 3% to 7%. Furthermore, it is interesting to note that 'catching-up' EU countries, such as Greece, Portugal and Spain, recorded very low changes in dual productivity during the 1990s despite above-average economic growth coupled with above-average inflation rates. This may imply that mechanisms other than the B-S effect could be at work and bring about changes in relative price levels.

Table 4. Inflation Differential and the Real Appreciation of the Exchange Rate Implied by the Balassa-Samuelson Effect vis-à-vis Germany or the Euro Area (%)

(in %)	Czech R.	Estonia	Hungary	Latvia	Lithuania	Poland	Slovakia	Slovenia
Backé et al. (2003); a	0.4		4.5			9.4		3.5
Golinelli and Orsi (2002); a	4.1		1.95			4.9		
Rosati (2002); a	0.95	2	3.9			4.15		2
Rother (2000); a								2.55
Sinn and Reutter (2001); a	2.7	3.2	6.7			4		3.2
Average	2.04	2.6	4.26			5.61		2.81
Burgess et al. (2003)		0.43		0.4	0.47			
Égert (2002)	0.2		1.4			1.85	-0.7	-0.5
Égert (2004)		0.65						
Égert et al. (2003)	-0.2	0.1	0.75	-0.3	-0.1	1.6	1.5	0.7
Felk et al. (2002)	-0.29							
Halpern and Wyplosz (2001); a	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Kovács (2001)			1.5					
Kovács and Simon (1998)			1.6					
Kovács (2002)	0.1		1.9					0.7
Mihaljek and Klau (2004); a	-0.3		1			0.8	0.0	0.0
Average	0.09	0.55	1.31	0.37	0.46	1.31	0.45	0.38
Average real appreciation: 1993–2001	~5.00	~10.00	~3.00	~10.00	~10.00	~5.00	~4.00	~1.50

Source: Authors' own calculations based on the original papers.

Note: Figures are average annual changes. Furthermore, figures are average figures of the range given in the original paper.

a) = the inflation differential against Germany computed using a Balassa-Samuelson implied inflation rate of 0.35% for the euro area / Germany (Swagel (1999), Lommatzsch and Tober (2003) and Égert et al. (2003) put the size of the B-S effect to 0% (1990 to 1996), to 0.1% (1995-2002) and to 0.55% (1995-2000), respectively.)

34 Kovács (2003) argues that the B-S effect is not likely to exceed 2% per annum even in the longer run. Kozamernik (2003) makes model-based projections and concludes that the yearly inflation rate imputable to the B-S effect would range from 1% to 1.5% in Slovenia (0.4% to 0.9% in terms of an inflation differential vis-à-vis Germany).

35 One should not forget that these figures are based on past data. One may argue that the maximum value of 2% can be affected by different future developments. On the one hand, a slowdown in productivity increases in the open sector as acceding countries' productivity levels approach EU productivity levels. On the other hand, EU accession may foster productivity growth in the open sector due to the deepening of EU integration. But this may be overcompensated by. Also, productivity gains in the sheltered sector may pick up. Although the share of (market) services in the acceding countries' national and harmonized CPI (20% to 35%) is still lower than what we can observe in the EU (40% to 45%), it may only increase progressively with higher real income per capita, and would not exacerbate the B-S effect's impact on the CPI.

36 This is in contrast with the long held view, advocated by Buiter and Grafe (2002) and Szapáry (2003) among others, that new EU member states in Central and Eastern Europe would not be able to fulfill the Maastricht criterion on price stability because of the B-S effect.

As documented in Figure 3a, both the CPI-based real exchange rate and the PPI-deflated real exchange rate underwent a certain trend appreciation from the early 1990s onwards in the transition economies and these two real exchange rates moved fairly closely together. This is supported by Cincibuch and Podpiera (2004) who show that sectoral real exchange rates in manufacturing industries experienced strong appreciation from 1997-2004. Clearly, the traditional B-S effect cannot explain the appreciation of the real exchange rate deflated by the PPI (as a proxy for tradable prices) because its impact passes through the non-tradable price channel. Indeed, the B-S effect that posits PPP to hold for tradable goods is meant to explain possible differences between changes in the overall inflation-based (CPI) and the tradable price-deflated (PPI) exchange rates.

This point is demonstrated by Égert et al. (2003), who, for a panel of 9 transition economies, report results for the relationship between different relative price measures on the one hand, and the CPI-based real exchange rate and the PPI-based real exchange rate on the other hand. The fact that both real exchange rates turn out to be cointegrated with the relative price measures is a further piece of evidence that the real appreciation cannot be fully associated with the B-S effect.[37]

7.1.2 Non-Market Non-Tradables: The Case of Administered and Regulated Prices

Notwithstanding the fact that the B-S effect can explain only part of the real appreciation of the transition countries' currencies, the currencies are not necessarily overvalued. Real appreciation induced by an increase in regulated prices of non-tradable goods might also be viewed as an equilibrium phenomenon insofar as increases in regulated prices imply an approach towards the market-based service price level and do not lead to a deterioration in competitiveness. Égert and Lommatzsch (2003), Égert (2004) and MacDonald and Wójcik (2004) investigated the effects of regulated price increases on the real exchange rate of the transition economies and found that an increase in regulated prices was linked to the real appreciation of the transition economies' currencies. MacDonald and Wójcik (2004) show that the regulated price channel dominates the effect of productivity increases. In contrast, Égert and Lommatzsch (2003) found evidence in favour of the coexistence of the regulated price and productivity channels.

7.1.3 Initial Undervaluation

During the late 1980s, the exports of the transition economies collapsed because of the dissolution of Council for Mutual Economic Assistance (CMEA). At the same time, imports rose steadily due to pent-up demand for foreign goods. This made it necessary to devalue the currencies of the CEE countries in both nominal and real terms. A great deal of uncertainty regarding the equilibrium exchange rate and the nominal exchange rate based hyperinflation-stabilisation pushed policymakers to prefer a devaluation larger than what would have been necessary to correct for external imbalances. The devaluation of the Polish zloty against the U.S. dollar went, for instance, roughly 20% below the then prevailing black market rate (Rosati 1994, 1996).

These devaluations may have led to, or may have amplified, initial undervaluations. As a consequence, the real exchange rate of the open sector, and consequently that of the whole economy, may have appreciated at the onset of the systemic transformation process reflecting an adjustment towards equilibrium. Krajnyák and Zettelmeyer (1998) report a strong undervaluation at the beginning of the transition period, which was observed for all transition economies until 1995 (end of the estimation period). Halpern and Wyplosz (1997) also detect undervaluations for most transition economies. However, they found the Hungary forint fairly valued and the Slovene tolar even overvalued in 1990. According to results reported in Begg, Halpern and Wyplosz (1999), the Hungarian, Polish and Slovene currencies were not undervalued in 1993.

This means that part of the "excess" appreciation of the actual real exchange rate (the difference between the appreciation of the actual and equilibrium real exchange rate) may have only been a "corrective" convergence towards its equilibrium level.

7.1.4 Trend Appreciation of the Real Exchange Rate of the Open Sector

[37] For the B-S effect to explain the entirety of the real appreciation, the CPI-deflated real exchange rate is expected to be connected with the relative price of non-tradables but no relationship should exist between the real exchange rate of the open sector and relative prices.

If the initial undervaluation was large enough, the correction towards equilibrium should have occurred quickly. This is confirmed by Halpern and Wyplosz (1997) and Begg, Halpern and Wyplosz (1999) for Poland. A quick adjustment towards equilibrium means indeed a collapse of the real exchange rate, what we can observe for the Baltic countries on Figure 3b.[38]

It is important to note, however, that the initial undervaluation and the resulting adjustment towards equilibrium is only part of the story. Instead, real appreciation in both CPI and PPI terms has turned out to be a continuous process, especially in the CEEC5. Thus, the initial depreciation of the real exchange rates did not make the currencies undervalued but was indeed necessary to withstand the sharp pressure of market forces.

The source of the appreciation of the tradable price-based real exchange rate may be more closely related to the transformation process. At the beginning of transition, both domestic and foreign consumers tend to prefer foreign goods. However, with economic restructuring that entails productivity increases in the tradable sector, the home economy becomes capable of producing a growing number of goods of better quality. This is why the preferences of domestic and foreign consumers shift towards home goods. An increasing reputation and home bias allow higher prices to be set for the goods produced in the home economy both in the foreign and the domestic markets reflected in positive tradable inflation differentials. Also, an improving export performance based on the aforementioned factors may lead to the appreciation of the nominal exchange rate (Égert and Lommatzsch, 2003).

Such an increase in non-price competitiveness can be best captured with labour productivity in the open sector, because technology is mostly imported from abroad via massive foreign direct investment (FDI), which, in turn, is reflected in huge productivity advances in the industrial sector.[39] Thus, productivity gains could operate not just via non-tradable prices, but also via the tradable price and the nominal exchange rate channels. For example, if rises in tradable prices fuelled by productivity advances are faster in the home economy than in the foreign economy, the resulting positive inflation differential in tradable prices causes the real exchange rate based on tradable prices to appreciate. Similarly, the appreciation of the nominal exchange rate also leads to an appreciation of the tradable price-based real exchange rate.

To illustrate this point, Égert and Lommatzsch (2003) reported significant long-term cointegrating vectors between the dual productivity differential and the tradable price-deflated real exchange rate for the Czech Republic, Hungary and Poland and also in panels of up to 9 transition economies. Bitans (2002), Bitans and Tiller (2003) and Vetlov (2003) report similar results for Latvia and Lithuania. The existence of such cointegrating vectors strongly supports the proposition that productivity gains lead to an appreciation through the tradable price channel. Cincibuch and Podpiera (2004) analyze sectoral real exchange rates in the manufacturing industry. By decomposing the real exchange rates into a quality adjustment bias and a pricing-to-market term, they show that the steady real appreciation found in some of the sectors is due to quality adjustment bias, i.e. an inappropriate adjustment for better quality.

Another form of appreciation of the real exchange rate, defined using tradable prices, results from the appreciation of the nominal exchange rate, based on expected future productivity gains. For example, capital inflows related to productive foreign investment may trigger future productivity gains and an increase in future export revenues that could counterbalance today's deterioration of the current account. Most importantly, this kind of nominal appreciation will be an ex post equilibrium phenomenon only if productivity advances materialize and export revenues actually increase. In the opposite case, in the event that productivity gains do not materialize, an expectation-driven nominal appreciation, viewed ex ante as an equilibrium phenomenon, may lead to an ex post overvaluation of the real exchange rate.

In earlier sections of this paper, we presented NOEM models, which feature home bias and international price discrimination and produce a strong correlation between the nominal and real exchange rates. However, it should be borne in mind that such models cannot produce a trend appreciation of the tradable price-deflated real exchange rate such as has been observed for the CEE economies. Furthermore, Cincibuch and Podpiera (2004) find for three CEE economies that pricing-to-market explains only medium term

[38] In econometric terms, such a collapse can be thought of as an I(2) process. For instance, Égert (2004) finds the Estonian real exchange rate against its Western European counterparts to be an I(2) process for the period 1993-2002.

[39] Therefore, R&D expenditures, which is often used as a measure of non-price competitiveness for industrialised countries, is an inappropriate measure for transition economies, since R&D is mostly produced abroad and is then imported by the transition economies via FDI.

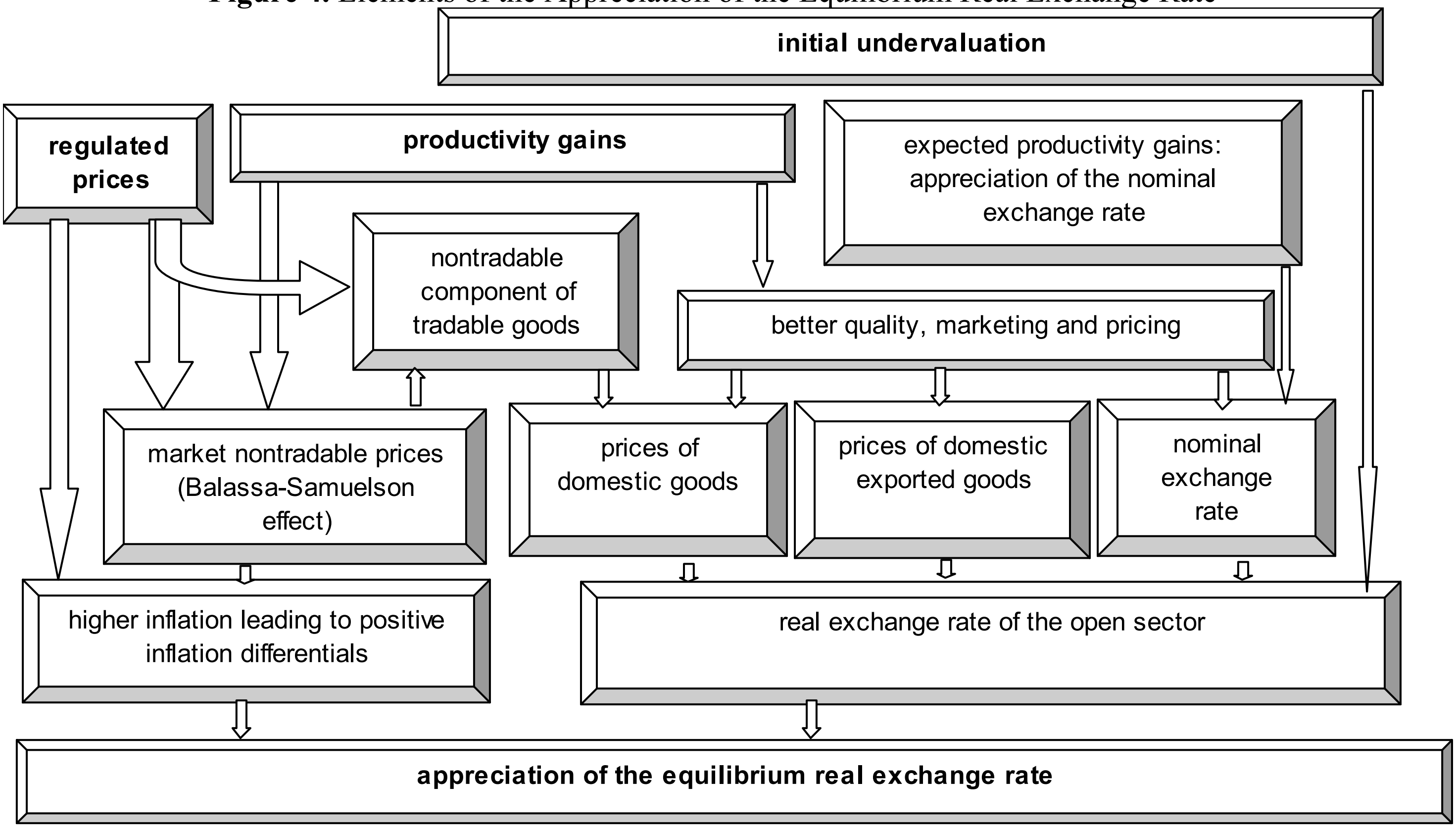
fluctuations but not the trend appreciation. However, with the move towards an increasingly flexible exchange rate regime in CEE countries - in, for instance, the Czech Republic, Hungary and Poland - could result in the predictions of the NOEM class of models being more useful for the future developments of exchange rates in these countries.

It is also worth noting that tradable prices also contain market-determined non-tradable components and elements of regulated items.[40] Thus, part of the appreciation of the PPI-based real exchange rate could be attributed indirectly to the B-S effect and to increases in regulated prices (see Rawdanowicz (2004) for econometric evidence).

A trend increase in disposable income per capita results in an increased demand for non-tradable goods of higher value. Improvements in productivity in the distribution sector may also cause the real exchange rate to appreciate, as advocated in MacDonald and Ricci (2001) and as shown in MacDonald and Wójcik (2004) for selected CEE economies.

Figure 4 summarizes the elements of the trend appreciation of the equilibrium real exchange rate in transition economies.

Figure 4. Elements of the Appreciation of the Equilibrium Real Exchange Rate



7.1.5 Measurement Bias of the "True" Size of the Real Appreciation

There is a more general problem in calculating the "true" size of a country's exchange rate overvaluation. Inflation measures, usually based on the CPI, are likely to overstate the "true" rate of inflation. The four sources of an upward inflation bias are as follows: (1) consumer substitution, (2) outlet substitution, (3) quality improvements, and (4) new goods bias (Boskin et al., 1996; Gordon, 2000).[41] Transition economies

[40] Adjustments in regulated prices are predominantly increases in non-market-based non-tradable prices. For regulated items partly represent inputs for tradable goods, those adjustments contribute to an increase in tradable prices. For homogeneous goods that eventually enter international competition either because they are exported or because they are subject to import competition, an increase in their non-market and market-based non-tradable component may lead to a loss in competitiveness and thus could not be viewed as an equilibrium phenomenon.

[41] Consumer substitution: changes in consumption patterns towards items with low price increases are not taken into account in the CPI. Outlet substitution: weights attributed in the CPI to different channels of distribution do not coincide with the observed patterns. The excessive weight of expensive traditional outlets at the expense of cheaper hypermarkets causes true CPI inflation to be

are even more prone to this bias than well-established market economies. For example, Hanousek and Filer (2001a,b) argue that in the Czech Republic, the bias due to quality changes may reach 50% of the CPI reported for food and goods and that the bias coming from the other sources are comparable to that measured for the U.S. economy and other industrialized countries. Although estimates are not available for other transition economies and for the PPI, the quality issue may also be very important in this case. Hence, the measured appreciation of the real exchange rate may be larger than the one based on unbiased inflation measures, i.e. the "true" appreciation.

It is also worth noting that real exchange rates for CEE countries based on the CPI are not fully consistent with those in developed economies. For example, the weight attributed to non-tradable goods in the CPI is considerably lower in the transition economies than in their Western counterparts. Using the same weights for tradable and non-tradable goods in the CPI for both the domestic and foreign economies would result in a slightly higher appreciation, which, however, would not compensate for the measurement bias.

7.2 Small BEER and Big FEER

In this section we examine some estimates of BEER models for transition economies and discuss some issues concerning these estimates in terms of parameter distortions and estimates issues arising from the use of time series methods relative to estimates obtained from panel methods. We then go onto examine misalignments obtained from these BEER and also consider some FEER estimates.

7.2.1 Signs of the Estimated Coefficients

In Table 5 we present a summary of various BEER estimates for transition economies. One thing that is noteworthy from these studies is that a wide range of fundamentals are used and the results often depend on the included fundamentals and the sample period. The use of different fundamentals may be a result of different theoretical frameworks or may simply reflect ad hoc choices.[42]

Table 5 reveals that an increase in the dual productivity (differential) always produces an appreciation of the real exchange rate. Terms of trade and public consumption to GDP also appear to be positively connected with the real exchange rate, although the evidence on this is less robust. The effects of net foreign assets and openness are much more controversial. For instance, an increase in net foreign assets is shown to produce an appreciation of the real exchange rate in Alonso-Gamo et al. (2002), Lommatzsch and Tober (2002b) and Burgess et al. (2003), while Hinnosar et al. (2003) and Rahn (2003) find the opposite effect for Estonia. The finding of Hinnosar *et al*. (2003) and Rahn(2003) is largely confirmed by Rahn for the Czech Republic, Hungary, Poland and Slovenia, and by Alberola (2003) for Hungary and Poland. In contrast, an increase in net foreign assets turns out to result in a real appreciation of the Czech currency. One reason why the sign on net foreign assets is ambiguous may relate to the shortness of the sample period, such that the real appreciation and net capital inflows occur simultaneously. This may be understood, for instance, in the framework of the NATREX model in which the evolution of net foreign assets is endogenous. If investment rises in the open sector, capital inflows, reflected in a decline in net foreign assets, cause the real exchange rate to appreciate in the medium-run. In the long run, when investment starts working in the open sector, the trade balance improves, resulting in an increase in net foreign assets, and producing an appreciation of the real exchange rate in the second phase.

Égert, Lahrèche-Révil and Lommatzsch (2003) provide a different explanation why different studies report different signs on the coefficient on net foreign assets. Countries in the catch-up process may have a negative steady-state net foreign assets position. In other words, in the medium term, they finance their growth via foreign capital. Strong capital inflows appreciate the real exchange rate in this phase. However, once the desired long-term foreign liabilities position is attained, the countries have to start servicing their debt. Thus, for any additional increase in net foreign liabilities, the real exchange rate depreciates. The authors use two panels composed of (1) small, open industrialised OECD countries and (2) transition economies from Central

overstated. Quality improvements: changes in prices due to quality changes are misconceived as price inflation. New goods bias: new goods are introduced into the CPI basket only with a delay.

[42] The fact that for the same country or for comparable panels, long-term relationships can be established, which include a different set of fundamentals, may also indicate that the real exchange rate may be linked to the fundamentals through multiple long-term relationships. Notice that the uncertainty regarding the fundamentals is still much smaller than, for instance, in growth economics. Durlauf et al. (2005) list about 100 variables used in the growth literature to account for differing cross-country growth rates.

and Eastern Europe. The results indicate that the sign of the net foreign assets variable is positive for the panel of OECD countries. The OECD panel can be thought of as reflecting long-run behaviour of the transition economies. For the panel of transition countries, the sign is negative, which may be taken as the medium-term effect. However, panel results mirror average behaviour of the panel. Based on a meta-regression analysis, Égert and Halpern (2004) suggest that some of the transition economies may already be in the long-run regime with a positive sign.

The same kind of controversy holds true for the coefficient on openness. While Braumann (1998), Begg, Halpern and Wyplosz (1999), Beguna (2002) and Csajbók (2003) find that an increase in the openness ratio leads to a real appreciation of the exchange rate, estimates in Avallone and Lahrèche-Révil (1999), De Broeck and Sløk (2001), Bitans (2002), Kim and Korhonen (2002), Vetlov (2002), and Égert and Lommatzsch (2003) show the opposite to be the case. A negative sign (an increase in openness leads to a depreciation of the real exchange rate) reflects the traditional view according to which openness is an indicator of trade liberalization: higher openness is associated with decreasing trade barriers, which raises imports more than exports. The deterioration in the trade balance makes the real exchange rate depreciate. However, an increase in openness can also represent improved supply capacities, which result in higher exports, and this can cause a real appreciation of the exchange rate. Nevertheless, this effect is expected to be captured by the productivity variables. Égert and Halpern (2004) find that in-sample and out-of-sample panel estimates lead to systematically higher coefficient estimates than those obtained using time series methods. However, the number of observations and the structure of the data do not allow an investigation of this ambiguity using probit analysis.[43]

7.2.2 Parameter Distortion

As we have noted, at the onset of the transition process, the real exchange rates of the transition economies may have been undervalued. The presence of such undervaluation could bias time-series and in-sample panel estimates of the equilibrium exchange rate due to the vector of slope coefficients, estimated from a regression of the observed real exchange rate projected onto the fundamentals, would differ from the true slope coefficient. This problem appears to be exacerbated in an in-sample panel setting if the initial undervaluations and the adjustment paths towards equilibrium are different across countries (Maeso-Fernandez; Osbath and Schnatz, 2004).

But a more general problem, which does not only apply to transition economies, is that BEERs are models of real exchange rate determination because they attempt to connect the observed real exchange rate to the fundamentals. Hence, empirically estimated coefficients are interpreted as equilibrium coefficients, which link the equilibrium exchange rate and the fundamentals, although they only represent the relationship between the observed real exchange rate and the fundamentals (the equilibrium relationship is assumed to equal the empirical long-term relationship). In this sense, real exchange rate determination models are used as models of equilibrium real exchange rates, although a distinction is made between an actual and total misalignment (in the latter fundamentals are calibrated at some notional equilibrium level). As a result, the estimated coefficients from BEER models are likely to be biased and thus probably yield biased real misalignments, irrespective of whether or not they are based on time series or panel methods. However, this bias is likely to be larger for estimates based on time series as well as on small- and medium-size panels. As a consequence, the extent of a misalignment derived from the estimates might depend on how well the observed real exchange rate can be modelled using fundamentals. Furthermore, if no long-term relationship can be established between the observed real exchange rate and its fundamentals, this does not mean necessarily that there is no relationship between the equilibrium real exchange rate and the fundamental variables.

[43] A future avenue of research would be to use all coefficient estimates for all countries.

Table 5. Signs of the Estimated Coefficients

	dependent variable	explanatory variables										
Time series		PROD	CAPITA	NFA	OPEN	TOT	GOV	PRIV	RIR	INV	FDEBT	REGD
Alberola (2003)	REER(CPI)	+ (LP)		+/-								
Alonso-Gamo et al. (2002)	REER(CPI)	+ (CPI/PPI)		-								
Avallone and Lahrèche-Révil (1999)	REER(CPI)		+		-	+	+	+				
Beguna (2002)	REER(CPI)				+	+	+					
Bitans (2002)	REER(CPI,PPI) EU	+ (LP)			-		-					
Bitans and Tillers (2003)	REER(PPI) EU		+	+		-						
Braumann (1998)	REER(CPI, PPI)	+ (RWAGE)			+		-			-		
Burgess et al. (2003)	REER(CPI)	+ (CPI/PPI)		-								
Csajbók (2003)	REER(CPI)	+ (LP)		+	+	+	+		+			
Darvas (2001)	RER (DEM)	+ (LP)		+					+/- (1)			
Égert and Lahrèche-Révil (2003)	REER(CPI)	+ (CPI/PPI)										
Égert and Lommatzsch (2003)	RER(CPI,PPI) DEM,EUR	+ (LP)			-				+/-		+/-	+
Filipozzi (2000)	REER(CPI)	+ (LP)								+		
Frait and Komárek (1999)	REER(CPI)	+ (real GDP)				+						
Hinnosar et al. (2003)	REER(CPI)	+ (LP)		+		+						
Kazaks (2000)	REER(CPI)	+ (LP)			-							
Lommatzsch and Tober (2002b)	REER(PPI)	+ (LP)		-					+			
Rahn (2003)	REER(CPI)	+ (CPI/PPI)		+								
Randveer and Rell (2002)	REER(CPI)	+ (LP)				+						
Rawdanowicz (2003)	RER(CPI) EU	+ (LP)				+			+			
Rubaszek (2003a)	REER(PPI)			+					+			
Vetlov (2002)	REER(PPI)	+ (LP)			-				-			
Panel												
Begg et al. (1999)			+		+		+					
Coricelli and Jazbec (2004)	P(t)/P(nt)	+ (LP)					+	+ (2)				
Coudert (1999)	RER(CPI) US	+ (CPI/PPI)									-	
De Broeck and Sløk (2001)	REER(CPI)	+ (LP)			-							
Dobrinsky (2003)	RER(CPI) EU	+ (TFP)	+				+					
Égert and Lommatzsch (2003)	RER(CPI,PPI) EU	+ (LP)			+				+		+/-	+
Fischer (2004)	REER(CPI)	+ (LP)				-	+		+/-			
Halpern and Wyplosz (1997)	RER(CPI) US	+ (GDP/worker)	+				+					
Kim and Korhonen (2002)	REER(CPI); RER(CPI) US		+		-		+			+		
Krajnyák and Zettelmeyer (1998)	RER(CPI) US		+									
MacDonald and Wójcik (2004)	REER(CPI)	+ (LP)		+/-					+			+ (3)
Maurin (2001)	REER(CPI)		+				+		+		-	

Note: + (-) means that an increase (decrease) in the given variables gives rise to an appreciation (depreciation) of the real exchange rate; REER(CPI) = real effective exchange rate based on the CPI; REER(PPI) = real effective exchange rate based on the PPI; RER(CPI) EU; RER(CPI) EUR; RER(CPI) U.S. = real exchange rate against the EU, the euro and the U.S., respectively; P(t)/P(nt) = the internal real exchange rate. See table 7 for the definition of the explanatory variables
(1) the foreign real interest rate
(2) the share of non-tradable consumption in private consumption
(3) regulated prices in the home country

7.2.3 Is there Misalignment out There?

The difficulty encountered in using BEER and FEER estimates to provide measures of misalignment of the real and the nominal exchange rate for ERM II entry is that very recent estimates are required. However, of the few estimates available, some are already outdated, referring to, for example, 1997 or 1998. Another problem is that some of the countries are rather poorly covered. For instance, there are only a few estimates available for Latvia, Lithuania, Slovakia and Slovenia.

For the Czech Republic, the equilibrium exchange rate seems to be overvalued in 2001 and 2002, since the estimated real misalignment ranges from 0% to +20%. Poland also exhibits signs of a misalignment in 2001 and early 2002, which might have been reversed by the strong depreciation of the nominal exchange rate. In the case of Hungary, most estimates show no evidence of misalignment prior to the abandonment of the crawling peg. Since then, the nominal exchange rate has appreciated by more than 10 per cent coupled with a positive inflation differential vis-à-vis its trading partners; this may have resulted in an above-equilibrium appreciation of the forint. This is widely acknowledged by available estimates. Although the Estonian kroon showed little signs of over- or undervaluation in 2000 and 2001, recent estimates for 2002 are more mixed on whether the real exchange rate is fairly valued or overvalued.

Table 6. The Magnitude of Real Misalignment

Country	Author(s)	Year	Misalignment
Czech Republic			
	Šmídková (1998)	1996	Eff: -1%- +5%
	Begg et al. (1999)	1997	Eff: NM
	Frait-Komárek (1999)	1998	Slightly +
	Kim and Korhonen (2002)	1999	Eff: -10%
	Coudert and Couharde (2003)	2001	EUR: -3/+1%
	Lommatzsch and Tober (2002b)	2001	Eff: 0%/+15%
	Égert and Lahrèche-Révil (2003)	2001:Q2	Eff:+15%
	Šmídková et al.(2003)	2002	Eff. +8-9%
	Rahn (2003)	2002:Q1	Eff. +9.7/+11%
		2002:Q1	EUR+13.7/+14.7%
	Alberola (2003)	2002:q4	Eff:+10%
	Égert and Lommatzsch (2003)	2002:Q4	EUR:+10-20%
Estonia			
	Begg et al. (1999)	1997	Eff: NM
	Filipozzi (2000)	1999	Eff: +5%
	Randveer and Rell (2002)	2000	Eff: NM
	Coudert and Couharde (2003)	2001	Eff: NM
	Šmídková et al.(2003)	2002	Eff. +13-14%
	Hinnosar et al. (2003)	2002	Eff: NM
	Rahn (2003)	2002:Q1	Eff. +5/+7%
		2002:Q1	EUR. +10/+12%
	Burgess et al. (2003)	2002:Q1	Eff:-3%
Hungary			
	Avallone and Lahrèche-Révil (1999)	1997	Eff: NM
	Begg et al. (1999)	1997	Eff: slightly +
	Coudert (1999)	1997	USD: NM
	Kim and Korhonen (2002)	1999	Eff: +40%
	Coudert and Couharde (2003)	2001	EUR: +2/+4%
	Lommatzsch and Tober (2002b)	2001	Eff: NM
	Égert and Lahrèche-Révil (2003)	2001 Q2	Eff: NM
	Csajbók and Kovács (2002)	2002	Eff: overvalued
	Šmídková et al. (2003)	2002	Eff. +6%
	Csajbók (2003)	2002	Eff. +3/+10%
	Rahn (2003)	2002:Q1	Eff. –3%/+5%
		2002:Q1	EUR+2.5%/+8.6%
	Alberola (2003)	2002:Q4	Eff: +10/+12%
	Égert and Lommatzsch (2003)	2002:Q4	EUR: +0/+8%
Latvia			
	Kazaks (2000)	1998	Eff: NM
	Beguna (2002)	2001	Eff:-2%
	Bitans (2002)	2001	Eff(EU): NM
	Burgess et al. (2003)	2002:Q1	Eff:-6%
	Bitans and Tillers (2003)	2002:Q4	Eff(EU): NM
Lithuania			
	Vetlov (2002)	2001	Eff: -7%
	Alonso-Gamo et al. (2002)	2002	Eff:-5%
	Burgess et al. (2003)	2002:Q1	Eff:-6%
Poland			
	Begg et al. (1999)	1997	Slightly +?
	Kim and Korhonen (2002)	1999	Eff: NM
	Kemme and Teng (2000)	1999	Eff. +2/+10%
	Lommatzsch and Tober (2002b)	2001	Eff: +10%
	Coudert and Couharde (2003)	2001	EUR: +3/+5%
	Égert and Lahrèche-Révil (2003)	2001 Q2	Eff: +11%
	Rawdanowicz (2003)	2002	Eff: NM
	Šmídková et al. (2003)	2002	Eff. +10-+12%
	Rahn (2003)	2002:Q1	Eff. +8%/+13%
			EUR. +13%/+17%
	Alberola (2003)	2001:Q2	Eff: +10%
		2002:Q4	Eff: -10%
	Rubaszek (2003a)	2001:Q2	Eff:+16%
		2002:Q4	Eff:+4.3%
	Rubaszek (2003b)	2002:Q4	EUR: +9%
		2003:Q2	EUR:NM
	Égert and Lommatzsch (2003)	2002:Q4	EUR: +0-6%
Slovakia			
	Braumann (1998)	1997	Eff: NM
	Begg et al. (1999)	1997	Eff: NM
	Kim and Korhonen (2002)	1999	Eff: NM
	Égert and Lahrèche (2003)	2001	EUR: +10%
	Égert and Lommatzsch (2003)	2002:Q4	EUR:+10/+15%
Slovenia			
	Begg et al. (1999)	1997	Slightly +?
	Coudert and Couharde (2003)	2001	EUR: +1/+2%
	Égert and Lahrèche-Révil (2003)	2001 Q2	Eff: NM
	Šmídková et al. (2003)	2002	Eff. NM
	Rahn (2003)	2002:Q1	Eff. –3%
		2002:Q1	EUR. -6%
	Égert and Lommatzsch (2003)	2002:Q4	EUR: -20%

Note: Positive figures indicate overvaluation, negative figures stand for undervaluation, Eff: in effective terms, EUR: against the euro, NM: no misalignment.

While these estimates might be useful for indicating whether or not a currency is overvalued, determining the precise size of a possible misalignment is a much harder task. In addition, a large number of available estimates refer to the real effective exchange rate. To obtain the equilibrium exchange rate vis-à-vis the euro, reliable information about the equilibrium USD/EUR cross rate is needed. This might also be subject to high uncertainty.

When interpreting the misalignment figures, the different time horizons at which, for instance, BEER, FEER and NATREX estimates apply, as shown earlier, should be borne in mind. In their meta-regression analysis, Égert and Halpern (2004) report results according to which the misalignment figures reported in the literature are systematically affected by the use of different theoretical backgrounds.

7.3 Time Series versus Panel Estimates

There is an apparent trade-off between the use of time series versus panel data. At best, time series span slightly more than ten years for transition countries, assuming no structural or smooth changes in the estimated relationships, and thus provide roughly 40 to 50 quarterly observations, which, from a strictly econometric point of view, might be insufficient. Panel data sets offer a way of increasing the span of the data and the power of any test based on the panel data set. Typically, three types of panels have been used in the literature: small panels including 6 to 9 countries, medium-size panels composed of 20 to 30 countries and large panels containing up to 80 or 90 countries. In addition, panels may or may not include the countries under investigation. Small panels are typically in-sample panels, whilst medium and large panels can be both in-sample and out-of-sample panels.

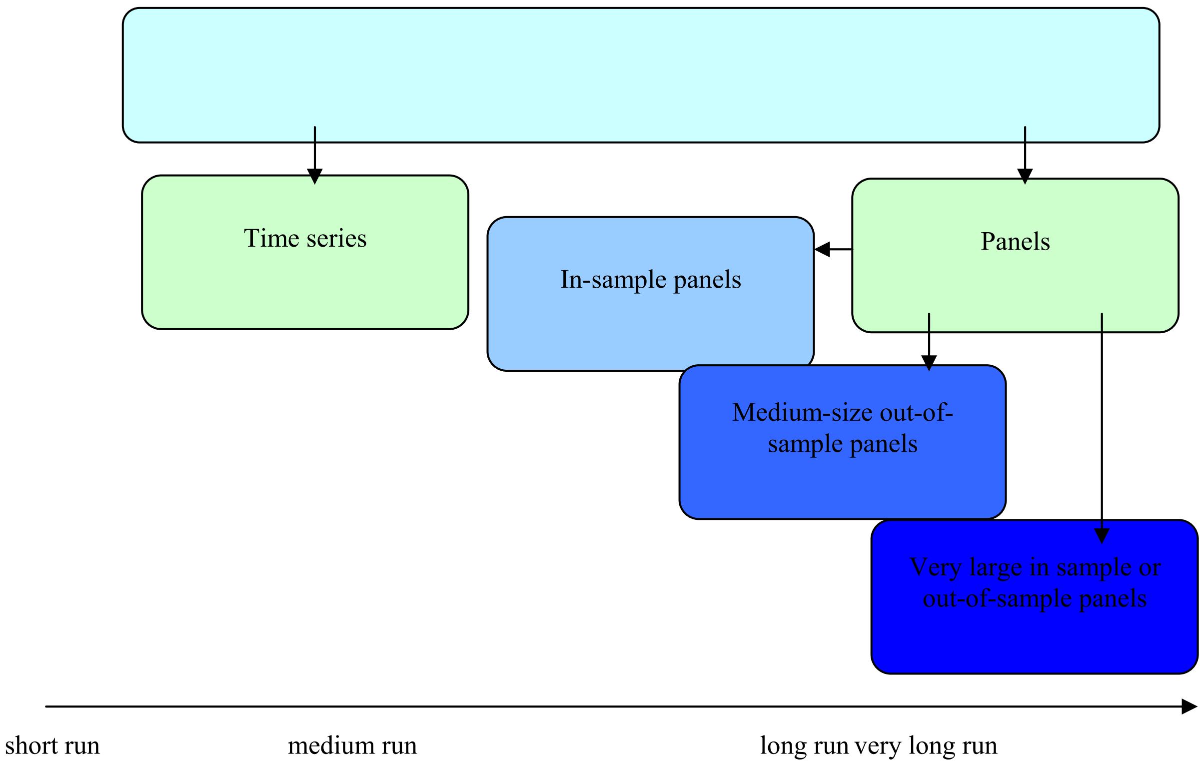
However, although panel methods have a number of advantages over either purely cross sectional or time series analysis, a number of issues remain. In general, medium-sized in-sample panel studies use a heterogeneous set of countries. From an econometric viewpoint, using panel data makes sense if homogeneity is verified for the countries. A typical panel data set used by, for example, Coricelli and Jazbec

(2001) or in Halpern and Wyplosz (2001) contains countries such as the Czech Republic and Slovenia on the one hand and Mongolia and Kyrgyzstan on the other. Yet only Kim and Korhonen (2002) and Csajbók (2003) test for homogeneity in the panels they use. In this context it is then difficult to interpret a common coefficient obtained for a set of economies which are so different.

One way around this problem is to use smaller panels composed of more homogeneous countries (De Broeck and Sløk, 2001; Dobrinszky, 2001) or very large panels (Halpern and Wyplosz, 1997; Krajnyák and Zettelmeyer, 1998). However, the problem raised in the case of time series estimates remains in small panels, i.e. estimates stand for the relationship between the observed real exchange rate, rather than the equilibrium real exchange rate, and a set of other variables. Moreover, in small panels based on annual data, the number of observations might drop significantly. The large panel setting assumes that market economies behave very similarly in the long term, and the estimated coefficients should reflect this long-term average behaviour. Therefore, these estimates could be applied to all countries. However, Maeso-Fernandez et al. (2003) argue that out-of-sample estimates do not provide a country-specific constant, and this could affect the level of the derived equilibrium real exchange rate when applied to individual countries.

A transition-based in-sample panel estimate can be thought of as reflecting the average behaviour of transition economies. Taking the example of an out-of-sample panel which includes industrialised countries, and assuming that transition economies will catch-up with those countries, such an out-of-sample estimate would provide an impression of how the equilibrium exchange rate of the transition countries would look by the time catching-up is accomplished, i.e. in approximately 20 to 30 years. Similarly, very large panels composed of nearly all countries in the world could be viewed as representing the very-long run behaviour of a market economy. Figure 5 gives an overview of the time horizons linked to the time and cross-sectional dimension of the data. This is confirmed by Égert and Halpern (2004): whether or not time series, in-sample or out-of-sample datasets are used for the estimations appears to yield strongly differing real misalignments.

Figure 5. The time horizon and the time and cross-sectional dimension of the data



7.4 Econometric Techniques

A related issue here is how appropriate the estimation methods actually are. As shown in Table 7, time series studies usually account for the nonstationary nature of the data and employ different cointegration techniques. In contrast to this is the observation that some of the panel studies do not consider nonstationarity and do not test for cointegration (see Halpern and Wyplosz, 1997; Coudert, 1999; and

Corricelli and Jazbec, 2001; for fixed and random effect OLS and Begg et al., 1999; and Dobrinsky, 2003; for GLS). It is admittedly difficult to test for cointegration when the time series dimension of the panel is limited. However, this issue can be tackled by running the regression in both levels and in first differences (Krajnyák and Zettelmeyer, 1998, and Maurin, 2001) or by applying nonstationary panel techniques: De Broeck and Sløk (2001) and Kim and Korhonen (2002) use PMGE and MGE and take a significant error correction adjustment parameter as evidence for cointegration. Crespo-Cuaresma et al. (2003) use a variety of estimation methods and systematically apply cointegration tests proposed by Kao (1999) to the residuals of the long-term relationships. Following a similar approach, Égert and Lommatzsch (2003) employ panel cointegration tests developed by Pedroni(1999).[44] The use of meta-analysis allows to show that employing alternative econometric techniques results in significantly different misalignments and in significantly different coefficient estimates for BEER studies (Égert and Halpern, 2004). Wagner and Hlouskova (2004) demonstrate by means of bootstrapping methods that standard critical values of panel cointegration tests may not be valid for small samples when testing for the relationship between the real exchange rate and the inflation differential on the one hand and the dual productivity differential on the other. As a consequence, long-term cointegration relationships detected in the literature may not reflect true long-term relationships. However, Wagner and Hlouskova use a panel of only 8 transition economies and 8 observations on each. The fact that most panel studies use quarterly or even monthly data and thus have a time dimension of about 40 to 120 observations per country may mitigate the non-cointegration finding.

[44] Although MacDonald and Wójcik (2002) use panel dynamic OLS, they do not report panel cointegration tests. Fischer (2002) reports coefficients on the basis of fixed-effect OLS, seemingly unrelated regression and PMGE and carries out Pedroni cointegration tests for the long-term relationship using OLS.

Table 7. Econometric Techniques Used in the BEER Studies

	Inference	Cointegration Tests
Time series		
Alberola (2003)	FIML	Johansen's trace and max
Alonso-Gamo et al. (2002)	FIML	Johansen's trace and max
Avallone and Lahrèche-Révil (1999)	FIML	Johansen's trace and max
Beguna (2002)	OLS	error correction term
Bitans (2002)	OLS	residual-based; error correction term
Bitans and Tillers (2003)	FIML, OLS	Johansen's trace and max
Braumann (1998)	OLS	None
Burgess et al. (2003)	FIML	Johansen's trace
Csajbók (2003)	OLS	residual-based unit root tests
Darvas (2001)	OLS	residual-based unit root tests
Égert and Lahrèche-Révil (2003)	FIML	Johansen's trace
Égert and Lommatzsch (2003)	OLS, DOLS, ARDL, FIML	residual-based; bounds testing approach; Johansen's trace
Filipozzi (2000)	FIML	Johansen's trace
Frait and Komárek (1999)	ARDL	error correction term
Hinnosar et al. (2003)	FIML	Johansen's trace: Cheung and Lai small sample adjustment
Kazaks (2000)	OLS	error correction model
Kemme and Teng (2000)	OLS	error correction term
Lommatzsch and Tober (2002b)	OLS	residual-based unit root tests
Rahn (2003)	FIML	Johansen's trace and max
Randveer and Rell (2002)	OLS	Johansen's trace; residual-based unit root tests
Rawdanowicz (2003)	FIML	Johansen's trace
Rubaszek (2003a)	FIML	Johansen's trace: Reimers small sample adjustment
Vetlov (2002)	OLS	error correction term
Panel		
Begg et al. (1999)	GLS	None
Coricelli and Jazbec (2004)	FE OLS	None
Coudert (1999)	FE and RE OLS	None
Crespo-Cuaresma et al. (2003)	FE OLS; FMOLS; DOLS; PMGE; MGE	Pedroni
De Broeck and Sløk (2001)	FE OLS; PMGE	error correction term for PMGE
Dobrinsky (2003)	GLS	None
Égert and Lommatzsch (2003)	FE OLS, DOLS, PMGE, MGE	Pedroni
Fischer (2002)	FE OLS; FE SUR; PMGE	Pedroni
Halpern and Wyplosz (1997)	FE OLS	None
Kim and Korhonen (2002)	FMOLS; PMGE; MGE	error correction term for PMGE
Krajnyák and Zettelmeyer (1998)	FE and RE OLS: in levels and 1st differences	None
MacDonald and Wójcik (2004)	DOLS	None
Maeso-Fernandez et al. (2004)	FMOLS, DOLS, ARDL	Pedroni, error correction term for PMGE and MGE
Maurin (2001)	FE OLS: in levels and 1st differences	None
Wagner and Hlouskova (2004)	FMOLS, DOLS, GLS	Pedroni

Note: OLS = ordinary least squares; GLS = generalised least squares; DOLS = dynamic OLS; FMOLS = fully modified OLS; ARDL = autoregressive distributed lags; FIML = full information maximum likelihood; PMGE = pooled mean group estimator; MGE = mean group estimator; FE OLS = fixed-effect OLS; RE OLS = random effect OLS; FE SUR = fixed-effect seemingly unrelated regression

7.5 Data and Measurement Problems

In this section we consider a number of measurement and methodological difficulties connected with the data sets typically used when analysing the exchange rates of CEE countries.

First, because an increase in the dual productivity differential is transmitted into the real exchange rate through the market-based non-tradable inflation, as predicted by the standard B-S effect, and also via multiple channels related to tradable prices, the relative price differential appears to be an extremely poor proxy for the dual productivity differential. In particular, the CPI-to-PPI ratio often used in the literature (see e.g. Coudert,1999; Alonso-Gamo et al., 2002; Burgess et al., 2003; Rahn, 2003) is even more affected by this problem given that the share of non-tradable goods in CPI is very low in the CEECs and because of the presence of regulated prices in the CPI. Égert, Lahrèche-Révil and Lommatzsch (2004) demonstrate this point. If the CPI-to-PPI ratio was an appropriate proxy for productivity, the two variables would then be highly correlated leading to multi-collinearity if used simultaneously. However, both variables turn out to enter the real exchange rate equation with the expected sign and are statistically significant, which basically confirms that they contain a different information set.[45]

Some authors (Sinn and Reutter, 2001, and Wagner and Hlouskova, 2004) use GDP deflators and formulate policy conclusions regarding inflation rates. Although the GDP deflator and the overall CPI behave fairly similarly in transition economies, their components (goods market-based services, regulated prices) exhibit substantial differences. This is why the use of GDP deflators instead of proper inflation series may lead to erroneous conclusions.

Second, in principle, labour productivity is given as output per total hours worked. In practice, however, the output-per-employee ratio is used. If there is a shift in full-time employment towards part-time employment (or vice versa), the number of employees is a poor proxy for total hours worked.

The classification of sectors into open and closed is also surrounded by a great deal of uncertainty:

1) Different classifications may be produce different dual productivity figures. For instance, in Mihaljek and Klau (2004), the open sector includes hotels and restaurants, and transport, storage and communication, which entails larger dual productivity in the Czech Republic than in all the other transition countries. This is in sharp contrast to other studies and with the estimates of the Czech central bank (see Kovács, 2002; Flek et al., 2002). Égert (2003) also shows that results are sensitive to how the open and the closed sectors are defined, and points out that one-size-fits-all techniques are not appropriate (a given sector can be viewed as tradable in one country and as non-tradable in another one). As the B-S model posits PPP to hold in the tradable sector, goods arbitrage – the mechanism ensuring PPP – should be potentially possible in the tradable sector. This, too, might be limited in the case of, for example, tourism or storage[46], since one cannot buy two nights in a five-star hotel, say, in Tallinn and sell them in Berlin or in Paris.

[45] In the case of multi-collineary, one of the variables switches sign and becomes insignificant. For the panel of OECD countries, the CPI-to-PPI ratio cancels out the productivity variable in that the latter switches sign but remains significant. This is in line with predictions of the class of NOEM models: 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 in the open sector's real exchange rate.

[46] One may argue that there is no need for goods arbitrage. It suffices that the given good/service is exported and that it is exposed to international price competition. In the case of tourism, it would mean that hotels in Tallinn, Paris and Berlin would closely monitor each others' prices. However, the trouble with this argument is that prices in tourism are largely determined by local factors such as labor costs and property prices. In addition, tourism is a highly differentiated good and prices may depend largely on preferences. Although one and the same package holiday to Estonia may actually cost the same for both customers in Germany and customers in Austria, there is no straightforward mechanism to equalize the price a customer in Germany, Austria or elsewhere would pay for one package holiday to Tallinn and another package holiday to Paris.

Table 8. Classification of Sectors into Open and Closed Sectors in Transition Economies

	Open Sector	Closed Sector
Alberola (2003)	Manufacturing	not considered
Backé et al. (2003)	Manufacturing	rest
Coricelli and Jazbec (2004)	industry + construction	rest, agriculture excluded
De Broeck and Sløk (2001)	industry + construction	rest, agriculture excluded
Dobrinsky (2003)	whole economy	
Égert (2002a,b)	Industry	not considered
Égert et al. (2003)	industry	rest
	industry and agriculture	rest
Filipozzi (2000)	Industry	rest, agriculture excluded
Fischer (2004)	industry and agriculture	rest
Flek et al. (2002)	Manufacturing	construction
Golinelli and Orsi (2002)	Industry	rest
Halpern and Wyplosz (2001)	Manufacturing / industry	services, agriculture and construction excluded
Hinnosar et al. (2003)	Manufacturing and agriculture	rest
	manufacturing, agriculture, hotels, restaurants, telecom and transport	rest
Kovács (2001, 2002), Kovács and Simon (1998)	Manufacturing	services, agriculture and public services excluded
Lojschova (2003)	Manufacturing	services and construction
Lommatzsch and Tober (2002a)	Industry	construction, trade, finance
MacDonald and Wójcik (2004)	Agriculture, mining, manufacturing, transport, telecom	rest
Mihaljek and Klau (2004)	Mining, manufacturing, hotels, transport, telecom	rest, agriculture and public administration excluded
Randveer and Rell (2002)	Agriculture, manufacturing, hotels, transport	rest (mining)
Rother (2000)	Manufacturing	rest, agriculture excluded
Rosati (2002)	Industry / industry and agriculture	Rest
Sinn and Reutter (2001)	Manufacturing and agriculture	construction, energy, services
Wagner and Hlouskova (2004)	Industry	services, agriculture and public services excluded

2) Agriculture has also proven difficult to classify as either a traded or non traded sector, with some researchers considering it as tradable while others do not. For instance, Fischer (2004) argues that half of the appreciation brought about by productivity gains can be attributed to productivity gains in agriculture. This is very questionable and is akin to saying that agriculture has a bellwether role during the catching-up process.

There is a more general statistical problem. Data definitions differ between individual transition economies and EU countries, in spite of ongoing data harmonization. In fact, the harmonization process implies changes in data definitions over time. In addition, data revisions occur relatively often in transition economies (the Czech Republic is a recent example), which might cast doubt on estimates derived using pre-revision data. Finally, the same time series for the same country can exhibit differences depending on whether it is drawn from national statistics, from the IMF or from OECD databases (Égert et al., 2003).[47] Another problem that needs addressing in this context is that the weights used to calculate effective exchange rates are adjusted to changes in foreign trade with a considerable lag and this may bias the estimates and also create a problem when backing out the bilateral equilibrium exchange rate against the euro.

If indices such as the CPI or PPI, on which the real exchange rate is usually based, or import and export price indices (for determining the terms of trade) are used, a question that has to be addressed is how to determine the year in which the exchange rate may be viewed as in equilibrium. Researchers usually rely on several methods:

1) The counterfactual approach is based on a subjective evaluation of the real exchange rate, the current account and other factors; the year in which these variables are believed to be in equilibrium is selected. A typical criterion is the year in which the current account is fully financed by FDI (Filipozzi, 2000; Randveer and Rell, 2002; Lommatzsch and Tober, 2002; Égert and Lahrèche-Révil, 2003). It is a question whether FDI linked to one-off privatization operation should be considered for this purpose or not. Clearly, the extent of the misalignment is likely to be sensitive to such judgments.

2) The nominal exchange rate implied by PPP is adjusted for differences in the level of productivity, which can be proxied by GDP per capita to derive the equilibrium nominal exchange rate for a particular year (usually for 1996 and 1999, as non-extrapolated data on price and productivity levels are available only

[47] Although the source of both IMF and OECD statistics are national statistical offices, these institutions may make corrections to the data and may update the data with a lag.

for those years): $\frac{P/P^*}{TFP/TFP^*}$ (see Brook and Hargreaves, 2001). A slightly more sophisticated version of this method is to use cross-section estimates when the relative price level or the real exchange rate gap is regressed on relative productivity, usually proxied by GDP per capita measured in PPP terms (De Broeck and Sløk, 2001; Randveer and Rell, 2002; Coudert and Couharde, 2003; Burgess et al., 2003; Čihák and Holub, 2001, 2003). Tables 9a and 9b show, however, that the result of such an exercise may be sensitive to the country sample, the year analyzed and the benchmark country.

An alternative consists of using levels data such as in the study of Maeso-Fernandez, Osbat and Schnatz (2004).

Table 9a. The Link between the Price Level and GDP per Capita or Employment in Studies Based on Cross-Section Regression

	Countries	Coefficient	Year	Benchmark	R2
Out-of-sample					
DeBroeck and Sløk (2001)	149	0.41	1996	US	0.63
Maeso-Fernandez et al. (2004)	24 (OECD)	0.50	2002	EU-15	0.65
Maeso-Fernandez et al. (2004) (1)	25 (OECD)	0.48	2002	EU-15	0.36
Pelkmans et al. (2000)	29 (OECD)	0.89	1996	Germany	0.88
In-sample					
Randveer and Rell (2002)	52	0.69	1996	Austria	0.83
Coudert and Couharde (2003)	120 (2)	0.25	2000	EU-15	0.24
Čihák and Holub (2001)	22	1.00	1999	Germany	0.91
Čihák and Holub (2003)	21-33	0.88 - 1.00	1993, 1996, 1999	Germany	0.88 - 0.93
Čihák and Holub (2003)	103 - 106	0.56 - 0.62	1998	Germany	0.70 - 0.79
Čihák and Holub (2003)	22 - 30	0.86 - 0.94	1999, 2001	EU-15	0.79 - 0.87

Notes: The coefficient is the slope coefficient from the regression:
RelativePriceLevel = a+b*GDPperCAPITA; out-of-sample means that the sample excludes transition economies; conversely, in-sample implies the inclusion of transition economies; R2 stands for the goodness-of-fit of the regression.
(1) GDP per workers in PPP terms is employed. The other studies apply GDP per capita in PPP terms.
(2) Only those countries are included whose GDP per capita is lower than that of the euro area

Table 9b Undervaluation and Overvaluation in Terms of Relative Productivity Levels

	Year	Undervalued	Fairly Valued	Overvalued
DeBroeck and Sløk (2001)	1993	CZ, EE, LV, LT, SK	HU, PL, SI	
	1999	CZ, SK	HU, EE, LV, LT, PL, SI	
Burgess et al. (2003) (1)	1993	EE, LV, LT		
	2001		EE, LV, LT	
Randveer and Rell (2002)	1993	EE		
	1996-1999		EE	
Coudert and Couharde (2003)	2000	CZ, EE, HU, SI, SK		LV, LT, PL
Čihák and Holub (2001, 2003)	1996, 1999	CZ, HU, SI, SK		PL

(1) They use estimates of DeBroeck and Sløk (2001)

However, it is noteworthy that some studies simply take the fitted values of the estimated relationship based on indices and do not seek to address the issue of the base year.

Another tricky issue for the BEER approach is how to measure the long-term values of the underlying fundamentals. One group of papers simply assumes that actual values correspond to long-term values (see Lommatzsch and Tober, 2002). Others employ statistical methods to extract the trend component of the series (Filippozi, 2000; Randveer and Rell, 2002). Finally, model-based fitted values are also useful for this purpose (e.g. Rubaszek, 2003; Égert and Lahrèche-Révil, 2003).

The FEER approach cannot escape these kinds of problems either. For example, Coudert and Couharde (2003) use in-sample panel estimates provided by Doisy and Hervé (2003) for seven transition economies to derive the long-term current account along the lines of the Macroeconomic Balance approach whereas Csajbók and Kovács (2002) consider the year 2000 as in equilibrium and use values for the current account from that year. Both methods rely heavily upon subjective expert evaluations. It should also be mentioned that the NIGEM model, on the basis of which FEER calculations are performed, has a number of shortcomings. For example, it is a one-sector economy model, and, second, some of the parameters are estimated using the panel of five transition economies (the Czech Republic, Estonia, Hungary, Poland and Slovenia), whilst others are calibrated. More generally, it is often the case that the home country variable is not taken in terms of the foreign country (see Jazbec, 2002). As the very concept of the real exchange rate is based on the comparison of the domestic and foreign economies, variables ought to be computed as the ratio of the home country variable to the foreign country variable (see MacDonald, 1998a,b; Clark and McDonald, 1999).

8 Concluding Remarks

In this paper, we have surveyed the literature on equilibrium exchange rates as it relates to the (former) transition economies in Central and Eastern Europe. Amongst our findings is the result that the trend appreciation usually observed for the exchange rates of these economies is affected by factors other than the usual Balassa-Samuelson effect, such as the appreciation of the tradable price-based real appreciation. Furthermore, and in contrast to industrialized OECD economies experience with floating exchange rates, pricing-to-market only explains medium term fluctuations of the real exchange rate for CEE countries. For the latter countries there would appear to be a huge quality adjustment bias as they started producing and exporting goods of higher quality. Also, we have argued that administered/regulated prices and the distribution sector are also important determinants of the trend appreciation of the real exchange rates of CEE countries.

Our literature overview suggests that deriving a precise figure for the equilibrium real exchange rates for the CEECs is close to mission impossible. This is because there is a great deal of model uncertainty related to the theoretical background and to the fundamentals chosen, and an array of methodological and statistical problems also renders the calculation of an equilibrium exchange rate very complicated. But, of course, similar difficulties are encountered when estimating the equilibrium exchange rate of the euro or the U.S. dollar. According to the European Central Bank (2002), for example, estimates of the equilibrium USD/EUR parity vary considerably within a range of 1.03 to 1.45. Consistent with this finding is the large degree of uncertainty with regard to the equilibrium value of the euro that Detken et al. (2002) detect when using alternative theoretical models and econometric techniques. *A fortiori*, therefore, calculations of equilibrium exchange rates for CEE countries should be produced with, perhaps quite wide, confidence bands.

In addition to using wide confidence intervals when calculating the equilibrium rates of CEE countries, we believe that, given no single equilibrium exchange rate approach is problem free, it is also important that a variety of different models should be used in the computation of equilibrium rates. Csajbók (2003), for example, sets a good example in this regard by producing estimation results for Hungary based on different theoretical approaches, such as the BEER, FEER, Macroeconomic Balance and NATREX. In addition, we also believe it important that a systematic sensitivity analysis of econometric estimates be used and that a range of different econometric techniques are employed to ensure robustness, as in Crespo-Cuaresma, Fidrmuc and MacDonald (2003), Égert and Lommatzsch (2003) and Maeso-Fernandez, Osbath and Schnatz (2004).

In sum our review has two important implications for the calculation of equilibrium exchange rates for CEE countries. First, in estimating the equilibrium exchange rate of any given economy, a systematic analysis is needed in terms of alternative economic and econometric specifications and in interpreting the range of the derived real misalignments, the connection of the alternative theoretical and empirical approaches should be borne in mind. Perhaps the most important message from our paper is that productivity changes in the CEE countries do not seem to have the benign effect on competitiveness that the Balassa-Samuelson hypothesis conjectures. This suggests that the CEE countries should exert considerable caution in deciding on the appropriate exchange rate to enter the ERM II and ultimately the euro as the choice of an inappropriate rate could well have dramatic implications for competitiveness.

References

Alberola, E. 2003. Real Convergence, External Disequilibria and Equilibrium Exchange Rates in EU Acceding Countries. Banco de España. Mimeo.

Alberola, E. and T. Tyrväinen. 1998. Is There Scope for Inflation Differentials in EMU? Banco de España Working Paper No. 9823.

Alberola, E., S. G. Cervero, H. Lopez and A. Ubide (2002) Quo vadis Euro*? The European Journal of Finance,* 8, 352-370.

Alberola, E., S. G. Cervero, H. Lopez and A. Ubide. 1999. Global Equilibrium Exchange Rates: Euro, Dollar, "Ins," "Outs," and Other Major Currencies in a Panel Cointegration Framework. IMF Working Paper No. 175.

Alonso-Gamo, P., S. Fabrizio, V. Kramarenko and Q. Wang. 2002. Lithuania: History and Future of the Currency Board Arrangement. IMF Working Paper No. 127.

Artus, J. 1978. Methods of assessing the long-run equilibrium value of an exchange rate. *Journal of International Economics* 8. 277–299.

Avallone, N. and A. Lahrèche-Révil. 1999. Le taux de change réel d'équilibre dans les pays en transition: le cas de la Hongrie. TEAM. University of Paris I – Sorbonne. Cahiers blancs no. 91.

Backé, P., J. Fidrmuc, T. Reininger and F. Schardax. 2003. Price dynamics in Central and Eastern European EU Accession Countries. *Emerging Markets Finance and Trade* 39(3). 42–78.

Baffes, J., I. A. Elbadawi and S. A. O'Connell. 1999. Single Equation of the Equilibrium Real Exchange Rate. In: Hinkle, L. and P. Montiel (eds.). Estimating Equilibrium Exchange Rates in Developing Countries. Washington D.C.: World Bank.

Balassa, B. 1964. The Purchasing-Power-Parity Doctrine: A Reappraisal. *Journal of Political Economy* 72(6). 584–596.

Barrell, R. and S. Wren-Lewis (1989). Fundamental Equilibrium Exchange Rates for the G7", CEPR Discussion Paper. 323.

Baumol, W.J. 1996. Children of Performing Arts, the Economic Dilemma: The Climbing Costs of Health Care and Education. *Journal of Cultural Economics*. 20. 183-206.

Baumol, W.J. and W.G. Bowen. 1965. On the Performing Arts: The Anatomy of Their Economic Problems. *American Economic Review*. 55(1/2). 495-502.

Baumol, W.J. and W.G. Bowen. 1966. Performing Arts: The Economic Dilemma. New York: Twentieth Century Fund.

Bayoumi, T., P. Clark, S. Symansky and M. Taylor. 1994. The Robustness of Equilibrium Exchange Rate Calculations of Alternative Assumptions and Methodologies. In: Williamson, J. (ed.). Estimating Equilibrium Exchange Rates. Washington D.C.: Institute for International Economics. 19–60.

Begg, D., Halpern, L. and Ch. Wyplosz. 1999. Monetary and Exchange Rate Policies, EMU and Central and Eastern Europe. Forum Report on the Economic Policy Initiative 5. London: CEPR and New York, Prague: EastWest Institute.

Beguna, A. 2002. Competitiveness and the Equilibrium Exchange Rate in Latvia. EuroFaculty Working Paper in Economics 16. August. Riga: University of Latvia and EuroFaculty.

Benigno, G. and C. Thoenissen. 2003. Equilibrium Exchange Rates and Capital and Supply Side Performance. *Economic Journal*. 113(486). 103-124.

Bergstrand, J. H. 1991. Structural Determinants of Real Exchange Rates and National Price Levels: Some Empirical Evidence. *American Economic Review* 81(1). 325–334.

Bhagwati, J. 1984. Why Are Services Cheaper in Poor Countries? *Economic Journal.* 94(374). 279-286

Bitans, M. 2002. Real Exchange Rate in Latvia: 1994–2001. Bank of Latvia Working Paper.

Bitans, M. and I. Tillers. 2003. Estimates of Equilibrium Exchange Rate in Latvia. Bank of Latvia, mimeo

Boskin, M. J., E.R. Dulberger, R.J. Gordon, Z. Griliches and D.W. Jorgenson. 1996. Toward a More Accurate Measure of the Cost of Living. Final Report to the U.S. Senate Finance Committee from the Advisory Commission to Study the Consumer Price Index.

Braumann, B 1998. Republic of Slovakia: Recent Economic Developments. IMF Staff Country Report No. 60. 35-47.

Brook, A. M. and D. Hargreaves. 2001. PPP-based Analysis of New Zealand's Equilibrium Exchange Rate. Reserve Bank of New Zealand Discussion Paper No. 1.

Buiter, W. H. and C. Grafe. 2002. Anchor, Float or Abandon Ship: Exchange Rate Regimes for Accession Countries. CEPR Discussion Paper No. 3184.

Burgess, R., Fabrizio, S. and Y. Xiao. 2003. Competitiveness in the Baltics in the Run-Up to EU Accession. IMF Country Report No. 114. Pages

Campos, N. and F. Coricelli. 2002. Growth in Transition: What We Know, What We Don't and What We Should. *Journal of Economic Literature*. 40(3). 793-836.

Canzoneri, M.B., R.E. Cumby and B. Diba. 1999. Relative Labour Productivity and the Real Exchange Rate in the Long-Run: Evidence for a Panel of OECD Countries. *Journal of International Economics*. 47. 245-266. !

Cassel, G. 1916a. The Present Situation of the Foreign Exchanges. *Economic Journal* 26(101). 62–65.

Cassel, G. 1916b. The Present Situation of the Foreign Exchanges. *Economic Journal* 26(103). 219–323.

Cassel, G. 1918. Abnormal Deviations in International Exchanges. *Economic Journal* 28(112). 413–415.

Čihák, M. and T. Holub. 2001. Convergence of Relative Prices and Inflation in Central and Eastern Europe. IMF Working Paper No. 124.

Čihák, M and T. Holub. 2003. Price Convergence to the EU: What Do the 1999 ICP Data Tell Us? Czech National Bank Working Paper Series No. 2.

Cincibuch, M. and J. Podpiera. 2004. Beyond Balassa-Samuelson: Real Appreciation in Tradables in Transition Economies. CERGE-EI Research Report. http://www.cerge-ei.cz/pdf/gdn/RRCIII_41_paper_01.pdf

Clarida, R. and J. Gali. 1994. Sources of Real Exchange Rate Fluctuations: How Important are Nominal Shocks? *Carnegie-Rochester Series on Public Policy.* 41. 1-56.

Clark, P. and R. MacDonald. 1999. Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs. In R. MacDonald and J. Stein (eds), Equilibrium Exchange Rates, Amsterdam: Kluwer. 285-322.

Clark, P. and R. MacDonald. 2000. Filtering the BEER – A Permanent and Transitory Decomposition. IMF Working Paper No. 144.

Coricelli, F. and B. Jazbec. 2004. Real Exchange Rate Dynamics in Transition Economies. *Structural Change and Economic Dynamics*, 15, 83-100.

Corsetti, G. and L. Dedola. 2004. Macroeconomics of International Price Discrimination. Mimeo.

Coudert, V. 1999. Comment définir un taux de change d'équilibre pour les pays émergents? *Economie Internationale*. 77. 1er trimestre. 45-65.

Coudert, V. and C. Couharde. 2003. Exchange Rate Regimes and Sustainable Parities for CEECs in the Run-up to EMU Membership. *Revue Economique*, 54(5): 983-1012

Crespo-Cuaresma, J., Fidrmuc, J. and R. MacDonald. 2003. The Monetary Approach to the Exchange Rate in CEECs. BOFIT Discussion Paper No. 14.

Csajbók, A. 2003. The Equilibrium Real Exchange Rate in Hungary: Results from Alternative Approaches. Paper presented at the 2nd Workshop on Macroecomic Policy Research. National Bank of Hungary. October 2–3.

Csajbók, A. and M. A. Kovács. 2002. FEER Enough? National Bank of Hungary. Mimeo.

Cumby, R. and J. Huizinga. 1990. The Predictability of Real Exchange Rate Changes in the Short Run and in the Long Run. *Japan and the World Economy.* 3. 17-38.

Darvas, Zs. 2001. Exchange Rate Pass-Through and Real Exchange Rate in EU Candidate Countries. Economic Research Centre of the Deutsche Bundesbank Discussion Paper No. 10.

De Broeck, M. and T. Sløk. 2001. Interpreting Real Exchange Rate Movements in Transition Countries. IMF Working Paper No. 56.

Detken, C., A. Dieppe, J. Henry, C. Marin and F. Smets. 2002. Model Uncertainty and the Equilibrium Value of the Real Effective Euro Exchange Rate. ECB Working Paper No. 160.

Dixit, A.K. and J. Stiglitz. 1977. Monopolistic Competition and Optimum Product Diversity. *American Economic Review.* 67(3). 297-308.

Djankov, S. and P. Murrell. 2002. Enterprise Restructuring in Transition: A Quantitative Survey. *Journal of Economic Literature*. 40(3). 739-792.

Dobrinsky, R. 2003. Convergence in Per Capita Income Levels, Productivity Dynamics and Real Exchange Rates in the EU Acceding Countries. *Empirica*. 30(3). 305-334.

Doisy M. and A. Hervé. 2003. Les déficits courants des PECO: quelles implications pour leur entrée dans l'Union européenne et la zone euro? *Economie Internationale*. 93. 1er trimestre. 59-88.

Driver, R. and S. Wren-Lewis (1998), Real Exchange Rates for the Year 2000, Washington: Institute for International Economics.

Driver, R. and S. Wren-Lewis. 1999. FEERS: A Sensitivity Analysis. in R. MacDonald and J. Stein (eds). Equilibrium Exchange Rates. Amsterdam: Kluwer. 135-62.

Driver, R. L. and P. F. Westaway. 2004. Concepts of Equilibrium Real Exchange Rates. Bank of England Working Paper (forthcoming).

Durlauf, S., P. Johnson and J. Temple. 2005. Growth Econometrics. in P. Aghion and S. Durlauf (eds.) Handbook of Economic Growth. Amsterdam: North Holland. forthcoming

EBRD. 2003. Transition Report 2003.

Égert, B. 2002. Investigating the Balassa-Samuelson Hypothesis in the Transition: Do We Understand What We See? A Panel Study. *Economics of Transition* 10(2). 273–309.

Égert, B. 2004. The Balassa-Samuelson Hypothesis in Estonia: Oil Shale, Tradable Goods, Regulated Prices and Other Culprits.*The World Economy* (forthcoming).

Égert, B. and A. Lahrèche-Révil. 2003. Estimating the Equilibrium Exchange Rate of the Central and Eastern European Acceding Countries: The Challenge of Euro Adoption. *Weltwirtschaftliches Archiv.* 139(4). 683-708

Égert, B. and K. Lommatzsch. 2003. Equilibrium Exchange Rates in Acceding Countries: How Large Is Our Confidence (Interval)? Oesterreichische Nationalbank. *Focus on Transition.* 2. 107-37.

Égert, B. and L. Halpern. 2004. Equilibrium Exchange Rates in Central and Eastern Europe: A Meta-Regression Analysis. Oesterreichische Nationalbank. Mimeo.

Égert, B., A. Lahrèche-Révil and K. Lommatzsch. 2004. The Stock-Flow Approach to the Real Exchange Rate of Transition Economies: Net Foreign Assets, Relative Prices, Out-of-Sample Estimates and Other Marvellous Concinnities, paper presented at the "CEPR/ESI Eighth Annual Conference: EMU Enlargement to the East and the West". September 24-25. Budapest.

Égert, B., I. Drine, K. Lommatzsch and Ch. Rault. 2003. The Balassa-Samuelson Effect in Central and Eastern Europe: Myth or Reality? *Journal of Comparative Economics* 31(3). 552–572.

Engel, Ch. 1993. Exchange Rates and Relative Prices: An Empirical Investigation. *Journal of Monetary Economics*. 32(1). 32-50.

Engel, Ch. 1999. Accounting for US Real Exchange Rate Changes. *Journal of Political Economy*. 107(3). 507-38.

European Central Bank. 2002. Economic Fundamentals and the Exchange Rate of the Euro, Monthly Bulletin. January. 41–53.

Faruqee, H. 1995. Long-Run Determinants of the Real Exchange Rate: A Stock-Flow Perspective. *IMF Staff Papers*. 42(1). 80-107.

Filer, R. K. and J. Hanousek. 2000. Output Changes and Inflationary Bias in Transition. *Economic Systems*. 24(3). 285-294.

Filipozzi, F. 2000. Equilibrium Exchange Rate of the Estonian Kroon, Its Dynamics and Its Impacts of Deviations. Bank of Estonia Working Paper No. 3.

Fischer, Ch. 2004. Real Currency Appreciation in Accession Countries: Balassa-Samuelson and Investment Demand. *Weltwirtschaftliches Archiv*, 140(2). 179-210.

Flek, V., L. Marková and J. Podpiera. 2002. Sectoral Productivity and Real Exchange Rate Appreciation: Much Ado About Nothing? Czech National Bank Working Paper Series No. 4.

Frait, J. and L. Komárek. 1999. Dlouhodobý rovnovážný re álný měnový kurz koruny a jeho determinanty. Czech National Bank Monetary Policy Division Working Paper No. 9.

Froot, K. A. and K. Rogoff. 1994. Perspectives on PPP and Long-Run Real Exchange Rates. NBER Working Paper No. 4952.

Froot, K. A., M. Kim and K. Rogoff. 1995.: The Law of One Price Over 700 Years, NBER Working Paper No. 5132.

Goldstein, M. and M. S. Khan. 1985. Income and Price Effects in Foreign Trade. Chapter 20 in Handbook of International Economics. Vol. 2. ed. by Ronald W. Jones and Peter B. Kenen. Amsterdam: Elsevier. 1985, pp. 1041-105.

Golinelli, R. and R. Orsi. 2002. Modelling Inflation in EU Accession Countries: The Case of the Czech Republic, Hungary and Poland. In: Charemza, W. W. and K. Strzala. (eds.). East European Transition and EU Enlargement: A Quantitative Approach. Berlin: Springer Verlag. 267–290.

Gonzalo, J. and C.W.J. Granger. 1995. Estimation of Common Long-Memory Components in Cointegrated Systems. *Journal of Business & Economic Statistics*. 13(1). 27-36.

Gordon, R. J. 2000. The Boskin Commission Report and Its Aftermath. NBER Working Paper No. 7759.

Halpern, L. and Ch. Wyplosz. 1997. Equilibrium Exchange Rates in Transition Countries. *IMF Staff Papers* 44(4). 430–461.

Halpern, L. and Ch. Wyplosz. 2001. Economic Transformation and Real Exchange Rates in the 2000s: The Balassa-Samuelson Connection. UNO Economic Survey of Europe. 227–239.

Hanousek, J. and R. K. Filer. 2001a. Consumers' Opinion of Inflation Bias Due to Quality Improvements in Transition in the Czech Republic. CERGE-EI Working Paper 184.

Hanousek, J. and R. K. Filer. 2001b. Evaluating Imperfections and Biases in Price Indexes during Transition. CERGE-EI Working Paper No. 186.

Haskel, J. and H. Wolf. 2001. The Law of One Price: A Case Study. *Scandinavian Journal of Economics*, 103(4), 545-58.

Hinnosar, M., R. Juks, H. Kaadu and L. Uusküla. 2003. Estimating the Equilibrium Exchange Rate of the Estonian Kroon. Bank of Estonia. Mimeo.

Huizinga. J 1987. An Empirical Investigation of the Long-run Behaviour of Real Exchange Rates. *Carnegie-Rochester Series on Public Policy*. 27. 149-214.

Isard, P., H. Faruquee, G. R. Kincaid and M. Fetherston. 2001. Methodology for Current Account and Exchange Rate Assessments. IMF Occasional Papers No. 209.

Ito, T., P. Isard and S. Symansky. 1997. Economic Growth and Real Exchange Rate: An Overview of the Balassa-Samuelson Hypothesis in Asia. NBER Working Paper No. 5979.

Jazbec, B. 2002. Balassa-Samuelson Effect in Transition Economies: The Case of Slovenia. William Davidson Working Paper No. 507.

Johansen, S and K. Juselius. 1992. Testing Structural Hypothesis in a Multivariate Cointegration Analysis of the PPP and the UIP for the UK. *Journal of Econometrics.* 53. pp 211-244.

Juselius, K. 1991. Long-run relations in a well defined statistical model for the data generating process: Cointegration analysis of the PPP and UIP relations between Denmark and Germany. in J. Gruber (ed.). Econometric decision models: New methods of modeling and applications. Springer Verlag. New York, NY.

Juselius, K. 1995. Do purchasing power parity and uncovered interest rate parity hold in the long run? An example of likelihood inference in a multivariate time-series model. *Journal of Econometrics*. 69(1). 211-240.

Juselius, K. and R. MacDonald. 2000. International parity relationships between Germany and the United States. Unpublished report. European University Institute.

Kao, C. 1999. Spurious Regression and Residual-Based Tests for Cointegration in Panel Data. *Journal of Econometrics*. 90(1). 1-44.

Karádi, P. 2003. Structural and Single Equation Estimation of the NATREX Equilibrium Real Exchange Rate of the Hungarian Forint. National Bank of Hungary. Mimeo.

Kazaks, M. 2000. Real exchange rate appreciation and loss of competitiveness. The case of Latvia. Presented at the Second Seminar of Managing Economic Transition in Eastern Europe. May 24, 2000. University College London. School of Slavonic and East European Studies.

Kemme, D. M. and W. Teng. 2000. Determinants of the Real Exchange Rate, Misalignment and Implications for Growth in Poland. *Economic Systems* 24(2). 171–205.

Kim, B. Y. and I. Korhonen. 2002. Equilibrium Exchange Rates in Transition Countries: Evidence from Dynamic Heterogeneous Panel Models. BOFIT Discussion Paper No. 15.

Kohler, M. 2000. The Balassa-Samuelson Effect and Monetary Targets. In: Mahadeva, L. and G. Sterne (eds.). Monetary Policy Frameworks in a Global Context. London and New York: Routledge. 354–389.

Kornai, J., E. Maskin and G. Roland. 2003. Understanding the Soft Budget Constraint. *Journal of Economic Literature*. 41(4). 1095-1136.

Kovács, M. A. (ed.). 2002. On the Estimated Size of the Balassa-Samuelson Effect in Five Central and Eastern European Countries. National Bank of Hungary Working Paper No. 5.

Kovács, M. A. 2001. The Equilibrium Exchange Rate in Hungary. National Bank of Hungary Background Study 3. Budapest.

Kovács, M. A. 2003. How Real Is the Fear? Investigating the Balassa-Samuelson Effect in CEC5 Countries in the Prospect of EMU Enlargement. Presented at "Monetary Strategies for Accession Countries". Budapest. 27 – 28 February.

Kovács, M. A. and A. Simon. 1998. Components of the Real Exchange Rate in Hungary. National Bank of Hungary Working Paper No. 3.

Kozamernik, D. 2003. Long-Run Growth and Price Convergence: Implications of a Two-Sector Neoclassical Growth Model and Application to the Slovenian Case. Prikazi in analize 11(2). Bank of Slovenia

Krajnyák, K. and J. Zettelmeyer. 1998. Competitiveness in Transition Economies: What Scope for Real Appreciation? *IMF Staff Papers* 45. 309–362.

Lee, J. and M. K. Tang. 2003. Does Productivity Growth Lead to Appreciation of the Real Exchange Rate? IMF Working Paper 154.

Lojschova, A. 2003. Estimating the Impact of the Balassa-Samuelson Effect in Transition Economies. Institute for Advanced Studies Working Paper No. 140.

Lommatzsch, K. and S. Tober. 2002a. Monetary Policy Aspects of the Enlargement of the Euro Area. Deutsche Bank Research Working Paper No. 4.

Lommatzsch, K. and S. Tober. 2002b. What Is behind the Real Appreciation of the Accession Countries' Currencies? An Investigation of the PPI-Based Real Exchange Rate. Presented at "Exchange Rate Strategies during the EU Enlargement." Budapest. 27 – 30 November.

Lommatzsch, K. and S. Tober. 2003. The inflation target of the ECB: Does the Balassa-Samuelson effect matter? DIW-Berlin. Mimeo.

MacDonald, R. 1995. Long-run Exchange Rate Modeling: A Survey of the Recent Literature. *IMF Staff Papers.* 42 (3). 437-489.

MacDonald, R. 1998a. What Determines Real Exchange Rates? The Long and Short of It. *Journal of International Financial Markets, Institutions and Money.* 8(2). 117-53

MacDonald, R. 1998b. What Do We Really Know About Real Exchange Rates? Oesterreichische Nationalbank Working Paper No. 28.

MacDonald, R. 2000. Concepts to Calculate Equilibrium Exchange Rates: An Overview. Deutsche Bundesbank Discussion Paper No 3.

MacDonald, R. 2004. Exchange Rate Economics: Theories and Evidence. Taylor and Francis. forthcoming.

MacDonald, R. and I.W. Marsh. 1997. On Fundamentals and Exchange Rates: A Casselian Perspective. *Review of Economics and Statistics.* 79(4). 655-64.

MacDonald, R. and I.W. Marsh. 1999. Exchange Rate Modelling, Amsterdam: Kluwer.

MacDonald, R. and L. Ricci. 2001. PPP and the Balassa Samuelson Effect: The Role of the Distribution Sector. IMF Working Paper No. 38.

MacDonald, R. and L. Ricci. 2002. Purchasing Power Parity and New Trade Theory. IMF Working Paper No. 32.

MacDonald R. and P. Swagel. 2000. Business Cycle Influences on Exchange Rates: Survey and Evidence, World Economic Outlook Supporting Studies. IMF.

MacDonald, R. and C. Wójcik (2004) Catching Up: The Role of Demand, Supply and Regulated Price Effects on the Real Exchange Rates of Four Accession Countries. *Economics of Transition.* 12(1). 153-179.

Maeso-Fernandez, F., Ch. Osbat and B. Schnatz (2004) Towards the Estimation of Equilibrium Exchange Rates for CEE Acceding Countries: Methodological Issues and a Panel Cointegration Perspective, European Central Bank Working Paper No. 353.

Maurin, L. 2001. Fundamental Determinants of RER for Transition Countries. In: Stierle, M. H. and T. Birringer (eds.). Economics of Transition: Theory, Experiences and EU-Enlargement. Berlin: Verlag für Wissenschaft und Forschung. 427–442.

Mihaljek, D. and M. Klau. 2004. The Balassa-Samuelson Effect in Central Europe: A Disaggregated Analysis. *Comparative Economic Studies,* 46(1): 63-94

Monacelli, T. 2004. Into the Mussa Puzzle: Monetary Policy Regimes and the Real Exchange Rate in a Small Open Economy. Journal of International Economics. 62. 191-217.

Mussa, M. 1986. Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications. Carnegie-Rochester Conference Series on Public Policy. 25. 117-214.!

Nurkse, R. 1945. Conditions of International Monetary Equilibrium. Essays in International Finance. Princeton: International Finance Section. Princeton University. Republished in the Theory of International Trade. Philadelphia: Blackiston. 1949. 3–34.

Obstfeld, M. and K. Rogoff. 2001. Perspectives on OECD Economic Integration: Implications for US Current Account Adjustment, paper presented at the Jackson Hole Conference, Federal Reserve Bank of Kansas.

Ostry, J. and C. Reinhart. 1992. Private Savins and Terms of Trade Shocks, *International Monetary Fund Staff Papers.*

Pedroni, P. 1999. Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors. *Oxford Bulletin of Economics and Statistics*. 61. Supplement 1. 653-670.

Pelkmans, J., Gros, D. and J. N. Perrer. 2000. Long-Run Economic Aspects of the European Union's Eastern Enlargement. The Netherlands Scientific Council for Government Policy Working Document 109.

Rahn, J. 2003. Bilateral Equilibrium Exchange Rates of the EU Accession Countries Against the Euro. BOFIT Discussion Paper No. 11.

Randveer, M. and M. Rell. 2002. The Relationship Between Competitiveness and Real Exchange Rate in Estonia. Bank of Estonia Research Paper.

Rawdanowicz, Ł. W. 2003. Poland's Accession to EMU: Choosing the Exchange Rate Parity. CASE Studies&Analyses 247. December 2002, and forthcoming in: De Souza, L.V. and B. Van Aarle (eds.). The Euro Area and the New EU Member States. New York: Palgrave Macmillan.

Rawdanowicz, Ł. W. 2004. Panel Estimations of PPP and Relative Price Models for CEECs: Lessons for Real Exchange Rate Modelling. CASE Studies&Analyses No. 276.

Rogoff, K. 1996. The Purchasing Power Parity Puzzle. *Journal of Economic Literature*. 34(2). 647-668.

Rosati, D. 1994. Output decline during transition. *Economics of Transition*. 2(4). 419–441.

Rosati, D. 1996. Exchange rate policies during transition from plan to market. *Economics of Transition*. 4(1). 159–186.

Rosati, D. K. 2002. The Balassa-Samuelson Effect in the EU Candidate Countries. In: Roger, G. and A. Inotai (eds.). Trade, Integration and Transition. Budapest: The World Bank and Institute for World Economics. Hungarian Academy of Sciences. 58–77.

Rother, C. P. 2000. The Impact of Productivity Differentials on Inflation and the Real Exchange Rate: An Estimation of the Balassa-Samuelson Effect in Slovenia. IMF Country Report. Republic of Slovenia: Selected Issues 56. April. 26–39.

Rubaszek, M. 2003. The Optimal ERM II Central Parity for the Polish Zloty. National Bank of Poland. mimeo

Rubaszek, M. 2004. A Model of Balance of Payments Equilibrium Exchange Rate: Application to the Zloty. *Eastern European Economics.* 2004. 42(3). 5-22.

Saal, D. and D. Parker. 2001. Productivity and Price Performance in the Privatised Water and Sewerage Companies of England and Wales. *Journal of Regulatory Economics* 20(1). 61-90.

Samuelson, P. 1964. Theoretical Notes on Trade Problems. *Review of Economics and Statistics* 46(2). 145–154.

Sarno, L. and M. P. Taylor. 2002. The Economics of Exchange Rates. Cambridge University Press.

Sinn, H. W. and M. Reutter. 2001. The Minimum Inflation Rate for Euroland. NBER Working Paper No. 8085.

Šmídková, K. 1999. Estimating the FEER for the Czech Economy. *Prague Economic Papers.* 8(1): 53-67

Šmídková, K., R. Barrell and D. Holland. 2003. Estimates of Fundamental Real Exchange Rates for the Five EU Pre-Accession Countries. *Prague Economic Papers.* 12(4): 291-316

Stein, J. L. 1994. The Natural Real Exchange Rate of the US dollar and Determinants of Capital Flows. in J. Williamson (ed.). Estimating Equilibrium Exchange Rates. Institute for International Economics. 133–176.

Stein, J. L. 1995. The Fundamental Determinants of the Real Exchange Rate of the U.S. Dollar Relative to Other G-7 Countries. IMF Working Paper No. 81.

Stein, J. L. 2002. The Equilibrium Real Exchange Rate of the Euro: An Evaluation of Research. *CESifo Economic Studies*. Zeitschrift für empirische Wirtschaftsforschung. 43(3). 349–381.

Stein, J. L. and G. C. Lim. 2002. Introduction to "Exchange rates in Europe and Australasia: Fundamental determinant, adjustments and policy implications." *Australian Economic Papers* 41(4). 329–341.

Szapáry, Gy. 2003. Les critères de Maastricht sont-ils trop sévères? (Is Maastricht Too Tough*?), Revue d'Economie Financière.* No. 71. 225-44

Vetlov, I. 2002. Analysis of the Real Exchange Rate and Competitiveness in Lithuania. Bank of Estonia Research Paper.

Világi, B. 2004. Dual Inflation and Real Exchange Rate in New Open Economy Macroeconomics. National Bank of Hungary Working Paper No. 5.

Wagner, M. and J. Hlouskova. 2004. What is really the story with this Balassa-Samuelson effect in the CEECs. University of Bern. Mimeo.

Williamson, J. 1994. Estimates of FEERs. In: Williamson, J. (ed.). Estimating Equilibrium Exchange Rates. Washington D.C.: Institute for International Economics. 177–244.

Wren-Lewis, S. 1992. On the Analytical Foundations of the Fundamental Equilibrium Exchange Rate, in Macroeconomic Modelling of the Long Run (ed.) Colin P. Hargreaves, Edward Elgar.

Zavoico, B. 1995. A Brief Note on the Inflationary Process in Transition Economies. IMF. Mimeo.